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(71) Applicant: **ELECTROLUX APPLIANCES AKTIEBOLAG**
105 45 Stockholm (SE)

(72) Inventors:
- **DAL BEN, Diego**
  33080 Porcia PN (IT)
- **GIOVANNETTI, Andrea**
  33080 Porcia PN (IT)
- **ZANDONA', Stefano**
  33080 Porcia PN (IT)

(74) Representative: **Electrolux Group Patents**
AB Electrolux
S:t Göransgatan 143
10545 Stockholm (SE)

(54) DRYER AND METHOD FOR PRODUCTION OF A DRYER

(57) The present invention relates to a dryer (10) comprising:
• a casing (12) including a basement (13);
• a laundry chamber (14) suitable to receive laundry to be dried;
• a process air circuit for circulating process air into said laundry chamber (14);
• a condensing device (22) for removing moisture from the process air coming from said laundry chamber (14) located within the process air circuit;
• a water collecting housing (30) for the collection of moisture condensed by said condensing device (22);
• a condensate tank (36) to collect water transferred from the water collecting housing (30);
• a pump unit (44) associated to said water collecting housing (30) for the removal of water contained therein and to pump it to the condensate tank (36);
• a first conduit (50) fluidly connecting a pump unit outlet (45) to a condensate tank inlet (37);
• a second conduit (60) fluidly connecting the condensate tank (36) to an inlet opening (23) arranged in the basement (13); and
• wherein the dryer (10) also includes a siphon-like element (52, 62) located in the first and/or in the second conduit (50, 60) to limit air transfer through the first and/or second conduit (50, 60).

The present invention also relates to a method for production of a dryer (10).

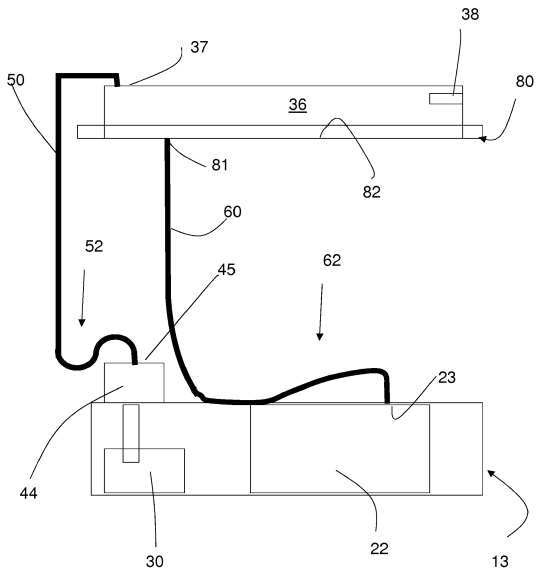

Fig. 5

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a dryer.
[0002] The present invention also relates to a method for production of a dryer.

BACKGROUND ART

[0003] Tumble dryers comprises a laundry chamber suitable to receive laundry to be dried and a process air circuit for circulating process air into the laundry chamber.
[0004] The process air circuit comprises a condensing device for removing moisture from the process air coming from the laundry chamber.
[0005] Condensation water formed in the condensing means is typically collected in a water collecting housing, preferably located in a basement of the dryer. The water in the collecting housing is then conveyed to a moisture tank arranged on an upper portion of the dryer so that it can be easily and periodically emptied by a user. The moisture tank is preferably in the form of a drawer slidably arranged on said upper portion of the dryer.
[0006] In order to convey the water from the collecting housing to the tank, a water-removing unit is provided at said collecting housing.
[0007] The water-removing unit preferably comprises pumping means which are advantageously activated on the base of the water level inside the collecting housing. For this purpose, as an embodiment, a level sensor may also be provided at the collecting housing. Pumping means typically comprises an electric pump and a conveying pipe connecting the pump to the tank. Furthermore, an overflow pipe is usually provided between the tank and the collecting housing which permits the water from the tank to be re-admit into the water collecting housing when the tank is full.
[0008] With respect to the pump unit, the Applicant considers advantageous to use pumps positioned in a substantially airtight environment.
[0009] However, airtight environment may cause a pressure difference between different volumes in the dryer, which in turn may cause an air flow from the tank to the pump via the conveying pipe or from the tank to the collecting housing via the overflow pipe (or vice-versa).

SUMMARY OF THE INVENTION

[0010] It is an object of the present invention to provide a dryer which solves at least partially the problems described above.
[0011] In particular, according to a first aspect, the present invention relates to a dryer comprising:

- a casing including a basement;
- a laundry chamber suitable to receive laundry to be dried;
- a process air circuit for circulating process air into said laundry chamber;
- a condensing device for removing moisture from the process air coming from said laundry chamber located within the process air circuit;
- a water collecting housing for the collection of moisture condensed by said condensing device;
- a condensate tank unit to collect water transferred from the water collecting housing;
- a pump unit associated to said water collecting housing for the removal of water contained therein and to pump it to the condensate tank unit;
- a first conduit fluidly connecting a pump unit outlet to a condensate tank unit inlet;
- a second conduit fluidly connecting the condensate tank unit to an inlet opening arranged in the basement; and
- wherein the dryer also includes a siphon-like element located in the first and/or in the second conduit to limit air transfer through the first and/or second conduit.

[0012] The dryer may be a front-loading dryer, which means that a laundry chamber in which the laundry is located has an axis which is positioned in a horizontal manner or slightly tilted with respect to the horizontal plane, or a top laundry dryer, where the axis of the laundry chamber is substantially vertical.
[0013] In a preferred embodiment, the laundry dryer is a front loading laundry dryer.
[0014] Preferably, the laundry chamber in which the laundry is located or removed is apt to rotate around its axis, e.g. it is a drum. Further, preferably the laundry chamber is part of a process air circuit in which process air is blown to dry the laundry.
[0015] The process air circuit, in particular a closed-loop circuit, includes a process air conduit for channeling a stream of air to dry the load. The process air circuit is connected with its two opposite ends to the drum. More specifically, hot dry air is fed into the drying chamber, flowing over the laundry, and the resulting humid (and to a lower temperature cooled down) air exits the same. In case of a closed-loop drying air circuit, the humid air stream, rich in water vapor, is then fed into a humidity removal element, such as a condensing device or heat exchanger. In a preferred embodiment of the invention, the humid air is fed to an evaporator of a heat pump system, where the moist process air is further cooled

down and the humidity present therein condenses. The resulting cool dry air is then heated up before re-entering again in the drying chamber by means of a hot drying air generator, which can be for example a condenser of the heat pump system, and the whole loop is repeated till the end of the drying cycle. Alternatively or in addition, to remove humidity from humid air stream exiting the drum, an air-air type heat exchanger may be used. Such heat exchanger receives ambient air as cooling fluid to cool down and remove humidity from humid air stream passing therethrough. Furthermore, the hot drying air generator may comprise an electrical or gas powered heating device. Heated air flowing through and on humid laundry contained in the drum, removes humidity from laundry. Humid air stream exiting the drum may be optionally dehumidified by an evaporator of a heat pump system, or an air-air type heat exchanger as explained above, before being exhausted outside the dryer.

[0016] The humidity removal element or condensing device is thus positioned in the process air circuit.

[0017] The dryer comprises a casing preferably including a front wall, a rear wall, side walls and a base section or basement. The front wall may comprise a front top panel to command the functioning of the dryer by the user. The casing defines the boundary between the internal or inner side of the dryer and the external side of the dryer. Further, preferably, the casing includes a door hinged to it, e.g. to the front wall in case of a front loading dryer, which is openable in order to introduce the laundry in the laundry chamber.

[0018] Preferably, a portion of the process air circuit is present in the basement of the dryer. More preferably, the condensing device is positioned in a portion of the process air circuit located in the basement of the dryer. The condensing device removes humidity from the moist air flowing within the process air conduit and therefore droplets of condensed water may form. These droplets by gravity tends to fall onto a surface positioned below the condensing device.

[0019] In order to collect the condensed droplets of water, the dryer includes a water collecting housing, which is apt to collect the water which condenses due to the presence within the air process circuit of the condensing device. The water collecting housing maybe positioned below the condensing device, or far from it and connected to the surface below the condensing device by a channel.

[0020] Preferably, a suitable duct or a plurality of ducts connects the location where the condensed water is formed, for example the surface or basin below the condensing device where water drips, to the water collecting housing.

[0021] In an embodiment, the basement may be divided in an upper and a lower shell. Between the two shells, upper and lower, the water collecting housing is located. Alternatively, the two shells both form a bowl shape wherein the water collecting housing is defined.

[0022] The condensing device of the present invention includes preferably a heat exchanger. In an embodiment such a heat exchanger includes an air-to-air heat exchanger. In a different embodiment, the laundry dryer includes a heat pump and the condensing device includes the evaporator of the heat exchanger.

[0023] Preferably, the condensing device is located between the upper and lower shells. Even more preferably, such duct(s) to channel the condensed water to the water collecting housing is(are) realized integral to said lower or upper shell. Preferably, the surface or basin onto which the condensed water drips positioned below the condensing device is also integral to the lower or upper shell. Preferably, also the water collecting housing in realized integral to the lower or upper shell of the basement.

[0024] In the following with the term "realized integral to" means that the element discussed is realized as a single unit together with another element, without discontinuities. A first element realized integral to a second element thus means that the two are a single piece, a unitary body.

[0025] The removal of the water from the water collecting housing in the basement takes place by means of a water removing unit.

[0026] The water removing unit includes a pump unit which pumps the water out from the water collecting housing. The water can be pumped from the housing for example to a condensate tank unit. This condensate tank unit in generally realized as a drawer, or includes a drawer, so that the excess water can be removed by the user. In order to pump the water away from the housing, the pump unit is at least for a portion introduced inside the water collecting housing.

[0027] Further, the condensate tank unit is preferably arranged on an upper portion of the dryer. The condensate tank unit preferably includes a condensate tank, which is preferably in the form of a drawer slidably arranged on said upper portion of the dryer. For example, the condensate tank can be slid out from the laundry by pulling it from the front wall.

[0028] The pump unit is apt to pump the condensed water connected to the water collecting housing to the condensate tank unit. For this purpose, a first conduit is provided, which connects an outlet of the pump unit to an inlet of the condensate tank unit, so that condensed water can be pumped upwards to the tank unit.

[0029] Further, the condensate tank unit preferably comprises a hopper, positioned below the condensate tank so that water spilled from the tank falls into the hopper. Advantageously, the hopper functions as an "overflow safety" in order to collect water from the condensate tank when the latter becomes full or water contained therein reaches a given level.

[0030] Preferably, the condensate tank unit includes a first aperture positioned on one of the sides of the condensate tank at a given level, so that if a level of the water in the water condensate tank raises above such given level, the water drops into the hopper. In this way, the condensate tank is always filled up to a predetermined maximum level or below. Any additional water pumped

by the pump unit to the condensed tank spills from the aperture and falls into the hopper.

[0031] Preferably, the condensate tank unit includes a second aperture positioned in the hopper to avoid that the water coming from the condensate tank fills the hopper completely. This aperture is connected to a second conduit. More preferably, the second aperture is positioned on a bottom surface of the hopper, so as - as soon as condensate water from the condensate tank reaches the hopper, it enters into the second conduit. The second aperture thus has the function of an outlet of the condensate tank unit.

[0032] The second conduit departing from the condensate tank unit, and preferably from the hopper of the same, ends in the basement. Preferably, the basement includes in a portion thereof, for example in the first or second shell, an inlet, so that the water overflowing the condensate tank can fall into the basement.

[0033] In case there is a pressure difference between the location of the pump unit, the location of the inlet in the basement where the water coming from the condensate tank unit is discharged, and/or the condensate tank unit itself, air may be transferred through the first and/or second conduit to even the pressures out in the various locations. The pressure difference may build up if one of these mentioned locations is substantially at least partially airtight.

[0034] In order to avoid this air exchange, at least a siphon-like element is positioned in the first and/or in the second conduit. The position of the siphon-like element may be any, as long as it is along the first and/or the second conduit. Possibly, two siphon-like elements are foreseen, one in the first and one in the second conduit.

[0035] The presence of the siphon-like element, which blocks a quantity of water in the conduit also when the pump unit is not active or when water is not dripping from the condensate tank unit to the basement, avoids or minimizes the possibility of air passage through the conduits. Pressure differences may be kept.

[0036] According to the above mentioned aspect, the dryer of the invention may include in combination or alternatively any of the following characteristics.

[0037] Preferably, the inlet opening arranged in the basement is located in a portion of the process air circuit. More preferably, the portion of the process air circuit is the same portion where the condensing device is positioned.

[0038] Advantageously, due to this positioning of the inlet opening, both the condensed water produced by the condensing device and the condensed water dripping from the condensate tank unit are collected in the same location. In a single location, all the condensed water is collected and can be for example channelled to the water collecting housing using a single canalization.

[0039] Preferably, the inlet opening arranged in the basement is located outside the water collecting housing.

[0040] Advantageously, the water collecting housing is positioned close to the pump unit. The pump unit needs a given volume to be mounted and it is preferable to avoid the location where the condensing device is present. Therefore, preferably the water is transferred, by suitable channels, from the location in the basement where the water is either condensing or dripping to the water collecting housing.

[0041] Preferably, the inlet opening includes an aperture in the process air circuit positioned higher than an upper surface of the condensing device.

[0042] The condensing device is positioned preferably inside the process air circuit and the inlet opening is also formed in such a circuit. For example, it can be formed on a top surface of a conduit of the air process circuit located higher than an upper boundary or surface of the condensing device.

[0043] Preferably, the siphon-like element is located at one end of the first and/or second conduit. More preferably, the siphon-like element is located at the end of the first conduit including the pump unit outlet and/or at the end of the second conduit including the inlet opening.

[0044] Available space may be present in proximity of the basement in order to place one or more siphon-like elements.

[0045] Preferably, said basement includes an upper portion and a lower portion assembled one onto the other and a channel located in the lower portion to transport water towards the water collecting housing, the inlet opening arranged in the basement being formed in said upper portion above said channel.

[0046] As mentioned, preferably the basement includes an upper and lower shell, which can be identified as an upper and lower portions of the basement. The upper and lower portions may have different shapes, and may include matching areas that can be coupled one another, preferably defining the channel of the air process circuit where process air may flow. Thus the air process conduit is substantially divided in an upper and lower parts by the division of the basement. Preferably, the lower portion or shell includes a channel, for example running below or at a side of the condensing device, and the upper portion or shell includes the inlet opening of the second conduit. Preferably, the inlet opening is positioned above the channel.

[0047] Preferably, said channel extends in a longitudinal direction of the basement in a region comprised between a side wall of the casing and a side of the condensing device.

[0048] Preferably, water from the second conduit is not wetting the condensing device. Therefore, preferably channel and inlet opening are positioned at a side of the condensing device, for example along a wall of the basement.

[0049] Preferably, said first and/or second conduit includes a hose connecting the pump unit outlet to the condensate tank inlet and/or the outlet of the condensate tank to the inlet opening arranged in the basement.

[0050] Advantageously, the conduits are realised in a simple manner by means of hoses.

[0051] Preferably, the siphon-like element comprises an S-bent hose portion.

[0052] Advantageously, the siphon-like element does not require additional elements to be produced and mounted on the dryer, an S-shaped torsion of the hose produces a siphon which is suitable for the intended purposes.

[0053] Preferably, a cross section of the first conduit has a different dimension than a cross section of the second conduit.

[0054] The conduits may have the same or different sections depending on the average amount of water flowing therein.

[0055] Preferably, the siphon-like element is removable from the first conduit and/or the second conduit.

[0056] Advantageously, this allows an easy repair and maintenance.

[0057] Preferably, the dryer according to the invention includes a heat pump system having a refrigerant circuit in which a refrigerant can flow, said refrigerant circuit including a first heat exchanger where the refrigerant is cooled off, a second heat exchanger where the refrigerant is heated up, said first and second heat exchanger being apt to perform heat exchange between said refrigerant flowing in said refrigerant circuit and said process air; the first and the second heat exchangers each defining an inlet for the process air where the process air enters the first or second heat exchanger and an air outlet where the process air leaves the first or second heat exchanger, wherein the inlet opening arranged in the basement is located between the air process inlet of the second heat exchanger and the air process outlet of the first heat exchanger.

[0058] More preferably, the inlet opening arranged in the basement is located between the air process inlet of the second heat exchanger and the air process inlet of the first heat exchanger and/or between the air process outlet of the second heat exchanger and the air process inlet of the first heat exchanger.

[0059] Preferably, the water from the condensate tank unit is not wetting the heat exchangers and thus is formed in such a location that water falling into the basement by gravity does not touch the heat exchangers.

[0060] Preferably, the inlet opening arranged in the basement is located upstream the pump unit in a direction of flow of the condensation water.

[0061] Advantageously, water is directed to the water collecting housing by means of gravity. The water collecting housing preferably also collects the water overflown from the condensate tank unit.

[0062] Preferably, the dryer according to the invention includes a holding member to hold the first conduit and/or the second conduit to minimize its/their relative movements, the holding member being positioned at a height lower than a height at which the inlet opening arranged in the basement is formed.

[0063] Advantageously, the conduits, being relatively long, are kept in position by one or more holding members.

[0064] Preferably, said water removing unit includes a support body to support said pump unit, said support body being integral in a single piece construction with said upper or lower shell.

[0065] The support body supports the pump unit and, in order to limit the number of separated parts to be assembled in the dryer of the invention, the support body is an integral part of the upper or lower shell. Preferably, the support body is an integral part of the upper shell of the basement.

[0066] Preferably, said water collecting housing is integral in a single piece construction with said lower or upper shell.

[0067] A further minimization of the number of dryer's component is preferably obtained using as a single "multi-purpose" unit the lower or upper shell of the basement. The water collecting housing where water is collected thus includes a basin directly formed in the lower or upper shell, without a further introduction of a detached/detachable water collecting housing to be inserted in the basement. Preferably the water collecting housing is integral to the lower shell. More preferably, the water collecting housing includes lateral walls and a bottom wall which are preferably integrally formed in a single piece construction with the lower shell.

[0068] According to a second aspect thereof, the present invention relates to a method for production of a dryer, the dryer including:

- a casing including a basement;
- a laundry chamber suitable to receive laundry to be dried;
- a process air circuit for circulating process air into said laundry chamber;
- a condensing device for removing moisture from the process air coming from said laundry chamber located within the process air circuit;
- a water collecting housing for the collection of moisture condensed by said condensing device;
- a condensate tank to collect water transferred from the water collecting housing;
- a pump unit associated to said water collecting housing for the removal of water contained therein and to pump it to the condensate tank;

wherein the method includes:

- connecting a pump unit outlet to a condensate tank inlet with a first conduit;
- connecting the condensate tank to an inlet opening

arranged in the basement with a second conduit; and

- bending the first and/or the second conduit in a S shape in order to form a siphon-like element or installing a siphon-like element in said first and/or the second conduit.

[0069] By the above-mentioned method for production of a dryer, the dryer according the present invention discussed above is obtained, so that all the advantages discussed above with respect of the dryer of the present invention are obtained by the above-mentioned method. Further, the production of the siphon-like elements is rather simple and does not require additional components to be produced and mounted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0070] Further features and advantages of the present invention shall become clearer from the following detailed description of a preferred embodiment thereof, made with reference to the attached drawings and given as an indication and not for limiting purposes.

[0071] In particular, the attached drawings are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification. The drawings together with the description serve to explain the principles of the invention. In the drawings, corresponding characteristics and/or components are identified by the same reference numbers. In such drawings:

Fig. 1 is a prospective view of a dryer according to the present invention;

Fig. 2 is a side view of the dryer of Fig. 1;

Fig. 3 is a sectional side view of the dryer of Fig. 2, viewed from the section plane III - III of Fig. 2;

Fig. 4 is an enlarged side view of a part of the dryer of Fig. 2;

Fig. 5 is a schematic representation of a dryer of Figure 1; and

Fig. 6 is an enlarged prospective view of a dryer of Fig. 5, provided with further components according to the present invention (first and second conduits).

DETAILED DESRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

[0072] Figs. 1-6 illustrates a dryer 10 according to the present invention.

[0073] The dryer 10 advantageously comprises a casing 12 having a front side and a back side, defined for example by a front and rear wall 10a, 10b. Preferably, a loading/unloading opening (not visible in the drawings) is formed at its front wall 10a. This opening is closable by a door 16, visible in figure 2. A laundry chamber (or laundry drum) 14 is rotatably arranged inside the casing 12. The rotatable drum 14 defines an inner volume to contain laundry, i.e. which is suitable to receive laundry to be dried. The drum 14 has preferably a cylindrical shape and includes preferably an open side 14a, facing the opening closed by door 16.

[0074] Further, the casing 12 includes a basement 13 which represent its lowermost portion. Front and rear walls 10a, 10b are preferably connected to the basement.

[0075] It should be observed that, in the present description and in the attached claims, when relative terms such as "front", "back", "rear", "lateral", "top", "bottom", etc. are used, they refer to the normal operational position of the dryer 10 when in use, e.g. located on a floor which usually is (substantially) horizontal. The location of the door 16 of the dryer 10, generally coupled to the front side 10a of the casing 12 in order to access the drum 14, defines the "front" of the dryer 10 itself. Given the horizontal plane on which the dryer 10 is located, "top" and "bottom" - as their normal common meaning - refer to the position of an object along a vertical axis.

[0076] The dryer 10 comprises a process air circuit for circulating process air into the drum 14. In particular, the dryer 10 is arranged in such a way that an air stream may circulate between the drum 14 and an air stream channel. The air stream channel extends preferably below and behind the drum 14; advantageously a portion of the front wall is comprised in the air stream channel. The process air circuit advantageously comprises a fan, not illustrated, which blows the flow of drying air through the drum 14.

[0077] In figure 4 a portion of the process air channel is shown using arrows 11, which indicate the direction of flow of the process air in the bottom of the dryer 10.

[0078] Dryer 10 further includes a condensing device 22, which is preferably arranged within the air stream channel 11, advantageously but not necessarily below the drum 14.

[0079] During operation of the dryer 10, the air stream, advantageously heated before entering the drum 14, circulates through the drum 14 and the air stream channel, so as to remove the moisture from the laundry loaded into the drum 14. The condensing device 22 cools down the air stream exiting from the drum 14 and removes moisture from the air stream. After passing the condensing device 22, the air stream is heated up again within the air stream channel, for example by a heating device. Then, the air stream is introduced into the drum 14 again. Thus, the air stream circulates within a closed loop.

[0080] The condensing device 22 removes moisture from the process air coming from the laundry chamber 14 located within the process air channel. Preferably therefore, the condensing device 22 is located within process air channel 11. More preferably it is positioned below drum 14.

[0081] Preferably, in the present embodiment the heat-

ing device is included in a heat pump 40, shown in figure 4, for example it includes a condenser 42 of the heat pump. Alternatively, an electric heater can be used as well, when a heat pump is not present, or even in combination with the heat pump.

[0082] As mentioned above, circulation of the process drying air inside the drum 14 evaporates the moisture from the wetted laundry so as to form a moisture-laden process air, or moist process air. The moist process air then exits the drum 14 preferably at the front side of the dryer 10, as depicted in figure 4. The moist process air enters into the basement 13 where the moisture included in the process air is at least partially removed by means of the condensing device 22, in this case the evaporator 41 of heat pump 40. In figure 1, 2 and 7, a heat exchanger casing 7 is shown apt to house the condensing device 22, in the depicted embodiment both heat exchangers (condenser 42 and evaporator 41) of heat pump 40. The heat exchanger casing 7 is a portion of the process air channel 11.

[0083] In the present embodiment, moist air passes the evaporator 41 and is cooled by the evaporator itself. The evaporator 41 condenses the water vapor of the moist air and the water formed therein falls in a bottom surface 110, better detailed below.

[0084] The process air conduit 11 then exits the basement 13, preferably from the back of the basement, and the process air is fed again to the drum 14.

[0085] The basement 13, with now reference to figures 1 and 2, includes a lower shell 13a and an upper shell 13b, which are coupled together defining the basement 13. The upper shell 13b forms the upper portion of the basement, while the lower shell 13a forms the lower portion of the basement. Both upper and lower shells form together a front, back and lateral sides of the basement. Preferably, the upper and the lower shell 13b, 13a are realized in polymeric material and are preferably formed in a molding process. In the basement, thus as internal volume to the shells can be defined as the "interior" to the basement.

[0086] Preferably, the basement portion of the process air conduit 11 is also formed as a combination of the upper and lower shell 13b, 13a, that is the basement portion of the process air conduit 11 is divided in two half, a lower half and an upper half, each half realized integral to with the respective shell, defining an air process duct basement portion.

[0087] The basement portion of the process air circuit 11 includes the casing 7 for the heat pump 40.

[0088] The casing 7 for the heat exchangers 41, 42 includes a bottom surface, which in turn comprises the bottom surface 110 on which the condensed water drips from the evaporator 41.

[0089] Preferably, the bottom surface 110 is realized as an integral part of the lower shell 13a.

[0090] Further, dryer 10 includes a water collecting housing 30 to collect the condensed water. By means of duct(s) or channel(s), such as duct 28 visible in figures 3 and 4, from the bottom surface 110 the condensed water is collected in the water collecting housing 30. The collecting housing 30 is preferably arranged in the interior of the basement 13 of the dryer 10, between upper 13b and lower shell 13a. Preferably, water collecting housing 30 is also preferably integral to the lower shell 13a, that is water collecting housing 30 includes bottom wall 30a and lateral walls 30b which are a unitary single part with the lower shell 13a. More preferably, the water collecting housing 30 is arranged at the rear side of the lower shell 13a of the dryer 10, as illustrated in Figure 4. Preferably, two lateral walls 30b of the water collecting housing 30 are adjacent to a corner 17 formed in the basement 13. Preferably, the housing 30 is formed in a corner 17 of the basement 13, so that two lateral walls 30b of the housing 30 are two portions of the back side and of one of the two lateral sides of the basement 13.

[0091] Preferably duct 28 is located substantially parallel to one of the lateral sides of the basement. More preferably, it is located in proximity of one of the lateral side of the basement 13, that is, between the heat pump 40 and the boundary of the basement 3.

[0092] Duct 28 ends in water collecting housing 30. In order to better channel condensed water accumulated in surface 110 to water collecting housing 30, preferably duct 28 is slightly vertically tilted, that is a point of a bottom surface of duct 28 at surface 110 is higher in the vertical direction than a point where the duct 28 merges into the water collecting housing 30, so that water flows to water collecting housing 30 by gravity.

[0093] Preferably portion of the process air conduit 11 may be airtight or partially air tight so that the pressure therein is different than the pressure outside the conduit.

[0094] Furthermore, in addition to the condensing device 22 - heat pump 40 -, on the basement 13 are preferably arranged other operational devices of the dryer, like air pumping means or electric motors (not visible in the drawings). Advantageously, the upper and lower shells 13b, 13a of basement 13 are opportunely shaped so as to create air paths wherein the air is opportunely conveyed. Further, in case of a heat pump dryer, the basement 13 also hosts a compressor (also not visible) of the heat pump. These operational devices or components preferably are arranged in a specific outline within the basement 13.

[0095] Condensation water from the water collecting housing 30 is preferably conveyed to an extractable moisture tank 36 (see figure 1) located at the upper portion of the dryer 1, for example above drum 14. The moisture tank 36 is preferably in the form of a drawer slidably arranged in a box-shaped housing or hopper 80 (schematically depicted in figure 5) on said upper portion of the dryer 10 so that it can be easily and periodically emptied by a user. Hopper 80 contains moisture tank 36. Moisture tank 36 includes an aperture 38 (again only visible in figure 5) so that, if the water level inside moisture tank 36 is higher than the height of the aperture 38, water falls into the hopper 80.

[0096] Condensation water from the collecting housing 30 is conveyed to the extractable moisture tank 36 by means of a water-removing unit 18 associated to the collecting housing 30. The water-removing unit 18 preferably comprises a support body 21, a pumping unit 44 and preferably also a water level sensing device (not visible). The pumping unit 44 and the sensing device are preferably associated to the support body 21 in a removable way so that they can be easily mounted or removed during either manufacturing or maintenance.

[0097] The pump unit 44 is placed substantially in the basement 13.

[0098] Figures 5 and 6 illustrate a first conduit 50 which fluidly connects the pump unit 44 to the condensate tank 36, in particular fluidly connects a pump unit outlet 45 to a condensate tank inlet 37.

[0099] Fig. 6 also illustrates a second conduit 60 which fluidly connects the hopper 80 to an inlet opening 23 arranged in the basement 13. In particular, hopper 80 includes an outlet 81 positioned in a bottom wall 82 of the same. As soon as water from the condensate tank 36 falls into the hopper 80, it exits the latter via outlet 81.

[0100] The inlet opening 23 is preferably located in a portion of the process air circuit 11. Preferably, the above-mentioned portion of the process air circuit is the same portion where the condensing device 22 is positioned, that is the heat-pump casing 7.

[0101] The inlet opening 23 is preferably located outside the water collecting housing 30. Preferably, the inlet opening 23 includes an aperture in the process air circuit positioned higher than an upper surface of the condensing device 22.

[0102] Advantageously, the dryer 10 also includes a first and a second siphon-like elements 52, 62 located in the first and in the second conduit 50, 60 respectively, in order to limit air transfer through the first and second conduit 50, 60.

[0103] In an alternative embodiment (not shown), the siphon-like elements 52, 62 may be located only in one of the first and second conduit 50, 60.

[0104] Preferably, the first or second siphon-like element 52, 62 is located at one end of the first or second conduits 50, 60.

[0105] In the not-limiting, shown embodiment illustrated in Figures 5 and 6, the first siphon-like element 52 is located at one end of the first conduit 50, near the pump unit outlet 45, while the second siphon-like element 62 is located substantially near the inlet opening 23.

[0106] The first and second conduits 50, 60 include respective hoses connecting the pump unit outlet 45 to the condensate tank inlet 37 and, respectively, the outlet 82 of the hopper 80 to the inlet opening 23 arranged in the basement 13. A cross section of the first conduit 50 may have a different dimension than a cross section of the second conduit 60.

[0107] In order to keep the first and second conduit 50, 60 in position without movements caused by the vibration of the dryer during tumbling, the dryer 10 includes for each conduit a plurality of gripping elements, all indicated with 70, which follows the path of the conduits from one end to the other. Therefore, the gripping elements 70 are positioned in a plurality of locations distributed from the top of the dryer 10 till the basement 13. The gripping elements 70 keeping in place the second conduit 60 include a gripping element indicated with 70' which is positioned (see figures 2 and 6) lower than the position of the inlet 23 into the air process conduit 11.

[0108] The siphon-like elements 52, 62 comprise respective S-bent hose portions of the hoses. A simple design of the siphon-like elements is thus achieved.

[0109] Advantageously, although not visible from the drawings, the siphon-like elements 52, 62 may be removable from the first and second conduits 50, 60 respectively.

[0110] A method for production of a dryer according to what has been discussed above includes the step of connecting the pump unit outlet 45 to the condensate tank inlet 37 with the first conduit 50 and the step of connecting the hopper 80 to an inlet opening 23 arranged in the basement 13 with the second conduit 60. The method further includes the step of bending the first and/or the second conduit 50, 60 in a S shape in order to form a siphon-like element 52, 62 or installing a siphon-like element 52, 62 in said first and/or the second conduit 50, 60.

Claims

1. A dryer (10) comprising:

- a casing (12) including a basement (13);
- a laundry chamber (14) suitable to receive laundry to be dried;
- a process air circuit for circulating process air into said laundry chamber (14);
- a condensing device (22) for removing moisture from the process air coming from said laundry chamber (14) located within the process air circuit;
- a water collecting housing (30) for the collection of moisture condensed by said condensing device (22);
- a condensate tank unit (36,80) to collect water transferred from the water collecting housing (30);
- a pump unit (44) associated to said water collecting housing (30) for the removal of water contained therein and to pump it to the condensate tank unit (36,80);
- a first conduit (50) fluidly connecting a pump unit outlet (45) to a condensate tank unit inlet (37);
- a second conduit (60) fluidly connecting the condensate tank unit (36,80) to an inlet opening (23) arranged in the basement (13); and
- wherein the dryer (10) also includes a siphon-

like element (52, 62) located in the first and/or in the second conduit (50, 60) to limit air transfer through the first and/or second conduit (50, 60).

2. The dryer (10) according to claim 1, wherein the inlet opening (23) arranged in the basement (13) is located in a portion of the process air circuit.

3. The dryer (10) according to claim 1 or 2, wherein the inlet opening (23) arranged in the basement (13) is located outside the water collecting housing (30).

4. The dryer (10) according to any of the preceding claims, wherein the siphon-like element (52, 62) is located at one end of the first and/or second conduit (50, 60).

5. The dryer (10) according to claim 4, wherein the siphon-like element (52, 62) is located at the end of the first conduit (50) including the pump unit outlet (44) and/or at the end of the second conduit (60) including the inlet opening (23).

6. The dryer (10) according to any of the preceding claims, wherein said basement (13) includes an upper portion (13b) and a lower portion (13a) assembled one onto the other and a channel (28) located in the lower portion to transport water towards the water collecting housing (30), the inlet opening (23) arranged in the basement (13) being formed in said upper portion above said channel (28).

7. The dryer (10) according to claim 6, wherein said channel (28) extends in a longitudinal direction of the basement (13) in a region comprised between a side wall of the casing (12) and a side of the condensing device (22).

8. The dryer (10) according to any of the preceding claims, wherein said first and/or second conduit (50, 60) includes a hose connecting the pump unit outlet (44) to the condensate tank inlet (37) and/or the outlet of the condensate tank (36) to the inlet opening (23) arranged in the basement (13).

9. The dryer (10) according to any of the preceding claims, wherein the siphon-like element (52, 62) comprises an S-bent hose portion.

10. The dryer (10) according to any of the preceding claims, wherein a cross section of the first conduit (50) has a different dimension than a cross section of the second conduit (60).

11. The dryer (10) according to any of the preceding claims, wherein the siphon-like element (52, 62) is removable from the first conduit and/or the second conduit (50, 60).

12. The dryer (10) according to any of the preceding claims when dependent on claim 2, including a heat pump system (40) having a refrigerant circuit in which a refrigerant can flow, said refrigerant circuit including a first heat exchanger where the refrigerant is cooled off, a second heat exchanger where the refrigerant is heated up, said first and second heat exchanger being apt to perform heat exchange between said refrigerant flowing in said refrigerant circuit and said process air; the first and the second heat exchangers each defining an inlet for the process air where the process air enters the first or second heat exchanger and an air outlet where the process air leaves the first or second heat exchanger, and wherein the inlet opening (23) arranged in the basement (13) is located between the air process inlet of the second heat exchanger and the air process outlet of the first heat exchanger.

13. The dryer (10) according to claim 12, wherein the inlet opening (23) arranged in the basement (13) is located between the air process inlet of the second heat exchanger and the air process inlet of the first heat exchanger and/or between the air process outlet of the second heat exchanger and the air process inlet of the first heat exchanger.

14. The dryer (10) according to any of the preceding claims, wherein the inlet opening (23) arranged in the basement (13) is located upstream the pump unit (40) in a direction of flow of the condensation water.

15. The dryer (10) according to any of the preceding claims, including a holding member (70) to hold the first conduit (50) and/or the second conduit (60) to minimize its/their relative movements, the holding member (70) being positioned at a height lower than a height at which the inlet opening (23) arranged in the basement (13) is formed.

16. Method for production of a dryer (10), the dryer (10) including:

- a casing (12) including a basement (13);
- a laundry chamber (14) suitable to receive laundry to be dried;
- a process air circuit for circulating process air into said laundry chamber (14);
- a condensing device (22) for removing moisture from the process air coming from said laundry chamber (14) located within the process air circuit;
- a water collecting housing (30) for the collection of moisture condensed by said condensing device (22);
- a condensate tank (36) to collect water transferred from the water collecting housing (30);
- a pump unit (44) associated to said water col-

lecting housing (30) for the removal of water contained therein and to pump it to the condensate tank (36);

wherein the method includes:

- connecting a pump unit outlet (45) to a condensate tank inlet (37) with a first conduit (50);
- connecting the condensate tank (36) to an inlet opening (23) arranged in the basement (13) with a second conduit (60); and
- bending the first and/or the second conduit (50, 60) in a S shape in order to form a siphon-like element (52, 62) or installing a siphon-like element (52, 62) in said first and/or the second conduit (50, 60).

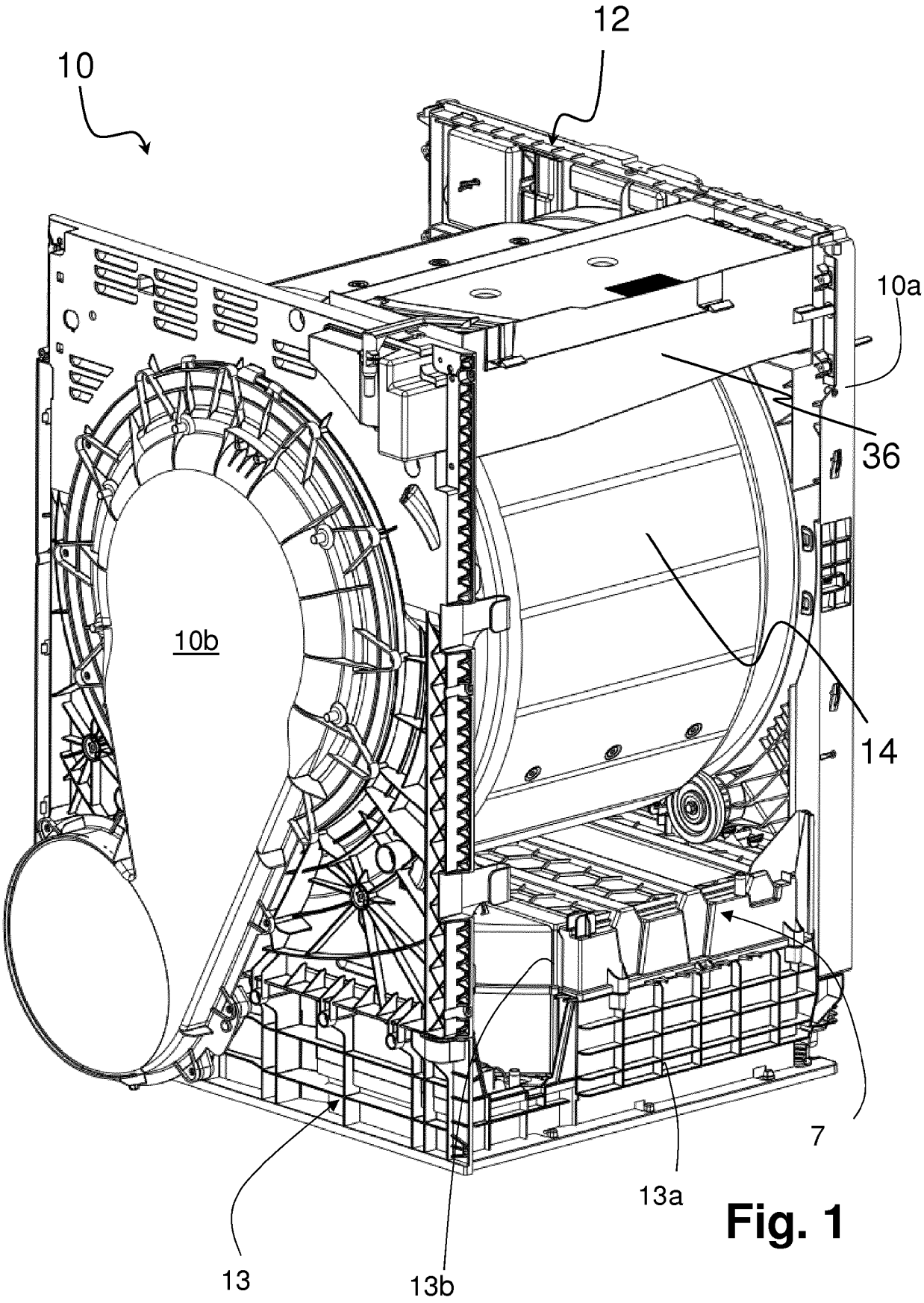

Fig. 1

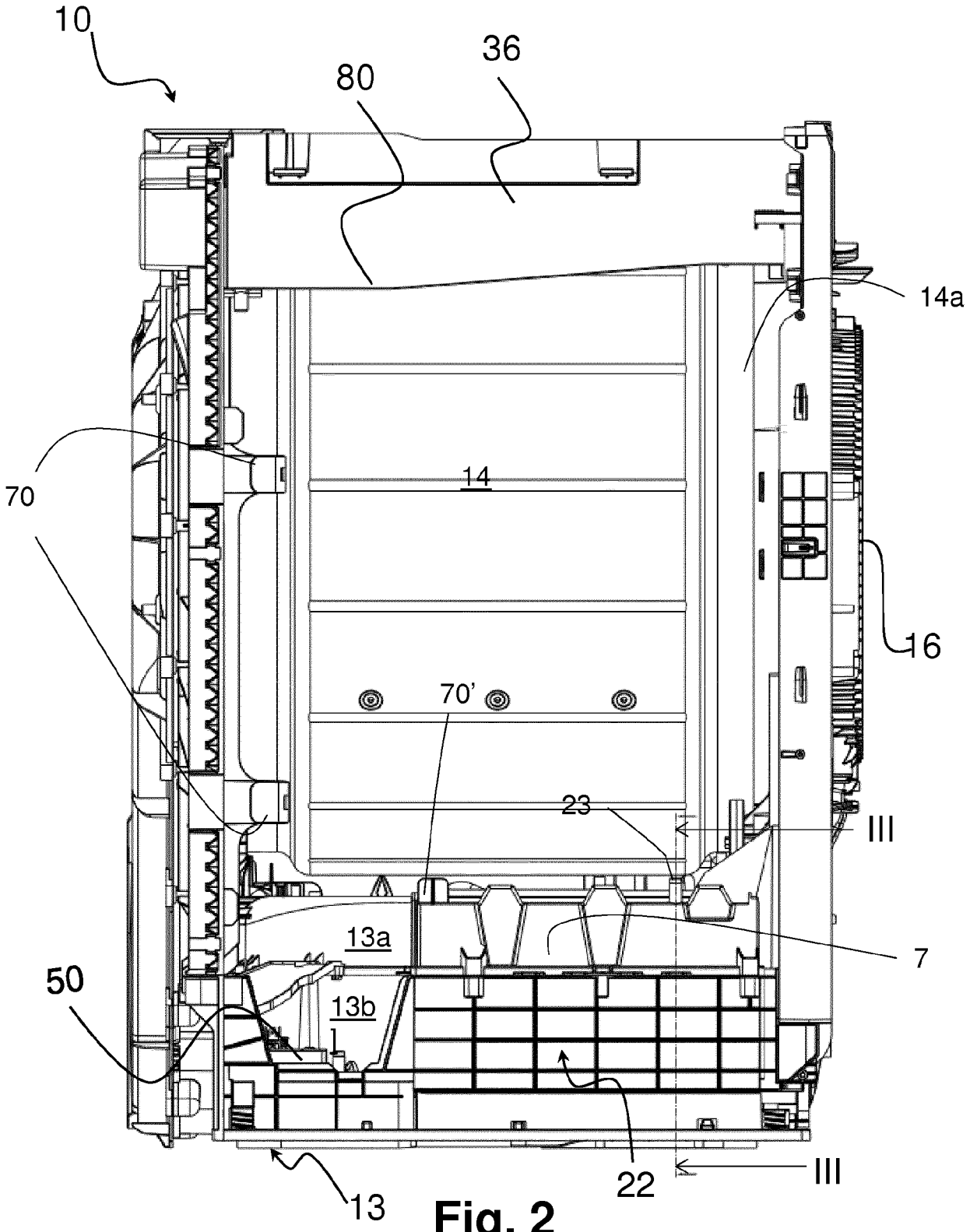

Fig. 2

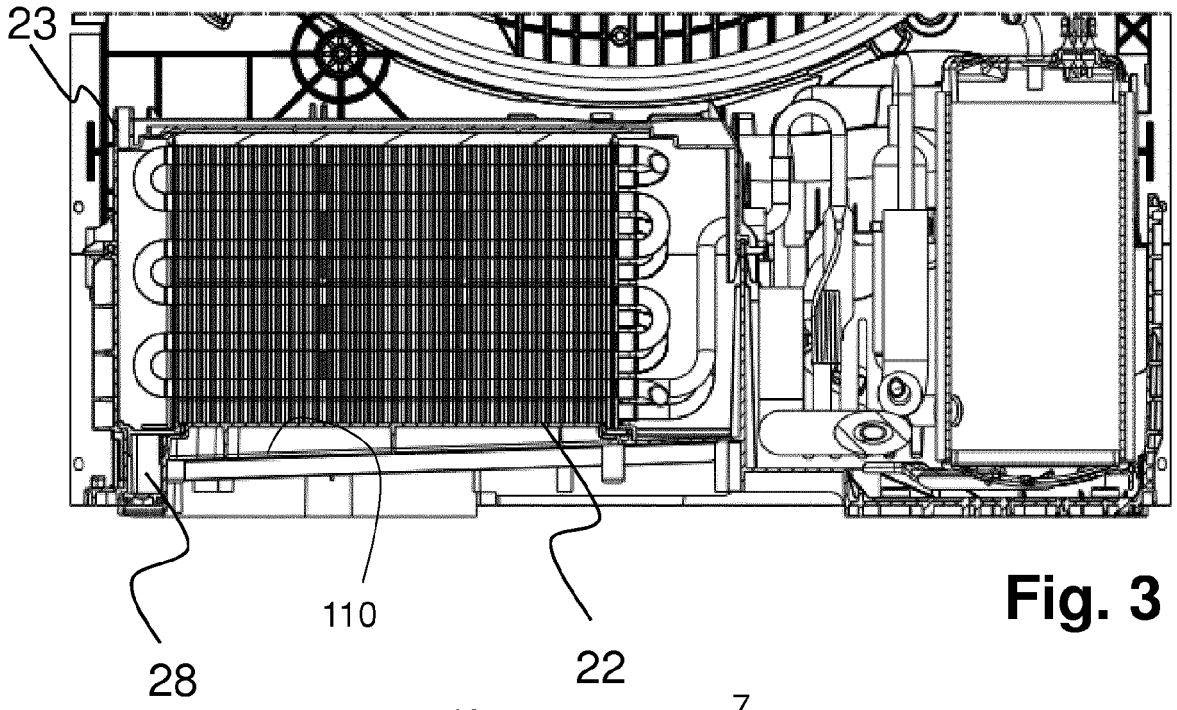

Fig. 3

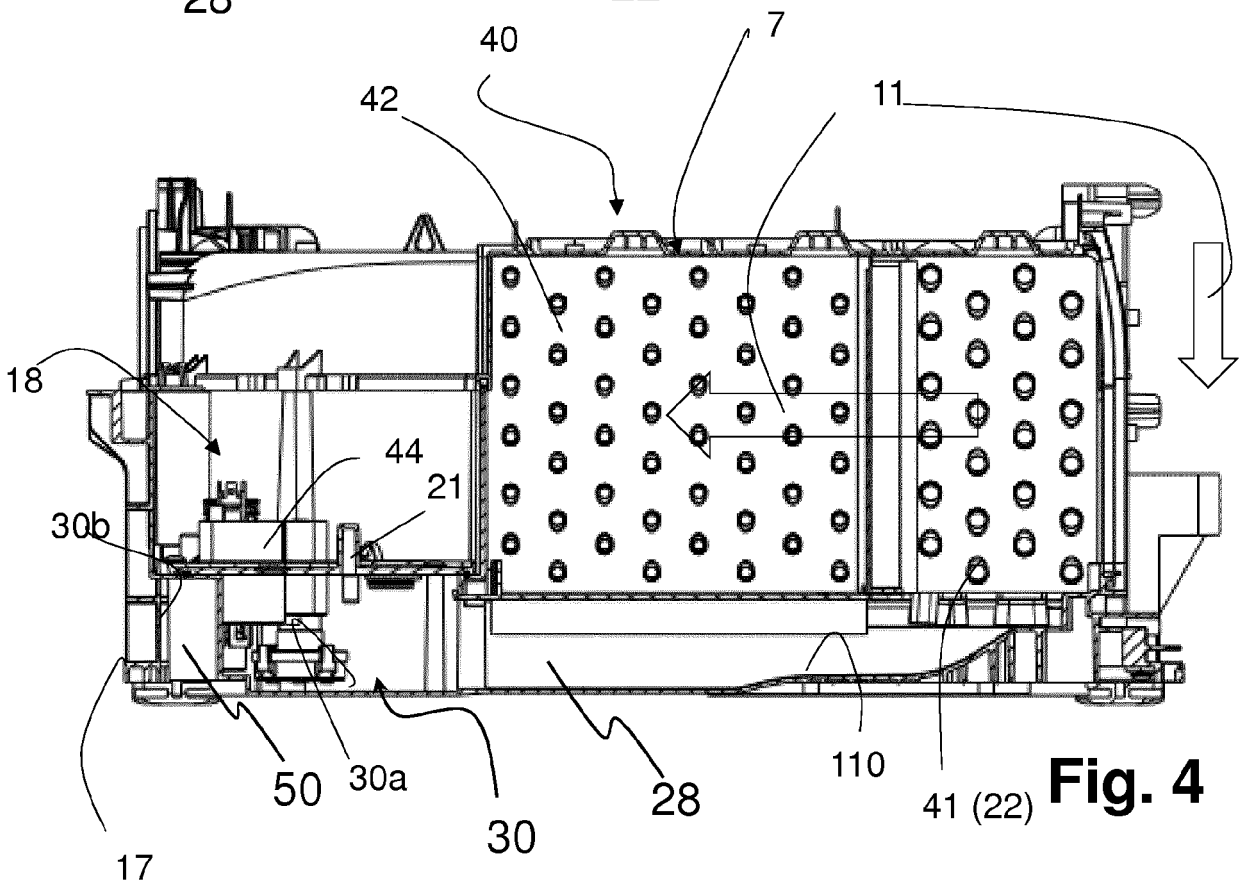

Fig. 4

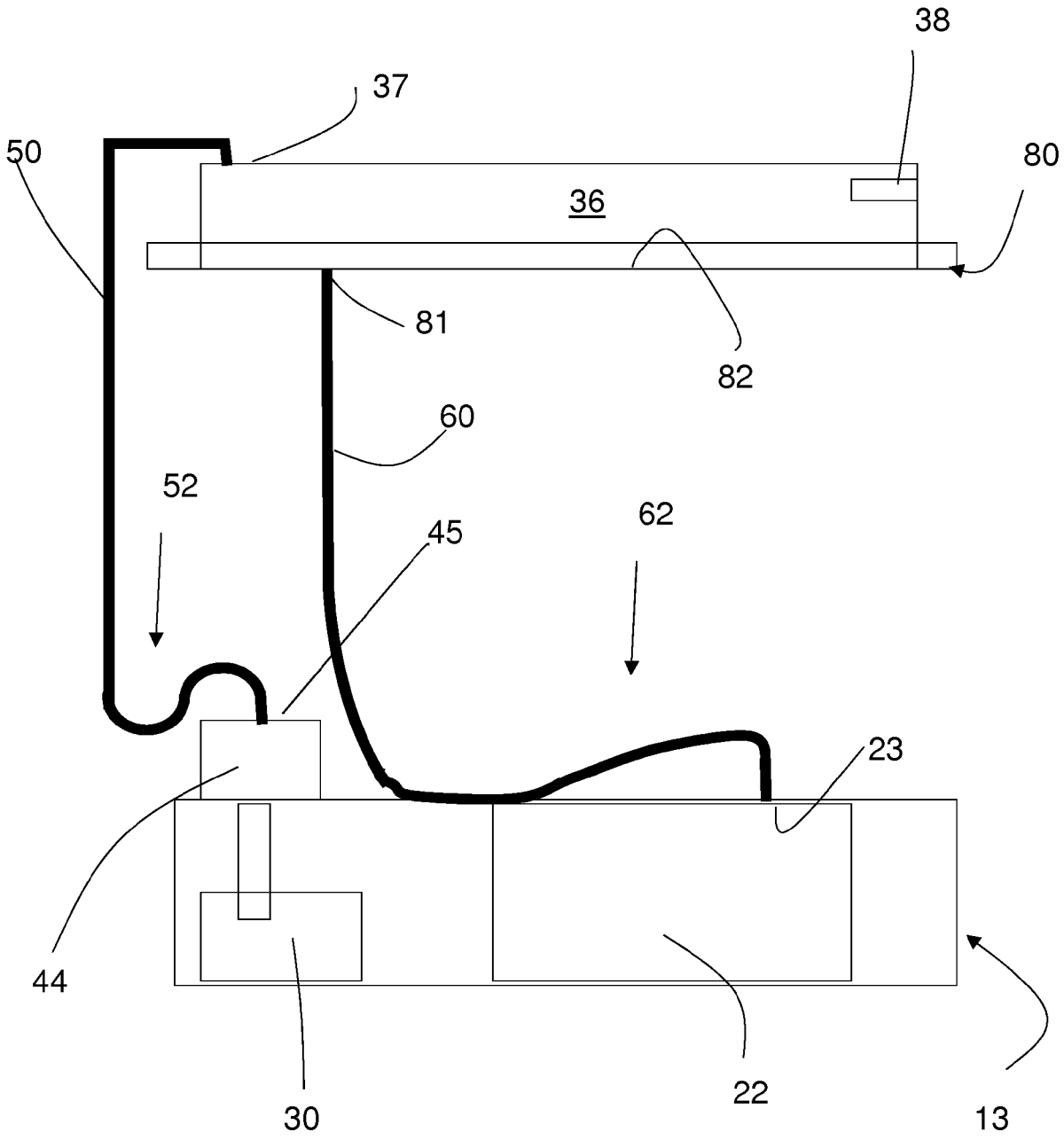

Fig. 5

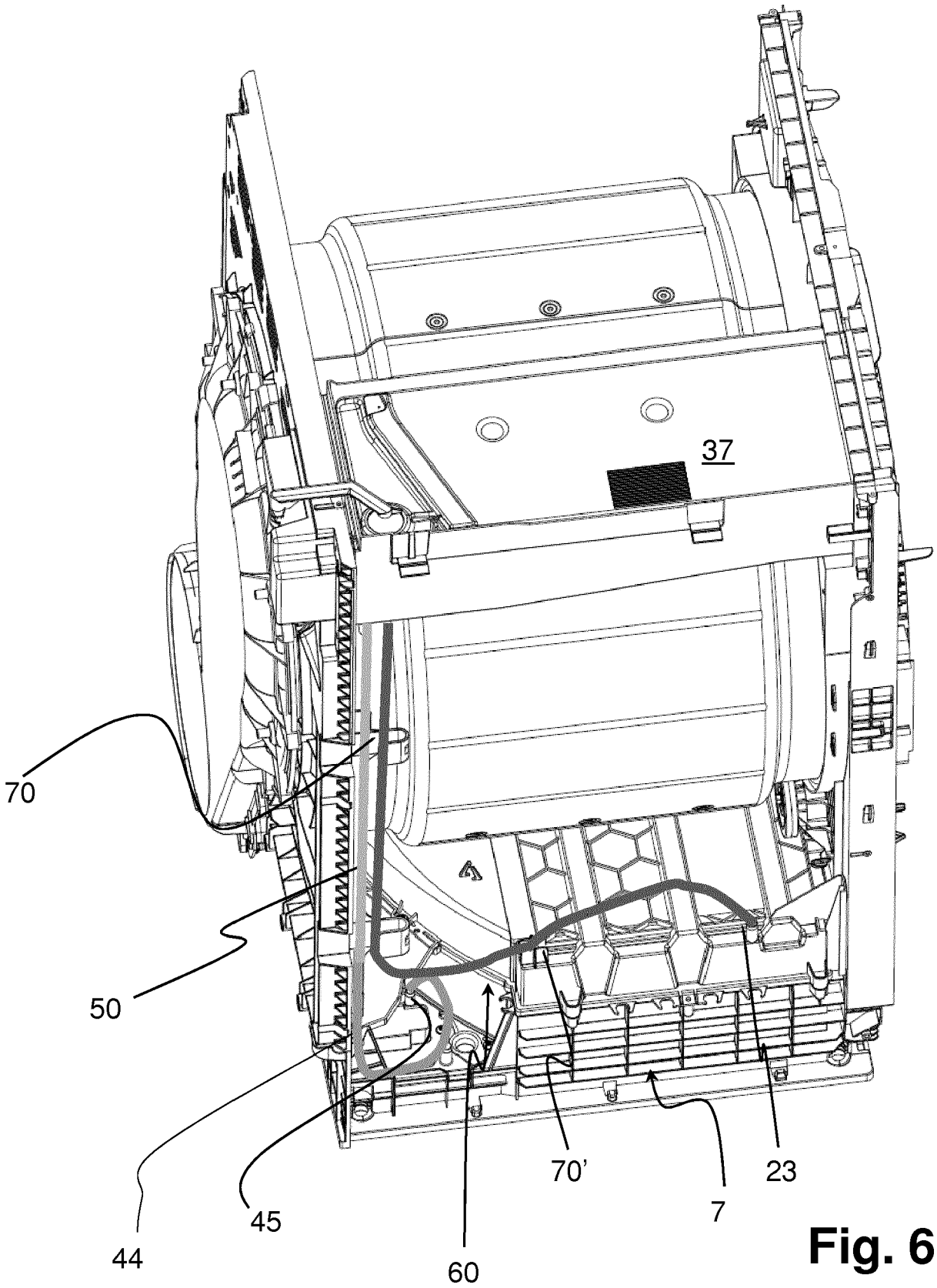

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 17 18 9498

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	WO 2015/101388 A1 (ELECTROLUX APPLIANCES AB [SE]) 9 July 2015 (2015-07-09) * page 12, line 25 - page 18, line 22 * * figures 2a-9 * -----	1-16	INV. D06F58/24 ADD. D06F58/20
X	WO 2014/169955 A1 (ELECTROLUX APPLIANCES AB [SE]) 23 October 2014 (2014-10-23) * figures 3-5b, 16a, 16b * -----	1-16	D06F58/22

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	5 February 2018	Bermejo, Marco

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 18 9498

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