



(11) **EP 2 573 253 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:
07.09.2016 Bulletin 2016/36

(51) Int Cl.:
D06F 58/20 ^(2006.01)

(21) Application number: **11182780.4**

(22) Date of filing: **26.09.2011**

(54) **Heat pump dryer**

Wärmepumpentrockner

Sèche-linge à pompe à chaleur

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

(43) Date of publication of application:
27.03.2013 Bulletin 2013/13

(73) Proprietor: **Electrolux Home Products
Corporation N.V.
1130 Brussels (BE)**

(72) Inventors:
• **Cavarretta, Francesco**
33080 Porcia (PN) (IT)
• **Bison, Alberto**
33080 Porcia (PN) (IT)

• **Zandona', Stefano**
33080 Porcia (PN) (IT)
• **Vignocchi, Massimiliano**
33080 Porcia (PN) (IT)

(74) Representative: **Nardoni, Andrea et al**
Electrolux Italia S.p.A.
Corso Lino Zanussi, 30
33080 Porcia (PN) (IT)

(56) References cited:
EP-A1- 1 790 769 EP-A1- 2 123 823
EP-A1- 2 333 149 EP-A2- 0 816 548
WO-A2-2010/071355 DE-A1- 4 118 289
DE-A1-102007 027 866 DE-U1-202009 005 871
JP-A- 2004 323 765

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] The invention relates to laundry treatment apparatus having a heat pump system in which process air for laundry treatment is dehumidified and heated.

[0002] In driers using a heat pump system for dehumidifying and heating the process air in a closed process air loop, excess energy has to be removed from the heat pump system as soon as the system has achieved a steady operation state. The so called steady state is an optimum operation state in which the dehumidifying capacity of the evaporator and the heating capacity of the condenser are optimized in view of drying the laundry and energy consumption of the heat pump system. In the steady state the excess energy is the heat power introduced to the system by the compressor and which would drive the system to an over-temperature and less-optimum operation, if not balanced. From prior art different approaches are known to balance the excess energy when reaching the steady state.

[0003] For example, a drier having a heat pump system for dehumidifying and heating process air is known from EP 0 197 132 B1. In one embodiment the process air is circulated in a process air loop from a laundry drum to an evaporator for cooling and dehumidifying the process air and a condenser for heating the process air and back to the drum. In the process air loop between the drum and the evaporator an air-air heat exchanger is arranged which removes heat from the process air whereby a portion of the humidity in the process air is condensed in the air-air heat exchanger in addition to condensation in the evaporator. The heat removal capacity corresponds to the power dissipated by the compressor to the heat pump system. The air-air heat exchanger may have a corrugated metal sheet arranged at the rear face of the dryer cabinet.

[0004] With the same intention in JP 2007-82586 A the laundry dryer has an air-air heat exchanger provided by a separate heat exchanger drum that is extending from the rear face of the laundry drum.

[0005] In addition to an air-air heat exchanger WO 2008/086933 A suggests a dryer with an auxiliary condenser cooled by ambient air to remove heat from the refrigerant loop in the heat pump system.

[0006] DE 10 2007 027 866 A1 suggests a laundry dryer with a closed process air loop, wherein the process air is guided through a horizontally rotating drum for storing laundry to be dried by the process air. A heat pump system having an evaporator for cooling and dehumidifying the process air, a condenser for heating the process air, a compressor for circulating the refrigerant through the heat pump system, and an expansion device is provided. An air/air heat exchanger is arranged upstream of the evaporator in the process air loop. The air/air heat exchanger has a first passage for the process air and a second passage for ambient air, wherein the second passage is arranged parallel but distant to the process air passage. In the first embodiment the process air passage is a vertical duct connecting the outlet of the drum to a horizontal portion of the process air channel. Further, the cooling air channel is arranged in parallel but spaced apart from the process air channel. In the second embodiment the air/air heat exchanger is arranged at a horizontal section of the process air channel.

[0007] EP 2 123 823 A1 discloses a laundry dryer of the condensation type that has a closed process air loop. At the sidewall of the dryer a first air/air heat exchanger is provided in which the process air coming from the drum is vertically guided in parallel to a channel through which ambient air flows. A pre-cooling of the process air is provided thereby such that the efficiency of a second air/air heat exchanger is improved.

[0008] The auxiliary heat exchanger known from EP 2 333 149 A1 removes excessive heat from the heat pump system by cooling the refrigerant flowing through the auxiliary heat exchanger. In the auxiliary heat exchanger the refrigerant is cooled by flowing cooling air from a blower through the heat exchanger.

[0009] EP 1 790 769 A1 provides a tumble dryer in which an air/air heat exchanger is arranged in a basement of the dryer. The air/air heat exchanger has the function of the single and only condenser for condensing the humidity of the drying air. Ambient cooling air is flowing through the heat exchanger in perpendicular manner with respect to the drying air, wherein the drying air is passing through the heat exchanger in a horizontal direction and perpendicular to the areas of a drying air inlet and outlet.

[0010] It is an object of the invention to provide a laundry treatment apparatus having a heat pump system in which a process air heat exchanger is integrated in a compact and/or cost-saving manner.

[0011] The invention is defined in claims 1 and 4, respectively. Particular embodiments are set out in the dependent claims.

[0012] According to claims 1 and 4, a laundry treatment apparatus having a laundry storing chamber for treating the laundry and a heat pump system for dehumidifying and heating process air vented through the laundry storing chamber is provided. For balancing at least a portion of the heat energy (i.e. heat power or temperature) from the heat pump system, a process air heat exchanger is provided which removes a portion of the heat of the process air circulated in the process air loop. Preferably the heat is transferred from the process air to ambient air (e.g. an air/air heat exchanger) which is available in the operating surroundings of the laundry treatment apparatus. The air/air heat exchanger provides a pre-cooling of the process air upstream the first heat exchanger (before entering the first heat exchanger). The process air heat exchanger can be arranged in a base of the apparatus where it is an advantage that the process air heat exchanger can be grouped with other elements of the heat pump system. The process air heat exchanger is part of or

integrated in a channel section unit of the process air channel in which the process air is circulated in the process air loop.

[0013] A process air channel is guiding the process air from and to the laundry storing chamber, preferably the storing chamber being a laundry drum. A section of the process air channel, preferably a front channel section or channel section unit guides the process air coming out of the laundry storing chamber downwards towards the base of the laundry treatment apparatus and deflects the process air flow from the downward direction to a horizontal direction. 'Downward' direction may include flow path sections that are vertical and/or (partially) inclined to the vertical or even partially horizontal - however with the net effect that in the channel section unit the process air is guided downward from a higher to a lower altitude level (in the normal operation orientation of the laundry treatment apparatus). Preferably the process air deflected to the horizontal flow direction enters into the first heat exchanger and/or a battery channel section of the process air channel.

[0014] The channel section unit is a fluff filter unit (e.g. a filter compartment) and/or is a service access unit of the apparatus.

[0015] According to claim 1, the process air heat exchanger is integrated or part of the channel section unit in which the process air is deflected from the downward direction to the horizontal direction. The process air heat exchanger is integrated in the channel section unit in that the process air heat exchanger comprises a cooling air channel that is running through the process air channel. Preferably the cooling air channel is running through the process air channel such that it is completely surrounded by process air.

[0016] According to claim 4, a heat exchanging interface surface or the essential proportion thereof (e.g. with respect to its heat exchanging surface) of the process air heat exchanger is forming a wall portion that is an outer wall of the process air channel. Both solutions provide an integration of the process air heat exchanger in a compact manner without or without substantial additional space requirement. Further elements are defined in claim 4.

[0017] In the alternative configuration the heat exchanging surface or interface between process air contact side and the cooling air contact side is forming a section of the outer wall of the process air channel defining the outer extension thereof. This means that the outer wall of the air channel, preferably of the channel section unit, is integral part of the process air heat exchanger. Preferably it is the substantial surface area portion of the heat exchanging interface area thereof. Therein the cooling air is just flowing over a portion of the process air channel outer side.

[0018] The process air loop is preferably a closed loop in which the process air is continuously circulated through the laundry storing chamber. However it may also be provided that a (preferably smaller) portion of the process air is exhausted from the process air loop and fresh air (e.g. ambient air) is taken into the process air loop to replace the exhausted process air. And/or the process air loop is temporally opened (preferably only a short section of the total processing time) to have an open loop discharge - which e.g. may be used to remove smell from the laundry treated.

[0019] The channel section unit represents a section or portion of the process air loop and is preferably a section that is normally not specifically provided to place or arrange the process air heat exchanger, but it is a section which would also be provided, if the heat pump system is designed without the process air heat exchanger. I.e. the process air heat exchanger does not require extra design and/or extra components to integrate the process air heat exchanger within the process air loop.

[0020] Preferably the process air heat exchanger is arranged close to and/or upstream the first heat exchanger and downstream the laundry storing chamber. Thereby the heat exchanging efficiency and the efficiency of the heat pump system is optimized in that heat energy is removed from the process air in a hot and high humid state and a pre-cooling for the first heat exchanger is provided. On the other hand by the close proximity to the first heat exchanger condensate that forms in the process air heat exchanger can be guided or discharged to the condensate collection device provided for the first heat exchanger. In an embodiment the process air heat exchanger is arranged in a channel section, for example in the channel section unit, which is at least partially formed by a base or bottom shell of the base section of the laundry treatment apparatus. In this case it is advantageous when the condensate collection and guiding structure for guiding the condensate formed at the process air heat exchanger is collected and guided to the condensate collection device by a structure provided at least partially in the bottom shell.

[0021] In an embodiment the channel section unit in which the process air heat exchanger is at least partially integrated in or is part thereof is arranged in a base section of the apparatus. Additionally or alternatively the heat exchanging interface surface or interface between the process air channel and the cooling air guiding face of the process air heat exchanger comprises at least 50%, 55%, 60%, 70%, 80% or 90% of the total heat exchanging interface surface of the process air heat exchanger for exchanging heat between the cooling air and the process air.

[0022] In an embodiment the base section of the laundry treatment apparatus has a bottom shell that is structured to form at least a portion of a battery channel. The battery channel is a portion of the process air channel in which at least the first heat exchanger (e.g. evaporator) and the second heat exchanger (e.g. condenser) are arranged. Preferably the bottom shell and the at least a portion of the battery channel is formed as an integral or monolithic element, e.g. formed by injection molded plastic. Preferable the bottom shell forms a lower portion of the battery channel and an upper shell forms the upper part of the battery channel.

[0023] The fluff filter unit is for example provided in the base of the apparatus, preferably accessible from the front of

the apparatus, and has a fluff filter which removes lint from the process air before it enters the first heat exchanger. Integration of the process air heat exchanger to the fluff filter unit means a minimum of adaptation and minimum change of the apparatus and can thus be implemented cost effective. The same applies in case the channel section unit is a service access unit that is used to maintain, clean or service components of the apparatus. For example the service access unit provides an access from outside of the apparatus cabinet to the interior of the process air loop, e.g. an opening in the cabinet and/or the process air channel for cleaning and/or removing heat exchanger fins of the first and/or second heat exchanger.

[0024] The process air heat exchanger exchanges heat between the process air circulated in the process air loop and cooling air. The cooling air is for example ambient air from the surroundings of the apparatus; it may however also be air taken from an air system or from an outside environment of the location where the apparatus is operated. The cooling air may be passively driven by convection where the heated cooling air is ascending and replaced by colder cooling air. In a preferred embodiment a cooling air flow is driven by a blower to or sucked from the process air heat exchanger. Preferably the blower is operated under the control of a control unit such that the start, the stop, the operation duration, the flow rate and/or the flow direction of the cooling air can be controlled. For example the cooling air flow is started only when a predefined refrigerant temperature and/or pressure is detected in the refrigerant loop. Actively driving the cooling air flow also provides the advantage to adapt the process air heat exchanger design and the path of the cooling air according to the place and technical requirements related to the channel section unit where the process air heat exchanger is provided. For example the cooling air may be flown laterally, vertically upward, vertically downward or a combination thereof across or through the process air heat exchanger.

[0025] Preferably the blower for blowing the cooling air is at or in a cover door or cover panel at the base of the apparatus. In the closed state the cover door or panel covers for example an access to a service opening in the cabinet of the apparatus and/or a portion of the process air channel forming the process air loop. For example the door or panel covers a fluff filter or service access unit. Preferably the blower is a flat blower whose blowing direction is perpendicular to the blower rotation axis (i.e. an axial blower). Preferably the cover door or panel provides openings in the cabinet to suck in cooling air and to blow it towards the process air heat exchanger.

[0026] Alternatively the blower is arranged at a side of the process air heat exchanger and/or channel section unit and laterally offset thereto or the blower is arranged vertically above or below the process air heat exchanger and/or channel section unit. In case of using the fluff filter unit or service access unit, there is no additional extension in the direction for accessing the units and no extra space is required between the process air heat exchanger and the outer surface of the apparatus cabinet. In an embodiment the blower is arranged in the base section of the apparatus laterally offset to the process air heat exchanger and an air guiding means is provided to guide the air from the blower to the process air heat exchanger or from the process air heat exchanger to the blower. The blower may be arranged below the channel section unit or in a lower section of the channel section unit and an air guiding means is provided to guide the cooling air from the blower to the process air heat exchanger or from the process air heat exchanger to the blower.

[0027] When the blower is arranged laterally or vertically downward or upward offset to the channel section unit and/or process air heat exchanger, preferably a cooling air guiding element or means is provided that guides the cooling air pushed or sucked by the blower towards or from the process air heat exchanger. The cooling air guiding element is for example one or more of: a channel, a deflector, a fin, a nozzle, a baffle or a combination thereof. By the air guiding means (element) the efficiency of heat exchange of the blown cooling air is increased. The air guiding means preferably is adapted to concentrate the air flow to the surface of the process air heat exchanger and/or to evenly distribute it over the surface of the process air heat exchanger. Preferably the air guiding means is portion of a cover or panel of the apparatus cabinet or of a fluff filter unit or service access unit. Thus a double function is provided by the air guiding means.

[0028] In one embodiment at least the element of the process air heat exchanger which is active in heat exchanging is a portion of the process air channel (which in turn forms part of the process air loop). In this way the length of the process air loop can be kept short and the necessity of reconfiguration is kept low. Preferably at least the heat exchanging element of the process air heat exchanger is integrated in, forms part of or is a door, a compartment cover or a drawer of the channel section unit. Then the process air heat exchanger or portion thereof is removable from the process air channel and can be serviced, e.g. can be cleaned at a section that is inside the process air loop during operation of the apparatus.

[0029] Alternatively or additionally the process air heat exchanger comprises at least one cooling air channel that is arranged partially or completely within the process air loop to be in heat contact with the process air flowing in the process air channel. With the at least one cooling air channel being within or crossing or passing through the process air loop the contact surface and the cross section of the process air channel where the process air exchanges with the process air heat exchanger are increased.

[0030] Preferably the heat exchanging surface of the process air heat exchanger is increased by using one or more thermally conductive elements like: a corrugated metal plate, a heat radiator element, a heat exchanger rip, a heat exchanger fin or combinations thereof. One or more of these may be provided on or at a surface being in contact with the process air (i.e. internal to the process air loop) or with the cooling air (i.e. to the outside of the process air channel

or the inside of cooling air channel).

[0031] In an embodiment the process air heat exchanger and/or the channel section unit comprises a condensate collector element and/or a condensate guiding element for collecting the condensate formed in the process air heat exchanger during cooling of the process air. Preferably the condensate is collected in the channel section unit and guided via a groove or channel to the condensate reservoir that is provided for the first heat exchanger. By the condensate groove or channel the condensate can be guided out of the process air heat exchanger to maintain its heat exchanging capacity. When using the condensate reservoir of the process air heat exchanger no additional condensate vessel is required and other components, like condensate pump or condensate level detector, can be used in common.

[0032] Preferably the condensate collector element has a groove or channel to guide the condensate to the condensate reservoir assigned to the first heat exchanger or to a collector through the first heat exchanger.

[0033] When at least a portion of the process air heat exchanger, preferably at least the element active in heat exchanging, is removably arranged at or in the process air channel, service can be provided for the process air heat exchanger outside the apparatus or process air loop in a user convenient way. Also by removing at least a portion of the process air heat exchanger, access to another part for servicing is improved or enabled, for example access to a fluff filter or to the first heat exchanger for cleaning or exchange. Preferably the process air heat exchanger or portion thereof is formed as a drawer that can be taken out of the process air channel, preferably together with a fluff filter, to enhance user convenience for repeated standard service like fluff removal. Preferably the fluff filter mentioned above is a second fluff filter that is arranged upstream the first heat exchanger and downstream a first fluff filter, the latter being arranged e.g. at or in the entrance for the process air into the front section of the process air channel which receives the process air from the laundry storing compartment.

[0034] In a further modification, the second fluff filter (the fluff filter mentioned above) is not provided (and preferably only the first fluff filter is provided). In this case it is preferred to provide a flushing device with at least one or more nozzles or liquid exits to spray or supply a liquid to the surface of the first heat exchanger and/or the process air heat exchanger to remove or wash-off fluff collected at said surface. The flushing liquid may be at least partially the condensate collected from the first heat exchanger and/or the process air heat exchanger. As described above, a condensate collection and guiding structure is associated with the first heat exchanger and/or the process air heat exchanger to collect and guide the condensate formed at the first heat exchanger and/or the process air heat exchanger to a condensate collection device. Thus the condensate collection structure serves at the same time as the flushing liquid collection structure. In this further modification the (second) fluff filter is not required and in consequence it is not required that a filter compartment for the (second) fluff filter is provided. In further consequence in this modification no filter drawer and/or filter servicing lid or opening is required in the process air channel for taking the fluff filter out for cleaning. However in this modification a service and access opening and lid or door may be provided by which inspection and - if required servicing - of the flushing unit may be performed.

[0035] In an embodiment the apparatus further comprises an auxiliary heat exchanger that is connected to the refrigerant loop of the heat pump system. The auxiliary heat exchanger further serves to remove - during the steady state and/or after the warm-up phase - excess heat deposited by the compressor. Preferably a blower is provided to flow cooling air across or through the auxiliary heat exchanger and more preferably the blower for providing cooling air for the process air heat exchanger is also blowing cooling air to the auxiliary heat exchanger. The common blower may provide the cooling air in parallel to the auxiliary and process air heat exchanger or first to the process air heat exchanger and then to the auxiliary heat exchanger or vice versa. The blower may be arranged between the auxiliary and process air heat exchanger or downstream (sucking cooling air) or upstream (blowing cooling air) to them. Preferably the auxiliary heat exchanger is arranged at a bottom wall or side wall of the apparatus cabinet.

[0036] Reference is made in detail to preferred embodiments of the invention, examples of which are illustrated in the accompanying figures, which show:

- Fig. 1 a schematic view of a dryer with a heat pump system,
- Fig. 2 a perspective view to a base unit housing the heat pump system,
- Fig. 3 a perspective view to a base unit with an integrated air/air heat exchanger,
- Fig. 4 the base section of Fig. 3 with opened filter door,
- Fig. 5a and 5b the lower section of the dryer in outer appearance with the air/air heat exchanger according to Fig. 3 with opened and closed filter door,
- Fig. 6 a perspective cross-section view of the heat pump dryer base section of Fig. 3 with process air flow and cooling air flow indicated,

Fig. 7a	a cross section of the base unit of Fig. 3 with the air/air heat exchanger under operation and an additional downstream auxiliary condenser as compared to Fig. 6, representing a second embodiment,
Fig. 7b	a bottom perspective view to the base section of Fig. 7a,
Fig. 8	another perspective view corresponding to the flow operation of Fig. 7a, however with reverse ambient air flow,
Fig. 9	another simplified, third embodiment of a convection-driven air/air heat exchanger,
Fig. 10a	another simplified, fourth embodiment of a blower-driven air/air heat exchanger,
Fig. 10b	another simplified, fifth embodiment of a blower-driven air/air heat exchanger having a condensate flushing device instead of a second fluff filter,
Fig. 11	a perspective view of the dryer base with removed front bottom panel and showing an air/air heat exchanger according to a sixth embodiment with a front exhaust,
Fig. 12	a partial cross-section view of Fig. 11 with the filter drawer extracted,
Fig. 13	the base unit of Fig. 11 with the air/air heat exchanger in partial cross-section indicating the process air flow and the cooling air flow,
Fig. 14	the base unit of Fig. 11 with the air/air heat exchanger in partial cross-section,
Fig. 15	the base unit of Fig. 11 with the air/air heat exchanger in cross-section from the dryer front to rear side indicating the process air flow and the cooling air flow in further detail,
Fig. 16	a perspective view from below to a lower section of a dryer with an air/air heat exchanger and an auxiliary condenser according to a seventh embodiment,
Fig. 17	the bottom section of Fig. 16 with process air flow and cooling air flow indicated,
Fig. 18	a perspective view to components for the air/air heat exchanger and the auxiliary condenser in the bottom section of the dryer of Fig. 16,
Fig. 19	another perspective partial cross-section view of the arrangement of Fig. 16 with the process air flow and the cooling air flow in further detail,
Fig. 20	a partially opened perspective view to the inner side of the bottom shell with condensate siphons,
Fig. 21	another simplified eight embodiment of a channel-like air/air heat exchanger, and
Fig. 22	a top view to a simplified arrangement with a blower mounted in a filter door according to a ninth embodiment.

[0037] Fig. 1 depicts in a schematic representation a home appliance 2 which in this embodiment is a heat pump tumble dryer. The tumble dryer comprises a heat pump system 4, including in a closed refrigerant loop in this order of refrigerant flow B: a first heat exchanger 10 acting as evaporator for evaporating the refrigerant and cooling process air, a compressor 14, a second heat exchanger 12 acting as condenser for cooling the refrigerant and heating the process air, and an expansion device 16 from where the refrigerant is returned to the first heat exchanger 10. Together with the refrigerant pipes connecting the components of the heat pump system 4 in series, the heat pump system forms a refrigerant loop 6 through which the refrigerant is circulated by the compressor 14 as indicated by arrow B. If the refrigerant in the heat pump system is operated in the transcritical or totally supercritical state, the first and second heat exchanger 10, 12 can act as gas heater and gas cooler, respectively.

[0038] The expansion device 16 is a controllable valve that operates under the control of a control unit to adapt the flow resistance for the refrigerant in dependency of operating states of the heat pump system 4. In alternative embodiments the expansion device 16 can be a capillary tube, a valve with fixed expansion cross-section, a throttle valve with variable

cross section that automatically adapts the expansion cross-section in dependency of the refrigerant pressure (e.g. by elastic or spring biasing), a semi-automatic throttle valve in which the expansion cross-section is adapted in dependency of the temperature of the refrigerant (e.g. by actuation of a thermostat and/or where the temperature of the refrigerant is taken at any of the components in thermal contact with the refrigerant.

[0039] The process air flow within the home appliance 2 is guided through a compartment 18 of the home appliance 2, i.e. through a compartment 18 for receiving articles to be treated, e.g. a drum 18. The articles to be treated are textiles, laundry 19, clothes, shoes or the like. In the embodiments here these are preferably textiles, laundry or clothes. The process air flow is indicated by arrows A in Fig. 1 and is driven by a process air blower 8. The process air channel 20 guides the process air flow A outside the drum 18 and includes different sections, including the section forming the battery channel 20a in which the first and second heat exchangers 10, 12 are arranged. The process air exiting the second heat exchanger 12 flows into a rear channel 20b in which the process air blower 8 is arranged. The air conveyed by blower 8 is guided upward in a rising channel 20c to the backside of the drum 18. The air exiting the drum 18 through the drum outlet (which is the loading opening of the drum) is filtered by a first fluff filter 22 arranged close to the drum outlet in or at the channel 20. Then the air flows through a second fluff filter 24 arranged close to the first heat exchanger 10. The first and second fluff filters 22, 24 are arranged in a front channel 20d forming another section of channel 20 which is arranged behind and adjacent the front cover of the dryer 2.

[0040] The front channel 20d further houses and/or is partially formed by an air/air heat exchanger 26. In the following embodiments the function of the air/air heat exchanger 26 is also indicated by reference numerals 26a, 26b, 26c, 26d or 60. During operation of the dryer 2, the air/air heat exchanger 26 transfers heat from the process air to ambient air, which is also denoted cooling air in the following. By transferring heat to the cooling air, during a steady state of operation of the heat pump system 4, thermodynamic balance is achieved between the closed loops of the process air loop and refrigerant loop 6. Thereby the electrical power consumed by the compressor 14 and which is not transformed to work power by compressing the refrigerant, i.e. heat power of the compressor is balanced in the - under ideal consideration - closed loops of refrigerant and process air. This means, in the steady state of the heat pump system 4 in which maximum or nearly maximum operation condition or efficiency is achieved after the warm-up period, the heat deposited by the compressor in the refrigerant loop 6 has to be balanced via air/air heat exchanger 26 to prevent overheating.

[0041] According to the invention, the excess heat can be removed solely or exclusively using the air/air heat exchanger as heat sink for the excessive heat (not considering the non-ideal heat loss like heat transfer from the drum or heat radiation at the refrigerant conducting components). However additionally heat can be removed by cooling air provided actively (blower) or passively (convection) to the compressor outer casing and/or to an auxiliary condenser or gas cooler.

[0042] The cooling air flow C, which is an ambient air flow in the embodiments, is taking heat from the surfaces of the air/air heat exchanger 26 and may be an actively driven or a passively driven air flow. In case of passive driving, air convection due to heating of the ambient air is used. In case of active driving the air flow, a blower 28 is used which may blow the air to or suck the air from the air/air heat exchanger 26. In the following embodiments also reference numerals 28a, 28b, 28c, 28d and 28e are used for the blower conveying air flow C. The air flow C can be exclusively used to cool the air/air heat exchanger 26. However it may also be provided that downstream or upstream (with respect to the flow direction) other components of the heat pump system 4 are cooled, for example an auxiliary heat exchanger 34 (see below) and/or the compressor. The air flow with respect to the auxiliary heat exchanger may be forward or backward, i.e. sucking from or blowing to the auxiliary heat exchanger. Preferably the blower 28 is operating as soon as the steady state is achieved or is approached. Preferably the blower operates continuously when steady state once has been achieved or is approached during the running drying cycle. Or the blower is operated according to cooling needs interruptedly or with varying conveyance speed.

[0043] In the following embodiments, optionally the auxiliary heat exchanger 34 acting as additional condenser (or gas cooler in case of transcritical or totally supercritical operation of the refrigerant cycle) is provided in the refrigerant loop as indicated by the dashed arrows of refrigerant flow and piping 6a and 6b in Fig. 1. Auxiliary heat exchanger 34 can also have reference numerals 34a or 34b in the following embodiments. In addition to the air/air heat exchanger 26, the auxiliary heat exchanger 34 dissipates heat to the ambient of the dryer 2. The sequence of the components in the refrigerant loop 6 can be modified in the embodiments herein in that the auxiliary heat exchanger 34 is not placed between the compressor 14 and the second heat exchanger 12 with respect to refrigerant flow, but (not shown) between the second heat exchanger 12 and the expansion device 16. This modification is applicable to all embodiments herein.

[0044] When the heat pump system 4 is operating in the steady state (i.e. normal mode after the warm-up period i.e. after starting the heat pump system 4 from low ambient state temperature), the first heat exchanger 10 transfers heat from the process air A to the refrigerant. By cooling the process air to lower temperatures, humidity from the process air condenses at the first heat exchanger 10, is collected there and the collected condensate is drained to a condensate collector 30. The process air cooled and dehumidified when passing the first heat exchanger passes then through the second heat exchanger 12 where heat is transferred from the refrigerant to the process air. The process air is sucked from exchanger 12 by the blower 8 and is driven into the drum 18 where it heats up the laundry 19 and receives the humidity therefrom. The process air exits the drum 18 and is guided in front channel 20d to the air/air heat exchanger

26 where it is pre-cooled before reaching the first heat exchanger 10. As in the first heat exchanger 10 in or at the air/air heat exchanger 26 condensate is formed during pre-cooling at the air/air heat exchanger 26. The condensate is collected and guided via a condensate channel 32 to the condensate collector 30 which also collects the condensate formed at the first heat exchanger 10. Preferably (see the below embodiments) the condensate from the air/air heat exchanger 26 is drained to the condensate collector and/or drainage provided at and for the first heat exchanger 10.

[0045] The main components of the heat pump system 4 are arranged in a base section 5 or basement of the dryer 2, different embodiments of which are shown in the following figures.

[0046] Fig. 2 shows a perspective view of the partially opened (in cross section) and partially disassembled dryer base section 5 of the dryer 2 with the heat pump system 4. The base section is housing the heat pump system and parts of the process air channel 20 in a bottom shell 40 forming the base frame of the dryer. A cover shell 41 (partially visible in Fig. 12) is placed over the bottom shell 40, wherein portions of both shells 40, 41 form the battery channel 20a in which the first and second heat exchanger 10, 12 (which form the battery of the heat pump system) are encased. The rear channel 20b and the blower 8 are also encased by bottom and top shells 40, 41. The motor 9 for driving blower 8 and the drum 18 is also located under the cover shell 42 and is located between blower 8 and compressor 14 in this embodiment. In Fig. 2 a blower 28' is shown for cooling the compressor 14 to balance heat in a conventional manner. However in the following embodiments the balancing of heat is made via air/air heat exchanger 26 and the use of the compressor blower 28' is optional or not required at all or the blower 28' is provided to additionally blow cooling air C to the air/air heat exchanger 26 (compare Fig. 21).

[0047] The blower 8 is partially encased by the rear channel 20b formed in the bottom shell 40 and partially (fan blades) by a blower shell 38 in which the rear or rising channel 20c is formed. Blower shell 38 is mounted to the bottom shell 40 and a rear wall (not shown) of the dryer in the final assembly steps. Fig. 2 also shows a filter drawer 36 which in this case is supporting the second fluff filter 24 and is taken out from the base 5. When inserted, the filter drawer 36 is located in the front channel 20d where its rear side abuts against the front side of the first heat exchanger 10 or a partition wall in the bottom shell 40 (see 80 in Fig. 20). The second fluff filter 24 may be integral or removable part of the filter drawer or in embodiments the fluff filter 24 may be arranged independently of the drawer 36 in front of the first heat exchanger 10 where it is held by separate fixing means, like a snap-frame or the like.

[0048] Fig. 3 shows a perspective view to the base section 5 of a dryer in a first embodiment wherein the main components of the heat pump system 4 and the integrated air/air heat exchanger are arranged in the base section 5. The control unit for controlling the operation of the heat pump system and the dryer (not shown) is arranged in the upper section of the dryer where also the control panel for user input and a display are arranged. A portion of the drum 18 is shown but its rotation support and the belt for drum driving via motor 9 is not shown in the embodiments. As mentioned above compressor cooling blower 28' may be provided or omitted or arranged at another location compared to the one shown in Fig. 2. The components explained above with reference to Figs. 1 and 2 are provided with the same reference signs in Fig. 3 (and in all following figures) as they have the same function and/or arrangement in the refrigerant loop 6 and process air loop.

[0049] In the first embodiment shown in Figs. 3 to 6 (and the second embodiment in Figs. 7a to 8) the air/air heat exchanger 26a (having the function of exchanger 26 in Fig. 1) is arranged at the inner side of the access or filter cabinet door 42. Filter door 42 is pivotably supported via hinges 44 at the bottom shell 40 and in closed state closes a front opening in the lower section of the front channel 20d. The front opening provides access to the removable filter drawer 36 which supports the second fluff filter 24. Sealing between the rim of the opening in front channel 20d and door 42 is provided by a sealing frame 48 (Fig. 4). The lower section of sealing frame 48 abuts the bottom shell 40 and the upper section of frame 48 abuts the cover shell 41 (compare Fig. 14). The air/air heat exchanger 26a is mainly formed of a corrugated metal plate that is sealed to the supporting door 42 in such a manner that the cooling air can pass through a slit-shaped opening 46 facing to the front of the dryer 2 (when door 42 is closed) on the one side and the cooling air can pass through openings at the bottom of the air channels formed by the sections of the exchanger metal plate which are extending inwardly into front channel 20d. I.e. between the exchanger metal plate and the door a sealed cool air channel is provided that is completely separated from the process air flow A. The bottom openings of the metal plate extensions correspond to openings in the bottom shell 40 which enable cooling air flow between the bottom shell 40 lower side and cool air channel between exchanger metal plate and inner side of door 42.

[0050] The exchanger metal plate may have a corrugated shape like a meander, a zigzag, inside and/or outside cooling ribs or any other form providing a high ratio of surface area/base area. The base area is the area seen from front side when door 42 is closed and the meander or zigzag refer to a cross-section when cut horizontally when door 42 is closed. The meander-form can best be seen in Fig. 4 where the filter door 42 is partially opened.

[0051] Fig. 5a depicts the lower section of the dryer 2 in assembled state and filter door 42 opened. The sides of the dryer are covered by covers forming part of the dryer case, wherein a lateral or side cover 54, a front cover 52 and at the bottom a base panel 50 are shown. When filter door 42 is closed, slit opening 46 connects the cooling air passage within air/air heat exchanger 26a directly with the ambient air. Fig. 5b shows the corresponding outer appearance of lower section of the dryer 2 with the filter door 42 closed.

[0052] Fig. 6 is a cross section view of the base section 5 of Fig. 3 with the filter door 42 closed. In the cross-section the flow paths of the process air flow A and the cooling air flow C are indicated by the arrows. The process air flow A flows in the front channel 20d which comes out from the drawing plane at the upper part and is deflected downward towards the filter 24 and the air/air heat exchanger 26a. The first fluff filter 22 is arranged at the loading door opening frame more at the right side relative to the loading door. When the process air has passed the first filter 22 in the channel 20d it is first deflected in left downward direction to the left bottom side in the section of channel 20d where the second filter 24 and the air/air heat exchanger 26a are arranged (i.e. the filter compartment). In the continuation of channel 20d the process air is further deflected to the horizontal for passing the air horizontally through the heat exchanger 10. When the process air flow A has passed the air/air heat exchanger 26a and the second filter 24, it passes the first heat exchanger 10 and the second heat exchanger 12. So the overall deflection of the front channel 20d is from the downward coming from the drum 18 and the first filter 22 to the horizontal into the battery channel 20a.

[0053] Fig. 6 further depicts the cooling air flow or path C for the first embodiment of dryer 2. The blower 28a is a tangential blower and sucks in the ambient air from below the bottom of the bottom shell 40 and directs it upwards between the U-shaped recesses of the corrugated metal plate of the air/air heat exchanger 26a towards the slit-shaped door opening 46 where the cooling air exits to the front side of the dryer. In the air/air heat exchanger 26a of the first embodiment (and the second described below) the corrugated metal plate is a portion of the outer wall of the front channel section 20d and at the same time a separation wall between the process air channel 20 and the cooling air flow path C. Even if the corrugated plate (preferably a metal plate) has recesses which mutually extend into the other channel, neither the process air channel 20 nor the cooling air channel 20, which is surrounding the cooling air path C, encloses the respectively other channel.

[0054] In the embodiment shown in Fig. 6 the cooling and process air flows are basically antiparallel. In an alternative configuration, the flow direction can be reverted so that along the corrugated metal plate of exchanger 26a the cooling and process air flows are parallel to each other (compare Fig. 7a). In further configuration the air inlet or outlet at the bottom side (depending on flow direction) is not from the backside (as shown in Fig. 6) or to the backside but to or from the front side of the dryer.

[0055] Fig. 7a shows a partial cross-section of the dryer 2 in a second embodiment. The second embodiment is based on the first embodiment with the difference that in addition to the air/air heat exchanger 26a an auxiliary condenser 34a is provided. Regarding the refrigerant flow, the aux condenser 34a is integrated in the refrigerant loop 6 as mentioned above in the context of Fig. 1. In this combination pre-cooling by air/air heat exchanger 26a upstream to the heat exchanger 10 and removal of excessive heat from the refrigerant is provided thereby. Mechanically the auxiliary condenser 34a is arranged in a respective recess at the exterior side of the bottom shell 40 at the bottom side thereof. The process air flow A is as before in the embodiment of Figs. 3 to 6.

[0056] Further from Fig. 7a the cooling air flow C can be seen entering the air/air heat exchanger 26a through slit opening 46, flowing across the outer surface of the exchanger metal plate, passing through the bottom openings in the exchanger metal plate and the bottom shell 40, passing through a blower 28a which exhausts the flow into and through the auxiliary heat exchanger 34a and from there to the outside of the dryer body at the bottom of the dryer. The blower 28a has the function of blower 28 in Fig. 1 or 6 and additionally cools the auxiliary heat exchanger 34a (which has the function of auxiliary heat exchanger 34 in Fig. 1). The blower 28a is a tangential blower that sucks in cooling air through the air/air heat exchanger 26a and exhausts it through auxiliary heat exchanger 34a. In an embodiment the air flow direction can be reverted as shown in Fig. 6, i.e. the blower can suck in cooling air through the auxiliary heat exchanger 34a and exhaust it through air/air heat exchanger 26a.

[0057] Fig. 7b provides a bottom perspective view to the base section 5 of Fig. 7a, where the arrangement consisting of air/air heat exchanger 26a, blower 28a and auxiliary heat exchanger 34a is apparent. A compact arrangement is provided, the requirement of modification of existing laundry apparatus is low and a high efficient, low-cost solution is implemented. Condensate forming at the air/air heat exchanger 26a is drained to the condensate channel and sump provided for the first heat exchanger 10 and from there it is guided to condensate collector 30 (compare also Fig. 20).

[0058] Fig. 8 shows a modification of the dryer 2 of the second embodiment shown in Figs. 7a and 7b where the cooling air flow C direction through the air/air heat exchanger 26a, the blower 28a and the auxiliary condenser 34a is reverted as compared to Fig. 7a

[0059] Fig. 9 illustrates a simplified third embodiment of the dryer base section 5 at the air/air heat exchanger. Here a simply flat heat conducting metal plate 60 is used as the air/air heat exchanger. However a corrugated metal plate as in the first embodiment can also be used instead. The process air flow A is guided by the metal plate 60 from above or laterally inclined above through the second fluff filter 24 towards the first heat exchanger 10. In this embodiment the cooling air flow C is driven by convection and enters through bottom openings 46a in the bottom shell 40, passes between the inner side of the front wall of the filter drawer 36 and the outer surface of metal plate 60, and exits through slit opening 46. The outer front wall forms here the filter door 42 formed integrally with the drawer and which can be extracted with the drawer 36 when pulling at the handle 37. The condensate formed on the inner surface of metal plate 60 is guided to the condensate sump 31 of the first heat exchanger 10 via a drainage 62 formed by metal plate 60 from where it is

drained to condensate collector 30. Thus drainage 62 is acting as the condensate channel 32 shown in Fig. 1. No additional blower is required in this case for the air/air heat exchanger.

[0060] In the fourth embodiment shown in Fig. 10a a blower 28b is used to drive the cooling air A over the air/air heat exchanger, which is formed by metal plate 60 as in the third embodiment of Fig. 9. The blower is supported in the structure of the bottom shell 40. The second fluff filter 24 is arranged horizontally in the drawer 36 and prevents collection of fluff in the air/air heat exchanger. By pulling out drawer 36 at handle 37 the second fluff filter 24 can be taken out of the front channel 20d (filter compartment) and fluff can be removed from the filter and air/air heat exchanger at a convenient location by the user. Again the drawer front wall forms the filter door 42. A plurality of openings 46 is provided for sucking in the cooling air which is exhausted by the blower 28b at bottom openings in bottom shell 40. Providing the cooling air inlet at the front side of the dryer 2 has the advantage that flow resistance is lower and dust collected at the cooling air inlet or opening can be more easily removed by the user from time to time. In this specific embodiment the dust can be removed together with cleaning filter 24. However as a modification the cooling air flow direction may be reverted such that normally colder air from the bottom is sucked in and exhausted through openings 46 (assisted by gravity convection).

[0061] The fifth embodiment shown in Fig. 10b is similar to the fourth embodiment shown in Fig. 10a and reference is made thereto relating to the elements shown and function thereof. The difference is that the second fluff filter 24 is omitted and only the first fluff filter 22 at the outlet side of the drum 18 is used. Fluff that escapes or unintentionally bypasses the first fluff filter 22 deposits on the inner wall of the metal plate 60 of the air/air heat exchanger and on the entrance region of the first heat exchanger 10. Deposition of fluff at the air/air heat exchanger is enhanced due to the condensation that takes place due to the pre-cooling of the process air A at the metal plate 60. From time to time the fluff deposited at the air/air heat exchanger and the first heat exchanger 10 is flushed away by sprays 104 ejected from spray nozzles arranged at a spray device 100. As shown, one spray nozzle is directed to metal plate 60 (i.e. the heat transfer surface of the air/air heat exchanger) and one to exchanger 10. However a single nozzle for spraying to both or a plurality of spray nozzles for each exchanger can be used. The liquid sprayed is preferably condensate previously collected in condensate collector 30 and sucked from there or an intermediate condensate tank by a pump 102 to the spray device 100. Alternatively instead of pump 102 a valve is opened for flushing and the condensate is provided from the condensate tank that is arranged at an upper region of the dryer 2.

[0062] As shown, filter drawer 36 is no longer required and instead a service drawer 106 is provided by which the service cover 106 can be removed for servicing access to the first heat exchanger 10 and/or the channel section 20d. When the service drawer 106 is taken out by pulling handle 37, the air/air heat exchanger 60 is extracted from the front channel 20d and can be externally cleaned from fluff, while fluff or other deposits can be taken from the front side of exchanger 10. In an alternative arrangement of the fifth embodiment no service access is provided and metal plate 60 is fixedly mounted to the front channel 20d to provide an integral or non-removable part of the channel outer wall.

[0063] Fig. 11 shows a perspective view of the dryer base section 5 with mounted side cover 54 and front cover 52, while a front bottom panel (50 in Fig. 5a) is removed. Figs. 11 to 14 relate to the sixth embodiment of integrating an air/air heat exchanger 26b in the front section channel 20d of the process air channel 20, in particular in the fluff filter section or compartment of the front channel 20d. The closed filter door 42 in Fig. 11 hides the air/air heat exchanger 26b which is shown in Fig. 12 where the filter drawer 36 is extracted from its front channel compartment. The cooling air is sucked in from the bottom front side of the dryer 2 via a radial blower 28c which is arranged at a left front section of bottom shell 40. The blower 28c blows the cooling air through a pipe which penetrates the front channel 20d and terminates in a blower outlet 66 which at the same time provides a flange to inlet 68 of the air/air heat exchanger 26b. The cooling air passes through the exchanger 26b horizontally and is deflected at the end of the exchanger downward where it exits at a heat exchanger outlet 70. When drawer 36 and exchanger 26b are inserted in the front channel 20d (Fig. 14), the outlet 70 is positioned mating to an exhaust outlet channel 72 which provides the flange to the exchanger outlet 70.

[0064] As can be seen in Fig. 12, the air/air heat exchanger 26b is integrated in drawer 36 which can be inserted and extracted from the filter compartment in channel 20d using the handle recesses 37 when the filter door 42a is opened. As compared to the first embodiment in Fig. 3, filter door 42a has no slit opening 46 as the cooling air passes through the interface openings 68/70 to and from exchanger 26b. Fluff filter 24 is shown positioned in front of the first heat exchanger 10, however in normal operation the frame for holding the second fluff filter 24 is snap-fitted to the inner frame of the drawer 36 such that it is inserted and removed by the user together with the drawer 36.

[0065] Figs. 13 and 14 show the base section 5 of Fig. 11 with the air/air heat exchanger 26b in partial cross-section. The cooling air flow C enters and exits at the front panel of the dryer, wherein respective openings are provided in the front bottom panel (not shown) to enable the cooling air to enter into the opening of blower 28c. As can be seen by the cross-section (Fig. 13) or partial cross-section (Fig. 14) of exchanger 26b, horizontal and vertical ribs or fins 76 extend in the interior of exchanger 26b in the flow direction to increase the effective heat exchanger surface in contact with the cooling air.

[0066] As shown in more detail in Fig. 15, the process air flow A is divided in the front channel 20d such that it completely

flows around the outer wall that is forming the cooling air channel of the air/air heat exchanger 26b passing through the interior of the front channel 20d. As compared to the first to sixth embodiment, the section or interface surface of the heat exchanger 26b that is in contact with the process air A is not an outer wall of the front channel 20d, but an internal wall thereof. In this way the outer surface area of the heat exchanger 26b being in heat exchanging contact with the process air A is maximized. In the embodiment shown, the outer surface of the exchanger 26b is essentially flat as the passing process air has a high temperature before entering the first heat exchanger 10. In addition by the essentially smooth outer surface, fluff capture is reduced and fluff removal by the user is simplified. In an embodiment of the exchanger 26b additional ribs or other surface-extending elements can be provided to increase the surface for heat exchanging with the process air. Process air flow and cooling air flow is as shown in Fig. 17 with the difference, that in the sixth embodiment the cooling air is exhausted from the exhaust channel 72 to the outside and front of the dryer (C in Fig. 11).

[0067] Figs. 16 and 17 represent a seventh embodiment of integrating an air/air heat exchanger, wherein the arrangement of the air/air heat exchanger 26b and blower 28b are identical to the one shown in the embodiment of Figs. 11 to 15. The difference is that the cooling air exiting the exchanger 26b is guided by a transfer channel 74 from the exchanger 26b into an auxiliary heat exchanger 34b. Arrangement and function of the auxiliary heat exchanger 34b is identical to the one of auxiliary heat exchanger 34a described in connection with the embodiment of Figs. 7a to 8 and reference is made thereto. The transfer channel 74 provides the interface for the heat exchanger outlet 70 as channel 72.

[0068] While Fig. 16 shows a perspective view from below to the lower section of the dryer with the air/air heat exchanger 26b extracted with the drawer 26 and the position of the auxiliary condenser 34b, Fig. 17 is the side section view to the bottom of this embodiment with the process air flow A and the cooling air flow C indicated. As in the embodiment shown in Fig. 7a the process air A comes from the first fluff filter 22 in the front channel 20d sloping from laterally above into the section of the filter compartment where it is passed over the air/air heat exchanger and deflected horizontally and rearward through the second fluff filter 24 and the first heat exchanger 10. The cooling air flow C enters horizontally the air/air heat exchanger 26b (perpendicular from behind the drawing plane) passed through the ribs in the inside of the exchanger (which looks like a grid in the cross section across the flow direction), is deflected downward in the exchanger exit end into the transfer channel 74 which guides the flow into the auxiliary heat exchanger 34b from where it is exhausted to the space below the dryer body.

[0069] Fig. 18 shows for the seventh embodiment the outer appearance and the course of the cooling air channel path. Fig. 19 provides a cross section through the cooling air channel path up to the transfer channel and in particular an axial cross section through the air/air heat exchanger 26b with the fins 76 as described above in connection with Fig. 13.

[0070] As in the embodiments above, the cooling air flow direction may be reverted such that in the seventh embodiment the cooling air enters at the auxiliary heat exchanger 34b and exits at the blower and in the sixth embodiment the cooling air enters the exhaust channel 72 (which is then the inlet channel) and exits at the blower 28c. In reverted flow the blower 28c is an axial or a tangential blower or a radial blower where the sucking opening of the blower is connected to the air/air heat exchanger 26b.

[0071] Fig. 20 shows a partially opened perspective view to the inner side of the bottom shell 40 applicable in the embodiments described herein. The figure depicts a view to the inner side of the left side outer wall of the bottom shell 40. The 10 and 20 in brackets indicate the positions of the first and second heat exchanger 10, 20 which are positioned between the vertical ribs and spacers provided at the inner side. The inner side of the bottom shell side wall forms part of the battery channel 20a. A portion of the rear channel 20b is shown on the right side and a portion of the front channel 20d is shown on the left side. The portion of the front channel 20d forms a portion of the filter compartment for receiving filter drawer 36 and the second fluff filter 24. When inserted, the second fluff filter 24 abuts against a filter stop 80 that is arranged between the first heat exchanger 10 and the filter and provides an air flow seal to the fluff filters back side to prevent process air and fluff bypassing the filter. The condensate water that is formed in the drying process at the auxiliary heat exchanger (applicable for all embodiments) is temporally collected in a filter siphon 82. The siphon 82 is filled with condensate (at least during drying operation) and prevents a bypass of process air and fluff along the condensate drainage path.

[0072] The air/air heat exchanger condensate water together with the condensate formed at the first heat exchanger 10 is guided to a battery siphon 84. The battery siphon prevents escape of the process air out of the process air loop (from the channel 20). From the battery siphon the condensate is drained to the condensate collector 30. The bottom of the bottom shell 40 in the region from the lower wall of the front channel 20d (filter compartment) along the battery channel 20a to the lower wall of the rear channel 20b is inclined to effectively drain the condensate towards the condensate collector 30, interrupted by the siphons 82, 84 in the interface between channel sections 20d/20a and 20a/20b, respectively.

[0073] Fig. 21 shows another simplified eighth embodiment of a channel-like air/air heat exchanger 26c which is arranged as a separate cooling air channel crossing or passing through the process air channel in the section of the front channel 20d, in particular passing the filter compartment thereof. As in the embodiments of Figs. 12 and 16, the air/air heat exchanger 26c is arranged in the extractable filter drawer 36 and has inlet and outlet interfaces 90, 92 or flanges. When

the drawer is fully inserted in its compartment, a sealed cooling air flow passage through the air/air heat exchanger is provided by the flanges such that there is no escape or mixture between the process air and the cooling air (the same interfacing function is provided for the embodiments of Figs. 12 and 16). The cooling air is exhausted at the side of the dryer through a side outlet 94. Instead of side outlet 94, the cooling air can be exhausted at the bottom or the front of the dryer. Instead of separate blower 28c, a blower 28d is used which is provided for cooling the compressor 14 (compare also blower 28' in Fig. 2). The air sucked in by blower 28d is guided in a compressor cooling channel 96 and at least partially exhausted towards the air/air heat exchanger 26c. The blower and/or the cooling air inlet may be provided at a front wall of the dryer instead of the side wall as shown. In an embodiment the air flow may be reverted.

[0074] Fig. 22 shows a top view to a region of the base section 5 where an air/air heat exchanger 26d according to a ninth embodiment is arranged in the filter drawer 36. In this embodiment a cooling air blower 28e is arranged in a laterally pivotable filter door 42b. The filter door 42b has vent openings 46b in the front and rear side and blows the cooling air C towards the outer surface of air/air heat exchanger 26d in the closed position of the door. The dashed rectangle indicates the opened position of door 42b. The exchanger 26d is formed of a corrugated metal sheet as can be seen from the cross section in the horizontal plane, similar to the corrugation described in connection with the embodiment of Fig. 4. From top to bottom the metal sheet additionally is bent towards the first heat exchanger 10, similar to the slope of metal plate 60 in Fig. 17. This top down slope provides condensate drainage towards the condensate sump of exchanger 10 (compare Fig. 20), increases the heat exchanging surface and improves the flow characteristics of the process air flow A and the cooling air flow C. Air flow C is directed from the front coming from the openings 46b across the air/air heat exchanger 26d downward to the bottom of the bottom shell 40 where it is exhausted through openings in bottom shell 40 (compare e.g. 46a in Fig. 9).

[0075] Individual components or group of components shown and described for the above embodiments can be combined among each other in any convenient way.

Reference Numeral List:

25	2	tumble dryer	40	bottom shell
	4	heat pump system	41	cover shell
	5	base section	42, 42a, 42b	filter door
	6, 6a, 6b	refrigerant loop	44	hinge
30	8	blower	46, 46b	door opening
	9	motor		
	10	first heat exchanger (evaporator)	46a	bottom opening
			48	sealing frame
	12	second heat exchanger (condenser)	50	base panel
35			52	front cover
	14	compressor	54	side cover
	16	expansion device	60	metal plate
	18	drum (laundry compartment)	62	drainage
	19	laundry	66	blower outlet
40	20	process air channel	68	heat exchanger inlet
	20a	battery channel	70	heat exchanger outlet
	20b	rear channel	72	exhaust channel
	20c	rising channel	74	transfer channel
45	20d	front channel	76	fin
	22	first fluff filter	80	filter stop
	24	second fluff filter	82	filter siphon
	26, 26a, 26b, 26c, 26d	air/air heat exchanger	84	battery siphon
			90	inlet interface
50	28, 28a, 28b, 28c, 28d, 28e	blower	92	outlet interface
			94	side outlet
	28'	compressor blower	96	compressor cooling channel
	30	condensate collector	100	spray nozzle
55	31	condensate sump	102	pump/valve
	32	condensate channel	104	flushing spray

(continued)

	34, 34a, 34b	auxiliary condenser	106	service drawer
			108	service cover
5	36	filter drawer	A	process air flow
	37	handle	B	refrigerant flow
	38	blower shell	C	cooling air flow

10 Claims

1. Laundry treatment apparatus, in particular dryer (2) or washing machine having drying function, comprising:

15 a laundry storing chamber (18) for treating laundry (19) using process air (A),
a process air loop (18, 20) for circulating the process air through the laundry storing chamber (18), and
a heat pump system (4) for dehumidifying and heating the process air, the heat pump system having a refrigerant
loop (6) comprising:

20 a first heat exchanger (10) for heating a refrigerant and cooling the process air (A),
a second heat exchanger (12) for cooling the refrigerant and heating the process air,
a refrigerant expansion device (16) arranged in the refrigerant loop between the second heat exchanger
(12) and the first heat exchanger (10),
a compressor (14) arranged in the refrigerant loop (6) between the first heat exchanger (10) and the second
heat exchanger (12), and

25 a process air heat exchanger (26, 26b-c) arranged at or in the process air loop upstream of the first heat
exchanger (10) for providing heat exchange between the process air (A) and cooling air (C), wherein the
process air heat exchanger provides a pre-cooling of the process air upstream the first heat exchanger,
wherein the process air loop (18, 20) comprises a process air channel (20), the process air channel com-
prising a channel section unit;

30 **characterized in that**

the process air heat exchanger (26, 26b-c) is at least partially integrated in or is part of said channel section
unit in which the process air (A) coming from the laundry storing chamber (18) is deflected from the downward
direction to the horizontal direction,

35 the process air heat exchanger (26b-c) comprises at least one cooling air channel (26b) arranged in and
guided through the channel section unit and wherein the at least one cooling air channel is in heat contact
with the process air (A) flowing through the channel section unit, and
said channel section unit is a fluff filter unit and/or a service access unit of the apparatus.

40 2. Apparatus according to claim 1, wherein the internal side of the cooling air channel (26b) is in contact with the cooling
air (C) and the external side of the cooling air channel (26b) is in contact with the process air (A).

45 3. Apparatus according to claim 1 or 2, wherein at least a portion of a heat exchanging interface surface of the process
air heat exchanger (26, 26a-c, 60) is forming a wall portion (60) defining an outer wall section of the process air
channel (20).

4. Laundry treatment apparatus, in particular dryer (2) or washing machine having drying function, comprising:

50 a laundry storing chamber (18) for treating laundry (19) using process air (A),
a process air loop (18, 20) for circulating the process air through the laundry storing chamber (18), and
a heat pump system (4) for dehumidifying and heating the process air, the heat pump system having a refrigerant
loop (6) comprising:

55 a first heat exchanger (10) for heating a refrigerant and cooling the process air (A),
a second heat exchanger (12) for cooling the refrigerant and heating the process air,
a refrigerant expansion device (16) arranged in the refrigerant loop between the second heat exchanger
(12) and the first heat exchanger (10),
a compressor (14) arranged in the refrigerant loop (6) between the first heat exchanger (10) and the second
heat exchanger (12), and

a process air heat exchanger (26, 26a) arranged at or in the process air loop upstream of the first heat exchanger (10) for providing heat exchange between the process air (A) and cooling air (C), wherein the process air heat exchanger provides a pre-cooling of the process air upstream the first heat exchanger, wherein the process air loop (18, 20) comprises a process air channel (20), the process air channel comprising a channel section unit,

characterized in that

the process air (A) coming from the laundry storing chamber (18) is deflected from the downward direction to the horizontal direction in said channel section unit,

said channel section unit is a fluff filter unit and/or a service access unit of the apparatus, and

at least a portion or a substantial portion of a heat exchanging interface surface of the process air heat exchanger (26, 26a) is forming a wall portion (60) defining an outer wall section and an outer extension of said process air channel section unit.

5. Apparatus according to claim 3 or 4, wherein the wall portion defining said outer wall section of the process air channel (20) has a process air channel interior side designed to guide the process air flow (A) external to the cooling air flow path (C) and has an exterior side designed to guide the cooling air (C) external to the process air loop (18, 20).
6. Apparatus according to any of the previous claims, comprising a base section (5, 40) structured to define the channel section unit and forming at least a portion of a battery channel (20a) of the process air loop (18, 20) for housing the first heat exchanger (10) and the second heat exchanger (12).
7. Apparatus according to claim 6, wherein the base section (5, 40) comprises a bottom shell (40) and a cover shell (41), forming the battery channel (20a) and the channel section unit.
8. Apparatus according to any of the previous claims, wherein the channel section unit comprises a condensate collector element (62, 82) adapted to collect condensate water condensed at the process air heat exchanger (26, 26a-c, 60) and adapted to guide the condensate towards a condensate reservoir (30).
9. Apparatus according to claim 8, wherein the condensate collector element (62, 82) is provided integrally with a bottom shell (40) of a base section (5) of the apparatus.
10. Apparatus according to any of the previous claims, wherein the process air heat exchanger is integrated in said channel section unit.
11. Apparatus according to any of the previous claims, wherein a liquid flushing device is arranged at or close to the process air heat exchanger (26, 26a-c, 60) adapted to flush fluff or deposits from a or the heat exchanging interface surface of the process air heat exchanger (26, 26a-c, 60) at a side thereof which is in contact with the process air (A).
12. Apparatus according to any of the previous claims, wherein said channel section unit comprises a service access opening or a service access opening is assigned to said channel section unit, wherein the service access opening provides a service access to the interior of the process air channel and is covered by a removable lid or door (42, 42a, 42b).
13. Apparatus according to any of the previous claims, comprising a blower (28, 28c-d) for blowing the cooling air (C) to the process air heat exchanger (26, 26a-c, 60), wherein in particular the blower is arranged at or in a cover or filter door (42, 42a) or cover panel (50) of the apparatus.
14. Apparatus according to any of the previous claims, wherein the channel section unit comprises a door (42), a compartment cover or a drawer (36) and wherein the process air heat exchanger (26a, 60) is integrated in or is part of the door (42), compartment cover or drawer (26).
15. Apparatus according to any of the previous claims, wherein the process air heat exchanger (26a-c, 60) has a metal plate, a corrugated metal plate, a heat radiator, heat exchanger ribs or heat exchanger fins.
16. Apparatus according to any of the previous claims, wherein at least a portion of the process air heat exchanger (26a) is movably or removably arranged or wherein at least a portion of the process air heat exchanger (26b-c, 60) is arranged in or at a removable part (36) of the channel section unit.

17. Apparatus according to claim 16, wherein the removable part (36) of the channel section unit is a drawer, a fluff filter drawer or an air guiding element.
18. Apparatus according to any of the previous claims, comprising an auxiliary heat exchanger (34, 34a-b) connected to the refrigerant loop (6) for at least temporally cooling the refrigerant.
19. Apparatus according to any of the previous claims, comprising the or a blower (28, 28a-d) for blowing cooling air (C) to the process air heat exchanger (26, 26a-c, 60), wherein the blower is further adapted to blow the cooling air or at least a portion of the cooling air to an auxiliary heat exchanger (34, 34a-b) or to the compressor (14) for removing heat therefrom.

Patentansprüche

1. Vorrichtung zur Behandlung von Wäsche, insbesondere Trockner (2) oder Waschmaschine mit Trocknerfunktion, aufweisend:

eine Wäschespeicherkammer (18) zum Behandeln von Wäsche (19) unter Verwendung von Arbeitsluft (A), einen Arbeitsluft-Kreislauf (18, 20) zum Zirkulieren der Arbeitsluft durch die Wäschespeicherkammer (18), und ein Wärmepumpensystem (4) zum Trocknen und Erwärmen der Arbeitsluft, wobei das Wärmepumpensystem einen Kältekreislauf (6) besitzt, welcher Folgendes aufweist:

einen ersten Wärmetauscher (10) zum Erwärmen eines Kältemittels und Kühlen der Arbeitsluft (A), einen zweiten Wärmetauscher (12) zum Kühlen des Kältemittels und Erwärmen der Arbeitsluft, eine Kältemittel-Ausdehnvorrichtung (16), welche in dem Kältekreislauf zwischen dem zweiten Wärmetauscher (12) und dem ersten Wärmetauscher (10) angeordnet ist, einen Kompressor (14), welcher in dem Kältekreislauf (6) zwischen dem ersten Wärmetauscher (10) und dem zweiten Wärmetauscher (12) angeordnet ist, und einen Arbeitsluft-Wärmetauscher (26, 26b-c), welcher an oder in dem Arbeitsluft-Wärmetauscher stromaufwärts des ersten Wärmetauschers (10) zum Bereitstellen von Wärmeaustausch zwischen der Arbeitsluft (A) und Kühlluft (C) angeordnet ist, wobei der Arbeitsluft-Wärmetauscher eine Vorkühlung der Arbeitsluft stromaufwärts des ersten Wärmetauschers bereitstellt, wobei der Arbeitsluft-Kreislauf (18, 20) einen Arbeitsluftkanal (20) aufweist, wobei der Arbeitsluftkanal eine Kanalabschnittseinheit aufweist;

dadurch gekennzeichnet, dass

der Arbeitsluft-Wärmetauscher (26, 26b-c) zumindest teilweise in die Kanalabschnittseinheit integriert oder Teil der Kanalabschnittseinheit ist, in welcher die von der Wäschespeicherkammer kommende Arbeitsluft (A) von der nach unten gerichteten Richtung in die horizontale Richtung abgelenkt wird, der Arbeitsluft-Wärmetauscher (26b-c) mindestens einen Kühlluftkanal (26b) aufweist, welcher in der Kanalabschnittseinheit angeordnet und durch diese hindurch geführt ist, und wobei der mindestens eine Kühlluftkanal mit der Arbeitsluft (A), welche durch die Kanalabschnittseinheit strömt, in Wärmekontakt steht, und die Kanalabschnittseinheit eine Flusenfiltereinheit und/oder Wartungszugangseinheit der Vorrichtung ist.

2. Vorrichtung nach Anspruch 1, wobei die innere Seite des Kühlluftkanals (26b) mit der Kühlluft (C) in Kontakt steht und die äußere Seite des Kühlluftkanals (26b) mit der Arbeitsluft (A) in Kontakt steht.

3. Vorrichtung nach Anspruch 1 oder 2, wobei mindestens ein Abschnitt einer wärmetauschenden Schnittstellenfläche des Arbeitsluft-Wärmetauschers (26, 26a-c, 60) einen Wandabschnitt (60) bildet, welcher einen äußeren Wandabschnitt des Arbeitsluftkanals (20) definiert.

4. Vorrichtung zur Behandlung von Wäsche, insbesondere Trockner (2) oder Waschmaschine mit Trocknerfunktion, aufweisend:

eine Wäschespeicherkammer (18) zum Behandeln von Wäsche (19) unter Verwendung von Arbeitsluft (A), einen Arbeitsluft-Kreislauf (18, 20) zum Zirkulieren der Arbeitsluft durch die Wäschespeicherkammer (18), und ein Wärmepumpensystem (4) zum Trocknen und Erwärmen der Arbeitsluft, wobei das Wärmepumpensystem einen Kältekreislauf (6) besitzt, welcher Folgendes aufweist:

einen ersten Wärmetauscher (10) zum Erwärmen eines Kältemittels und Kühlen der Arbeitsluft (A),
 einen zweiten Wärmetauscher (12) zum Kühlen des Kältemittels und Erwärmen der Arbeitsluft,
 eine Kältemittel-Ausdehnvorrichtung (16), welche in dem Kältekreislauf zwischen dem zweiten Wärmetau-
 scher (12) und dem ersten Wärmetauscher (10) angeordnet ist,
 5 einen Kompressor (14), welcher in dem Kältekreislauf (6) zwischen dem ersten Wärmetauscher (10) und
 dem zweiten Wärmetauscher (12) angeordnet ist, und
 einen Arbeitsluft-Wärmetauscher (26, 26a), welcher an oder in dem Arbeitsluft-Wärmetauscher stromauf-
 wärts des ersten Wärmetauschers (10) zum Bereitstellen von Wärmeaustausch zwischen der Arbeitsluft
 (A) und
 10 Kühlluft (C) angeordnet ist, wobei der Arbeitsluft-Wärmetauscher eine Vorkühlung der Arbeitsluft strom-
 aufwärts des ersten Wärmetauschers bereitstellt,
 wobei der Arbeitsluft-Kreislauf (18, 20) einen Arbeitsluftkanal (20) aufweist, wobei der Arbeitsluftkanal eine
 Kanalabschnittseinheit ausweist,
dadurch gekennzeichnet, dass
 15 die von der Wäschespeicherkammer (18) kommende Arbeitsluft (A) in der Kanalabschnittseinheit von der
 nach unten gerichteten Richtung in die horizontale Richtung abgelenkt wird,
 die Kanalabschnittseinheit eine Flusenfiltereinheit und/oder eine Wartungszugangseinheit der Vorrichtung
 ist, und
 mindestens ein Abschnitt oder ein wesentlicher Abschnitt einer wärmetauschenden Schnittstellenfläche
 20 des Arbeitsluft-Wärmetauschers (26, 26a) einen Wandabschnitt (60) bildet, welcher einen äußeren
 Wandabschnitt der Arbeitsluft-Kanalabschnittseinheit definiert.

5. Vorrichtung nach Anspruch 3 oder 4, wobei der Wandabschnitt, welcher den äußeren Wandabschnitt des Arbeits-
 luftkanals (20) definiert, eine Innenseite des Arbeitsluftkanals besitzt, welche dafür ausgelegt ist, den Arbeitsluftstrom
 (A) außerhalb des Kühlluftstrompfades (C) zu führen, und eine Außenseite besitzt, welche dafür ausgelegt ist, die
 25 Kühlluft (C) außerhalb des Arbeitsluft-Kreislaufs (18, 20) zu führen.
6. Vorrichtung nach einem der vorhergehenden Ansprüche, aufweisend einen Basisabschnitt (5, 40), welcher struk-
 turisiert ist, um die Kanalabschnittseinheit zu definieren, und mindestens einen Abschnitt eines Batteriekanals (20a)
 30 des Arbeitsluft-Kreislaufs (18, 20) zur Unterbringung des ersten Wärmetauschers (10) und des zweiten Wärmetau-
 schers (12) bildet.
7. Vorrichtung nach Anspruch 6, wobei der Basisabschnitt (5, 40) eine Bodenschale (40) und eine Abdeckhaube (41)
 aufweist, welche den Batteriekanal (20a) und die Kanalabschnittseinheit bildet.
 35
8. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die Kanalabschnittseinheit ein Sammelement (62,
 82) für Kondensat aufweist, welches dafür angepasst ist, Kondensatwasser zu sammeln, welches am Arbeitsluft-
 Wärmetauscher (26, 26a-c, 60) kondensiert, und dafür angepasst ist, das Kondensat in einen Kondensattank (30)
 zu leiten.
 40
9. Vorrichtung nach Anspruch 8, wobei das Sammelement (62, 82) für Kondensat integral mit einer Bodenschale
 (40) des Basisabschnitts (5) der Vorrichtung vorgesehen ist.
10. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei der Arbeitsluft-Wärmetauscher in die Kanalab-
 schnittseinheit integriert ist.
 45
11. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei eine Flüssigkeitsspülvorrichtung am oder in der
 Nähe des Arbeitsluft-Wärmetauschers (26, 26a-c, 60) angeordnet ist, welche dafür angepasst ist, Flusen oder
 Ablagerungen von einer oder der wärmetauschenden Schnittstellenfläche des Arbeitsluft-Wärmetauschers (26,
 50 26a-c, 60) an einer Seite davon abzuspülen, welche mit der Arbeitsluft (A) in Kontakt steht.
12. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die Kanalabschnittseinheit eine Wartungszugangs-
 öffnung aufweist oder eine Wartungszugangsöffnung der Kanalabschnittseinheit zugeordnet ist, wobei die War-
 tungszugangsöffnung einen Wartungszugang in das Innere des Arbeitsluftkanals bereitstellt und von einem ab-
 55 nehmbaren Deckel oder Tür (42, 42a, 42b) abgedeckt ist.
13. Vorrichtung nach einem der vorhergehenden Ansprüche, aufweisend ein Gebläse (28, 28c-d) zum Blasen der
 Kühlluft (C) zum Arbeitsluft-Wärmetauscher (26, 26a-c, 60), wobei insbesondere das Gebläse an oder in einer

Abdeckung oder Filtertür (42, 42a) oder Abdeckplatte (50) der Vorrichtung angeordnet ist.

14. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei der Kanalabschnitt eine Tür (42), eine Fachabdeckung oder eine Schublade (36) aufweist und wobei der Arbeitsluft-Wärmetauscher (26a, 60) in die Tür (42), Fachabdeckung oder Schublade (36) integriert ist oder Teil dieser ist.
15. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei der Arbeitsluft-Wärmetauscher (26a-c, 60) eine Metallplatte, eine gewellte Metallplatte, einen Wärmeradiator, Wärmetauscherrippen oder Wärmetauscherlamellen besitzt.
16. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei mindestens ein Abschnitt des Arbeitsluft-Wärmetauschers (26a) beweglich oder abnehmbar angeordnet ist, oder wobei mindestens ein Abschnitt des Arbeitsluft-Wärmetauschers (26b-c, 60) in oder an einem abnehmbaren Teil (36) der Kanalabschnittseinheit angeordnet ist.
17. Vorrichtung nach Anspruch 16, wobei das abnehmbare Teil (36) der Kanalabschnittseinheit eine Schublade, eine Flusenfilterschublade oder ein Luftleitelement ist.
18. Vorrichtung nach einem der vorhergehenden Ansprüche, aufweisend einen Hilfswärmetauscher (34, 34a-b), welcher mit dem Kühlkreislauf (6) für zumindest zeitliches Kühlen des Kühlmittels verbunden ist.
19. Vorrichtung nach einem der vorhergehenden Ansprüche, aufweisend das oder ein Gebläse (28, 28a-d) zum Blasen von Kühlluft (C) zum Arbeitsluft-Wärmetauscher (26, 26a-c, 60), wobei das Gebläse weiter dafür angepasst ist, die Kühlluft oder zumindest einen Teil der Kühlluft zu einem Hilfswärmetauscher (34, 34a-b) oder zum Kompressor (14) zu blasen, um davon Wärme abzuführen.

Revendications

1. Appareil de traitement de linge, en particulier sèche-linge (2) ou machine à laver ayant une fonction de séchage, comprenant :

un compartiment (18) de rangement du linge pour traiter le linge (19) au moyen d'air de processus (A), une boucle (18, 20) d'air de processus pour faire circuler l'air de processus à travers le compartiment (18) de rangement du linge, et un système de pompe à chaleur (4) pour déshumidifier et chauffer l'air de processus, le système de pompe à chaleur comportant une boucle (6) de fluide frigorigène comprenant :

un premier échangeur de chaleur (10) pour chauffer un fluide frigorigène et refroidir l'air de processus (A), un second échangeur de chaleur (12) pour refroidir le fluide frigorigène et chauffer l'air de processus, un détendeur (16) de fluide frigorigène disposé dans la boucle de fluide frigorigène entre le second échangeur de chaleur (12) et le premier échangeur de chaleur (10), un compresseur (14) disposé dans la boucle (6) de fluide frigorigène entre le premier échangeur de chaleur (10) et le second échangeur de chaleur (12), et un échangeur de chaleur (26, 26b-c) d'air de processus disposé au niveau de ou dans la boucle d'air de processus en amont du premier échangeur de chaleur (10) pour assurer un échange thermique entre l'air de processus (A) et l'air de refroidissement (C), l'échangeur de chaleur d'air de processus assurant un pré-refroidissement de l'air de processus en amont du premier échangeur de chaleur,

dans lequel la boucle (18, 20) d'air de processus comprend un conduit (20) d'air de processus, le conduit d'air de processus comprenant une unité de section de conduit,

caractérisé en ce que

l'échangeur de chaleur (26, 26b-c) d'air de processus est au moins partiellement intégré dans ou est la partie de ladite unité de section de conduit dans laquelle l'air de processus (A) provenant du compartiment (18) de rangement du linge est dévié de la direction vers le bas à la direction horizontale, l'échangeur de chaleur (26b-c) d'air de processus comprend au moins un conduit (26b) d'air de refroidissement disposé dans et guidé à travers l'unité de section de conduit et dans lequel ledit conduit d'air de refroidissement est en contact thermique avec l'air de processus (A) circulant dans l'unité de section de conduit, et

ladite unité de section de conduit est une unité de filtre à peluches et/ou une unité d'accès à l'entretien de l'appareil.

2. Appareil selon la revendication 1, dans lequel la face interne du conduit (26b) d'air de refroidissement est en contact avec l'air de refroidissement (C) et la face externe du conduit (26b) d'air de refroidissement est en contact avec l'air de processus (A).

3. Appareil selon la revendication 1 ou 2, dans lequel au moins une partie d'une surface d'interface d'échange de chaleur de l'échangeur de chaleur (26, 26a-c, 60) d'air de processus constitue une partie (60) de paroi définissant une section de paroi extérieure du conduit (20) d'air de processus.

4. Appareil de traitement de linge, en particulier sèche-linge (2) ou machine à laver ayant une fonction de séchage, comprenant :

un compartiment (18) de rangement du linge pour traiter le linge (19) au moyen d'air de processus (A), une boucle (18, 20) d'air de processus pour faire circuler l'air de processus à travers le compartiment (18) de rangement du linge, et un système de pompe à chaleur (4) pour déshumidifier et chauffer l'air de processus, le système de pompe à chaleur comportant une boucle (6) de fluide frigorigène comprenant :

un premier échangeur de chaleur (10) pour chauffer un fluide frigorigène et refroidir l'air de processus (A), un second échangeur de chaleur (12) pour refroidir le fluide frigorigène et chauffer l'air de processus, un détendeur (16) de fluide frigorigène disposé dans la boucle de fluide frigorigène entre le second échangeur de chaleur (12) et le premier échangeur de chaleur (10), un compresseur (14) disposé dans la boucle (6) de fluide frigorigène entre le premier échangeur de chaleur (10) et le second échangeur de chaleur (12), et un échangeur de chaleur (26, 26a) d'air de processus disposé au niveau de ou dans la boucle d'air de processus en amont du premier échangeur de chaleur (10) pour assurer un échange thermique entre l'air de processus (A) et l'air de refroidissement (C), l'échangeur de chaleur d'air de processus assurant un pré-refroidissement de l'air de processus en amont du premier échangeur de chaleur,

dans lequel la boucle (18, 20) d'air de processus comprend un conduit (20) d'air de processus, le conduit d'air de processus comprenant une unité de section de conduit,

caractérisé en ce que

l'air de processus (A) provenant du compartiment (18) de rangement du linge est dévié de la direction vers le bas à la direction horizontale dans ladite unité de section de conduit, ladite unité de section de conduit est une unité de filtre à peluches et/ou une unité d'accès à l'entretien de l'appareil, et au moins une partie ou une partie considérable d'une surface d'interface d'échange de chaleur de l'échangeur de chaleur (26, 26a) d'air de processus constitue une partie (60) de paroi définissant une section de paroi extérieure et un prolongement extérieur de ladite unité de section de conduit d'air de processus.

5. Appareil selon la revendication 3 ou 4, dans lequel la partie de paroi définissant ladite section de paroi extérieure du conduit (20) d'air de processus comporte une face intérieure de conduit d'air de processus conçue pour guider l'écoulement d'air de processus (A) à l'extérieur du trajet d'écoulement de l'air de refroidissement (C) et comporte une face extérieure conçue pour guider l'air de refroidissement (C) à l'extérieur de la boucle (18, 20) d'air de processus.

6. Appareil selon l'une quelconque des revendications précédentes, comprenant une section de base (5, 40) structurée pour délimiter l'unité de section de conduit et constituant au moins une partie d'un conduit (20a) de batterie de la boucle (18, 20) d'air de processus pour loger le premier échangeur de chaleur (10) et le second échangeur de chaleur (12).

7. Appareil selon la revendication 6, dans lequel la section de base (5, 40) comprend une coquille de fond (40) et une coquille de couverture (41) constituant le conduit (20a) de batterie et l'unité de section de conduit.

8. Appareil selon l'une quelconque des revendications précédentes, dans lequel l'unité de section de conduit comprend

un élément de collecteur (62, 82) de condensat, apte à recueillir l'eau de condensat condensée au niveau de l'échangeur de chaleur (26, 26a-c, 60) de l'air de processus et apte à guider le condensat vers un réservoir (30) de condensat.

- 5 9. Appareil selon la revendication 8, dans lequel l'élément de collecteur (62, 82) de condensat fait partie intégrante de la coquille de fond (40) de la section de base (5) de l'appareil.
- 10 10. Appareil selon l'une quelconque des revendications précédentes, dans lequel l'échangeur de chaleur de l'air de processus est intégré dans ladite unité de section de conduit.
- 15 11. Appareil selon l'une quelconque des revendications précédentes, dans lequel un dispositif de chasse par liquide est disposé au niveau ou près de l'échangeur de chaleur (26, 26a-c, 60) de l'air de processus et est apte à évacuer peluches ou dépôts d'une ou de la surface d'interface d'échange de chaleur de l'échangeur de chaleur (26, 26a-c, 60) d'air de processus sur une face de celle-ci qui est en contact avec l'air de processus (A).
- 20 12. Appareil selon l'une quelconque des revendications précédentes, dans lequel ladite unité de section de conduit comprend une ouverture d'accès pour l'entretien ou une ouverture d'accès pour l'entretien est affectée à ladite unité de section de conduit, dans lequel l'ouverture d'accès pour l'entretien fournit un accès d'entretien à l'intérieur du conduit d'air de processus et est couverte par un couvercle ou une porte (42, 42a, 42b) amovible.
- 25 13. Appareil selon l'une quelconque des revendications précédentes, comprenant un souffleur (28, 28c-d) pour souffler l'air de refroidissement (C) sur l'échangeur de chaleur (26, 26a-c, 60) d'air de processus, dans lequel le souffleur est en particulier disposé au niveau de ou dans un couvercle ou une porte filtrante (42, 42a) ou un panneau protecteur (50) de l'appareil.
- 30 14. Appareil selon l'une quelconque des revendications précédentes, dans lequel l'unité de section de conduit comprend une porte (42), un couvercle de compartiment ou un tiroir (36) et dans lequel l'échangeur de chaleur (26a, 60) d'air de processus est intégré dans ou fait partie de la porte (42), du couvercle de compartiment ou du tiroir (26).
- 35 15. Appareil selon l'une quelconque des revendications précédentes, dans lequel l'échangeur de chaleur (26a-c, 60) d'air de processus comporte une plaque de métal, une plaque de métal ondulée, un radiateur thermique, des échancrures d'échangeur de chaleur ou des ailettes d'échangeur de chaleur.
- 40 16. Appareil selon l'une quelconque des revendications précédentes, dans lequel au moins une partie de l'échangeur de chaleur (26a) d'air de processus est agencée mobile ou amovible ou dans lequel au moins une partie de l'échangeur de chaleur (26b-c, 60) d'air de processus est disposée dans ou au niveau d'une pièce amovible (36) de l'unité de section de conduit.
- 45 17. Appareil selon la revendication 16, dans lequel la pièce amovible (36) de l'unité de section de conduit est un tiroir, un tiroir de filtre à peluches ou un élément de guidage d'air.
- 50 18. Appareil selon l'une quelconque des revendications précédentes, comprenant un échangeur de chaleur auxiliaire (34, 34a-b) raccordé à la boucle (6) de fluide frigorigène pour refroidir au moins temporairement le fluide frigorigène.
- 55 19. Appareil selon l'une quelconque des revendications précédentes, comprenant le ou un souffleur (28, 28a-d) pour souffler l'air de refroidissement (C) sur l'échangeur de chaleur (26, 26a-c, 60) d'air de processus, dans lequel le souffleur est en outre apte à souffler l'air de refroidissement ou au moins une partie de l'air de refroidissement sur un échangeur de chaleur auxiliaire (34, 34a-b) ou sur le compresseur (14) pour en évacuer de la chaleur.

Fig. 1

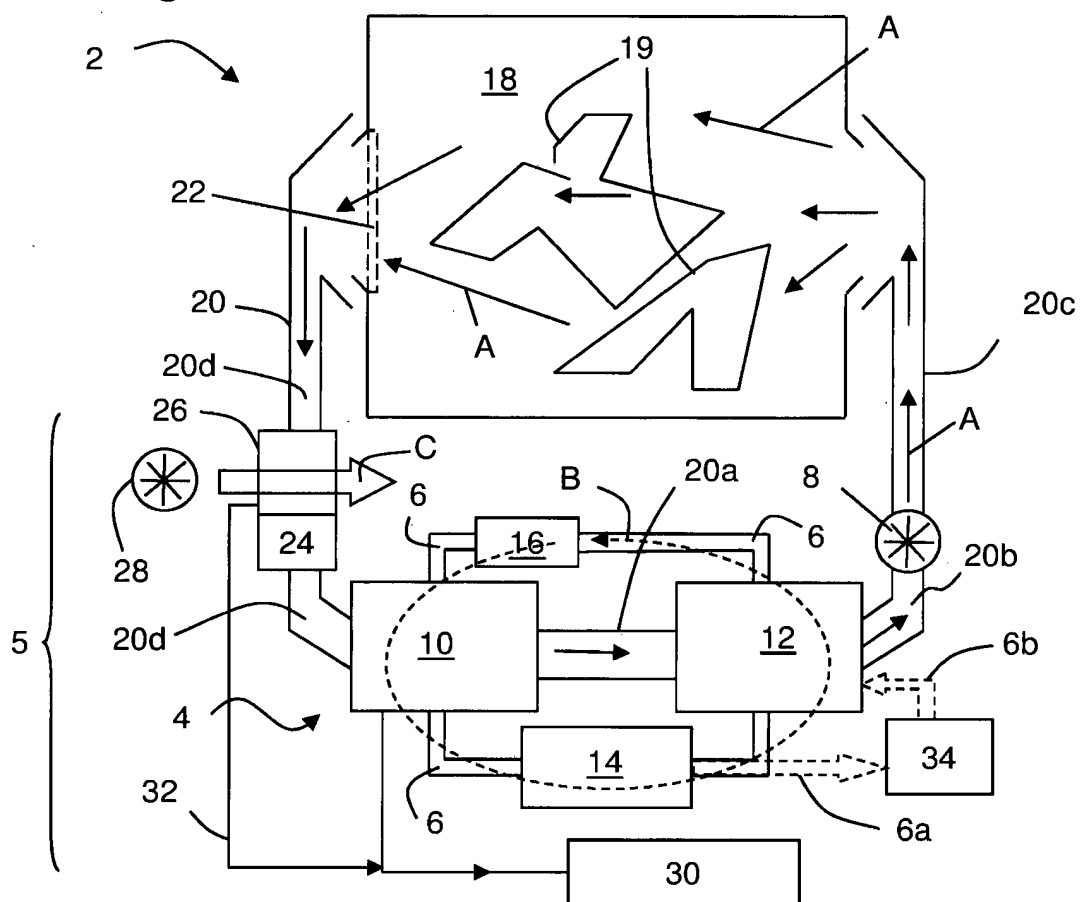
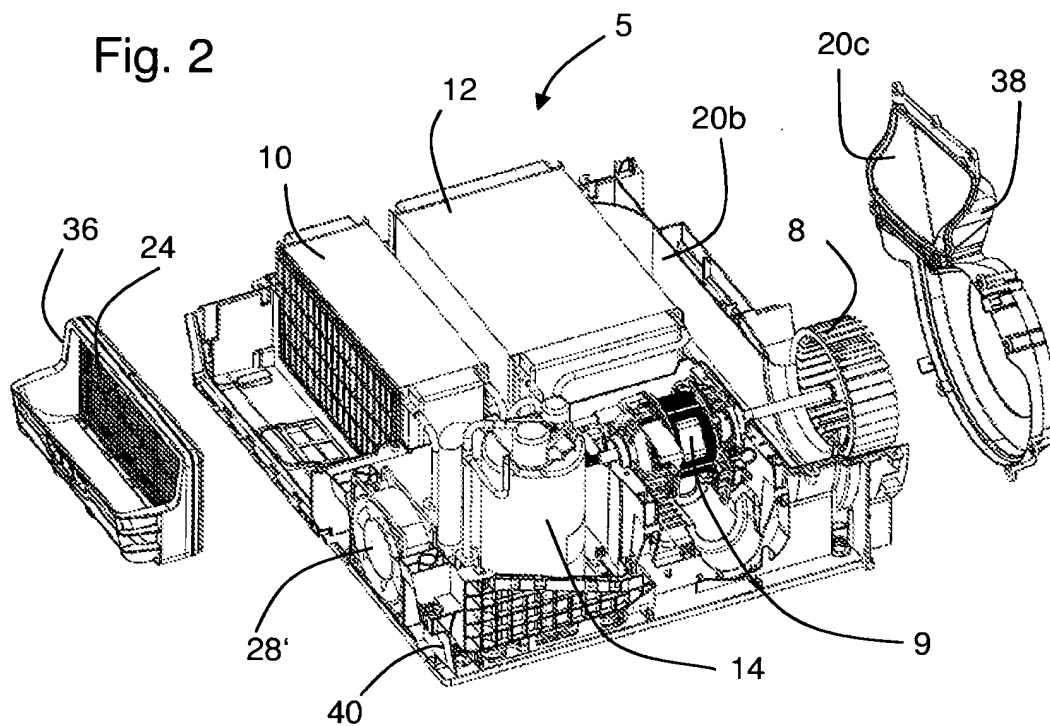
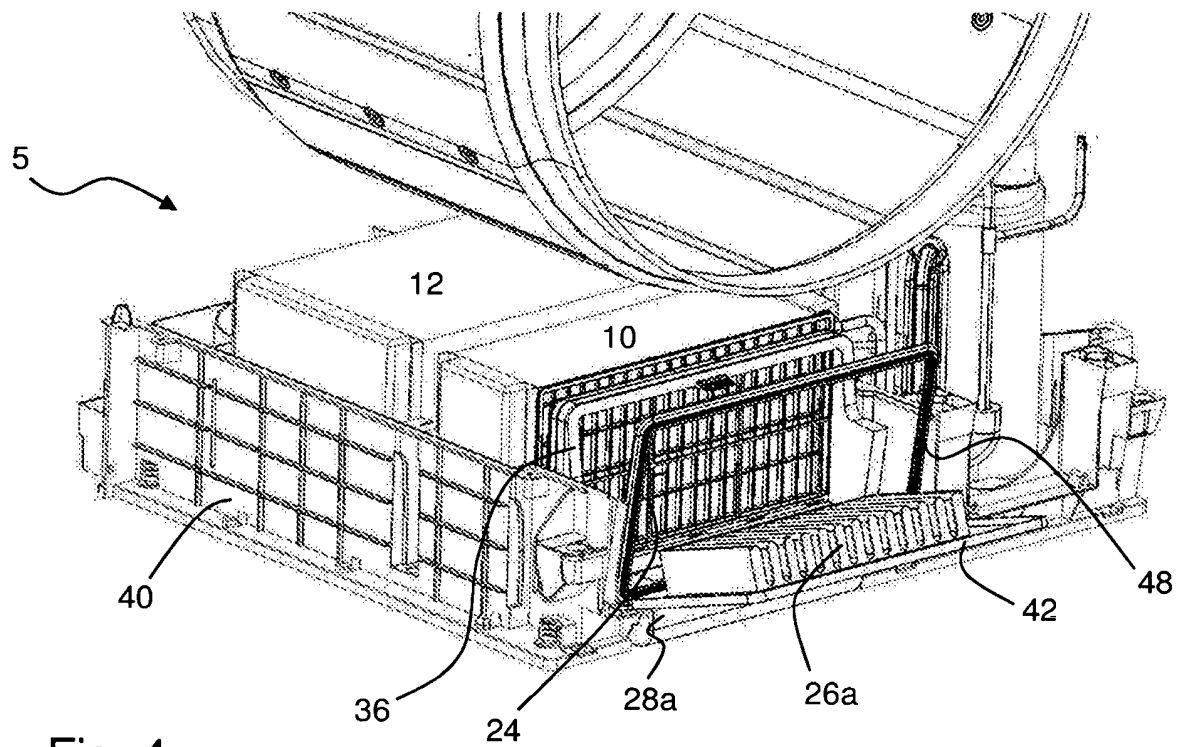
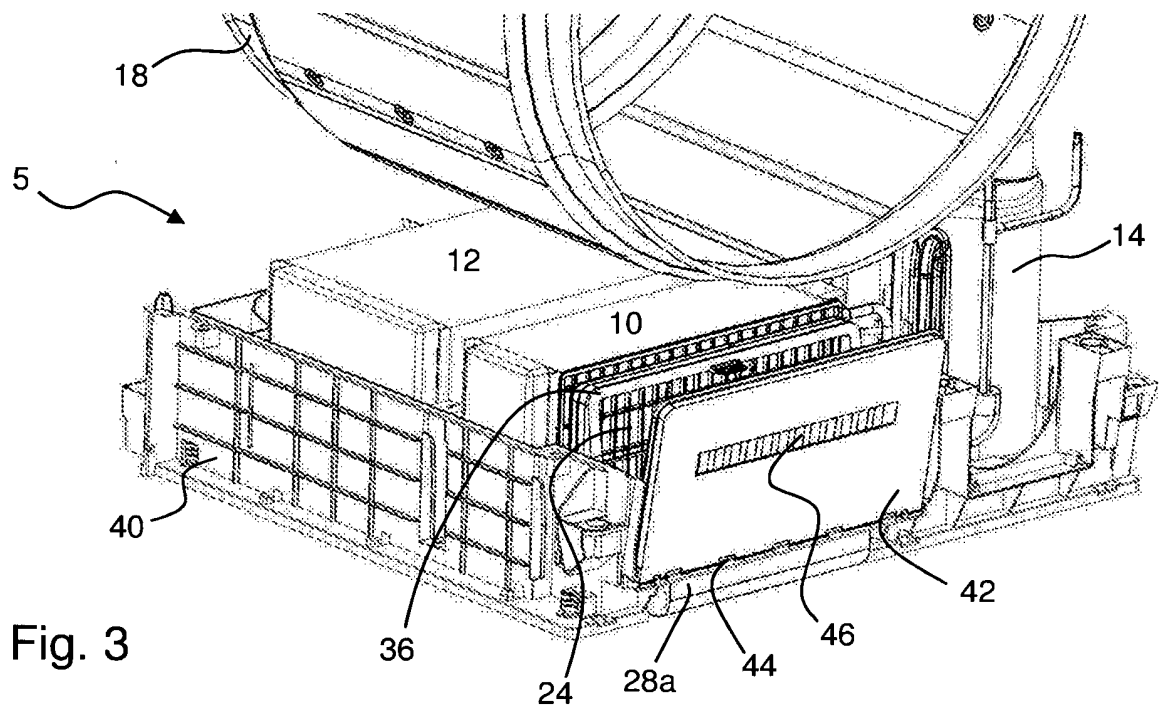
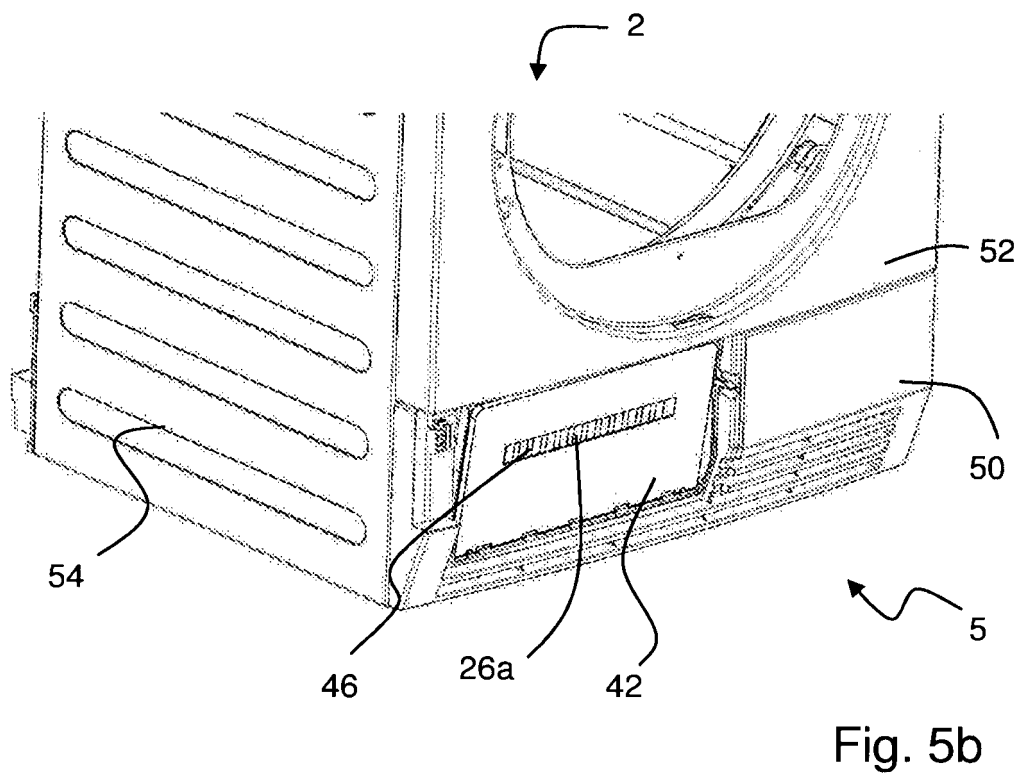
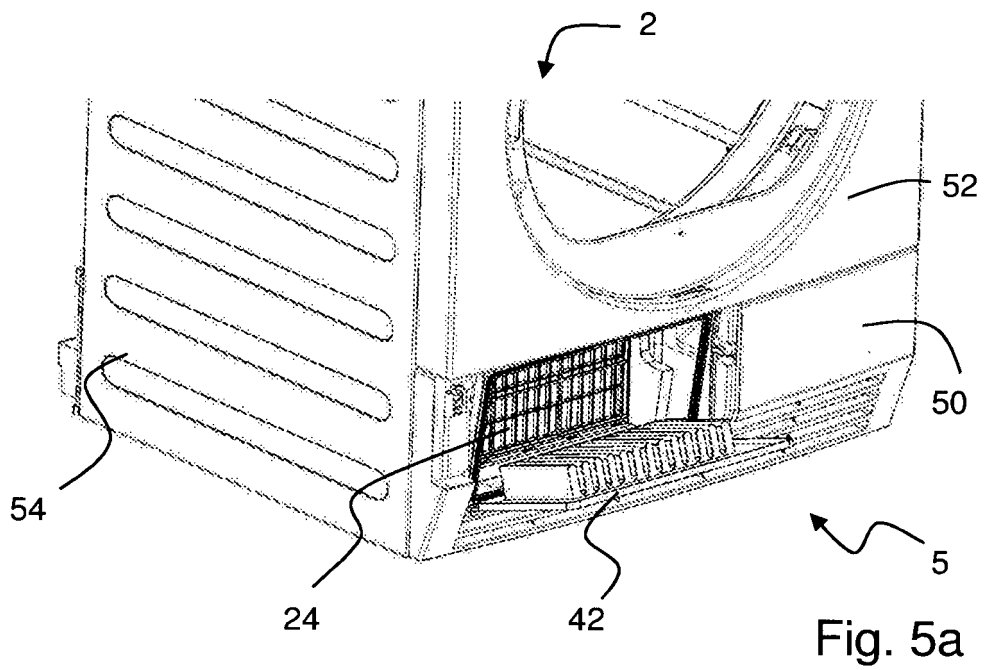
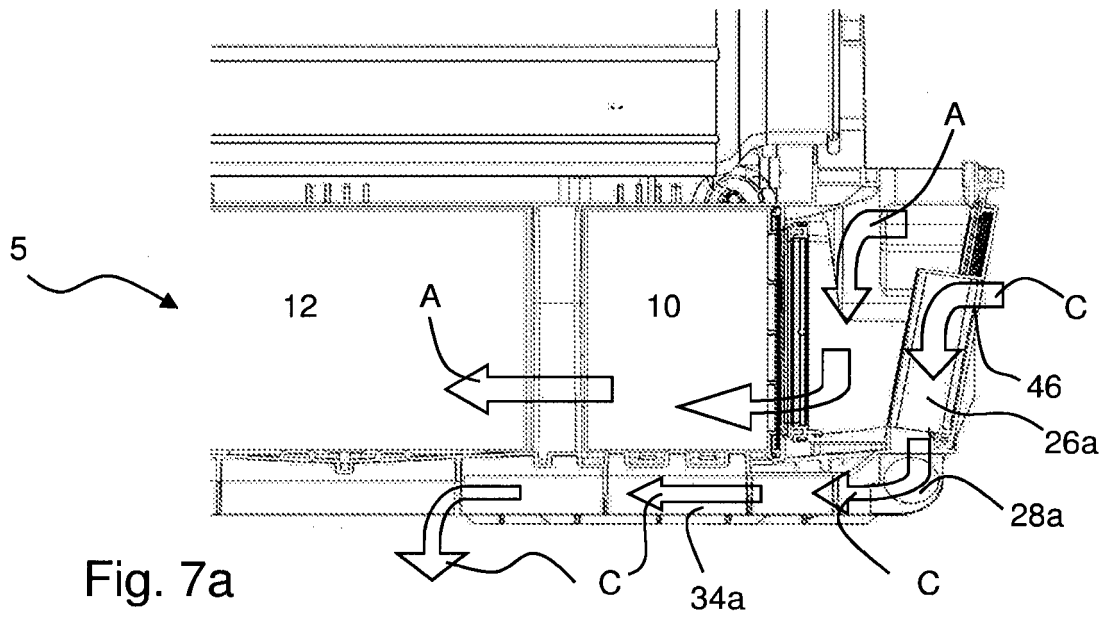
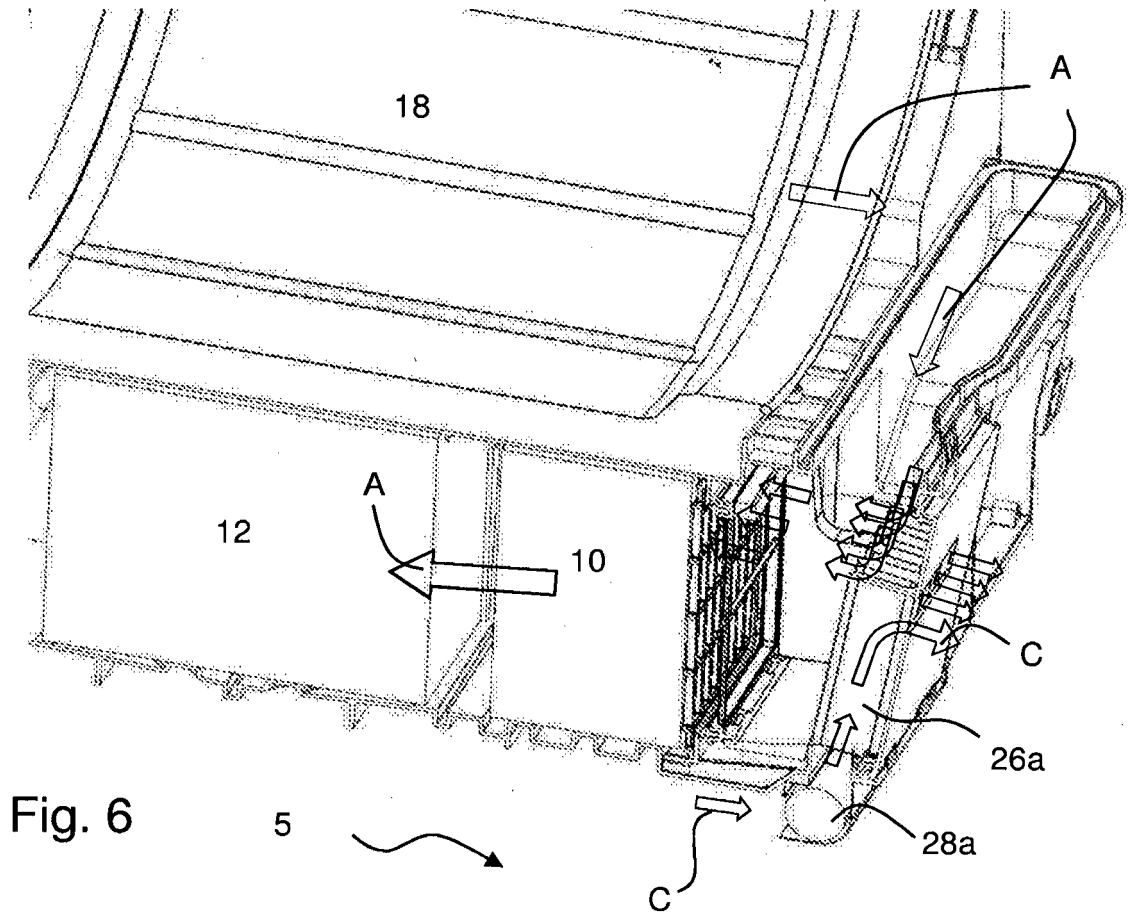


Fig. 2









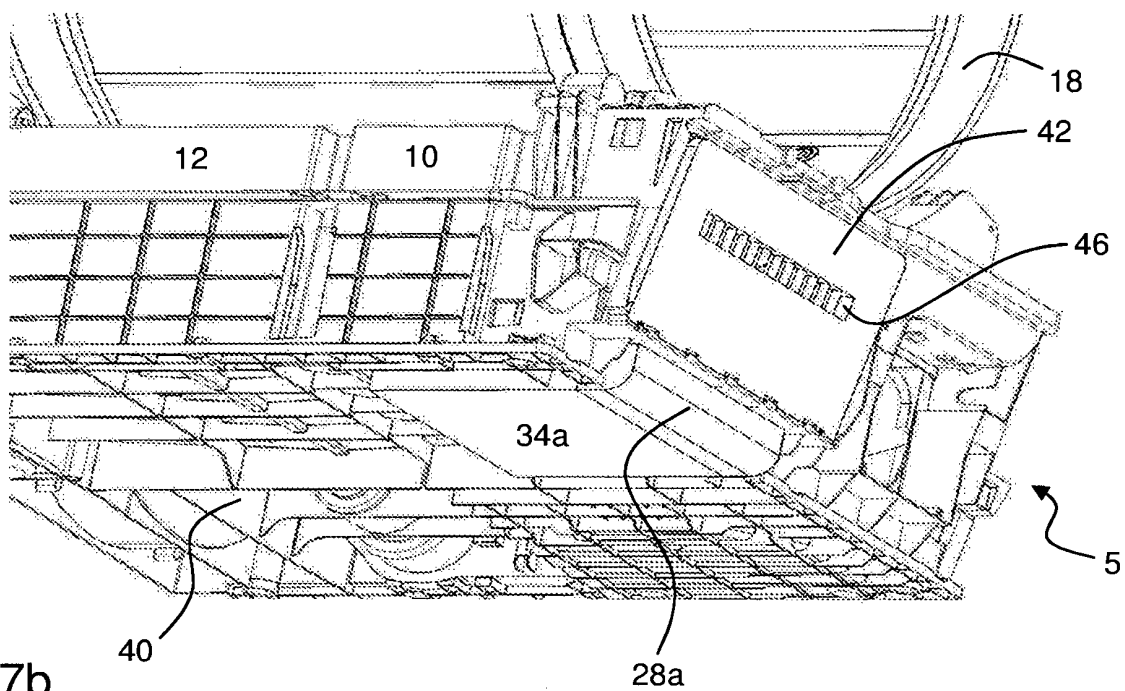


Fig. 7b

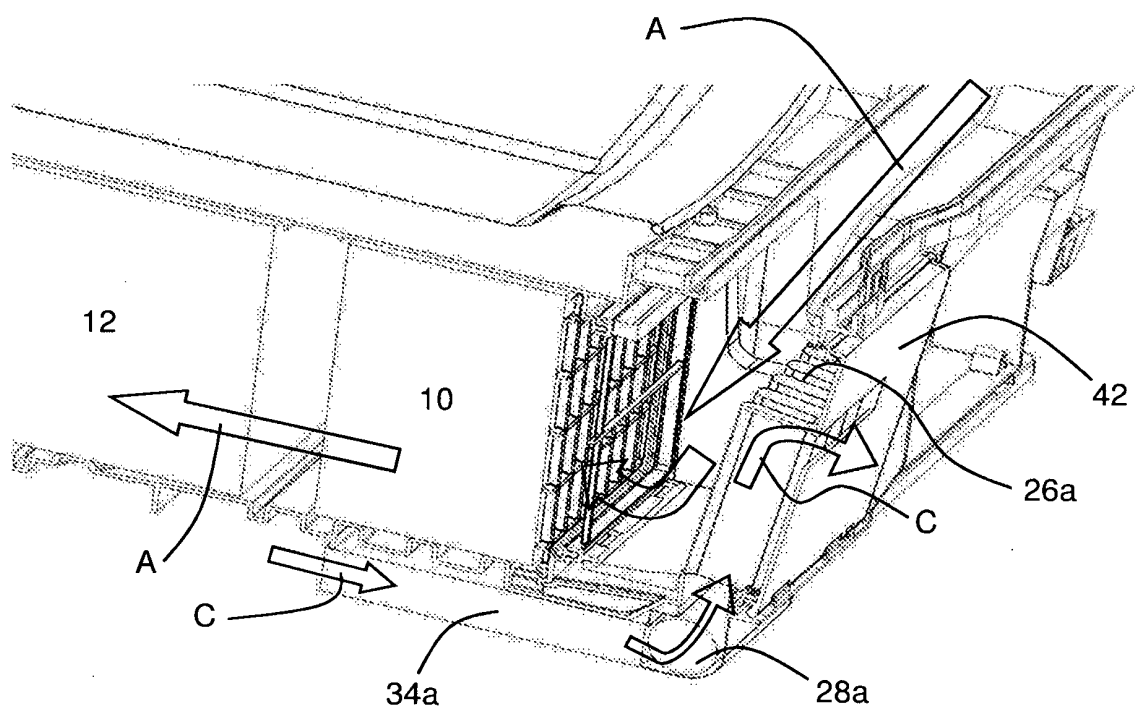
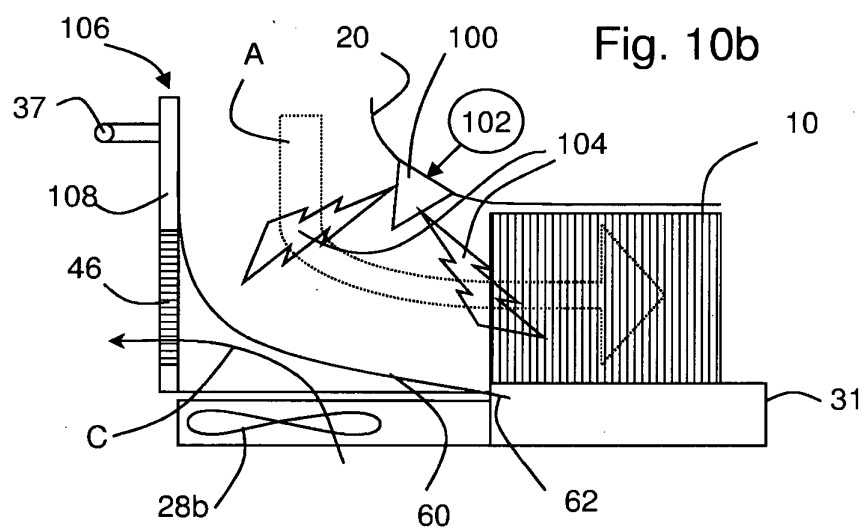
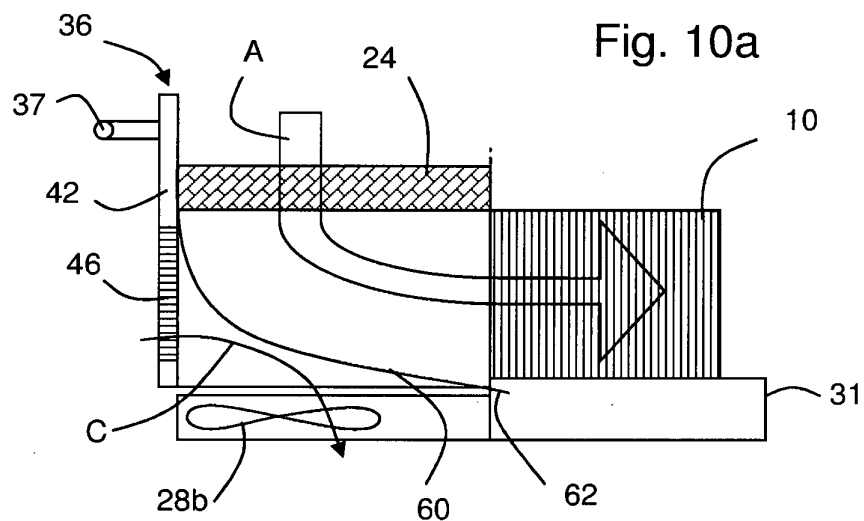
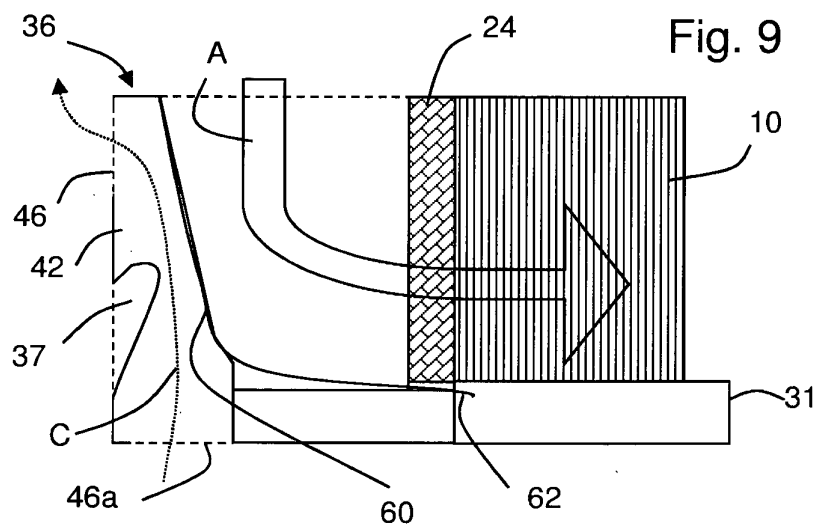


Fig. 8



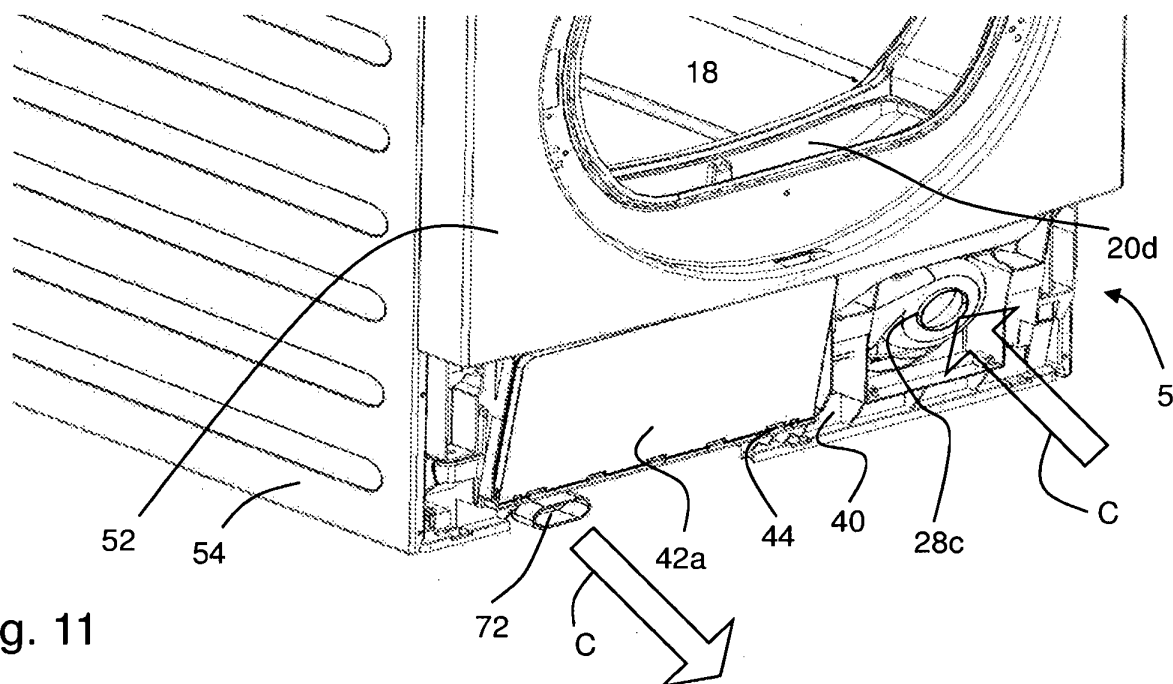


Fig. 11

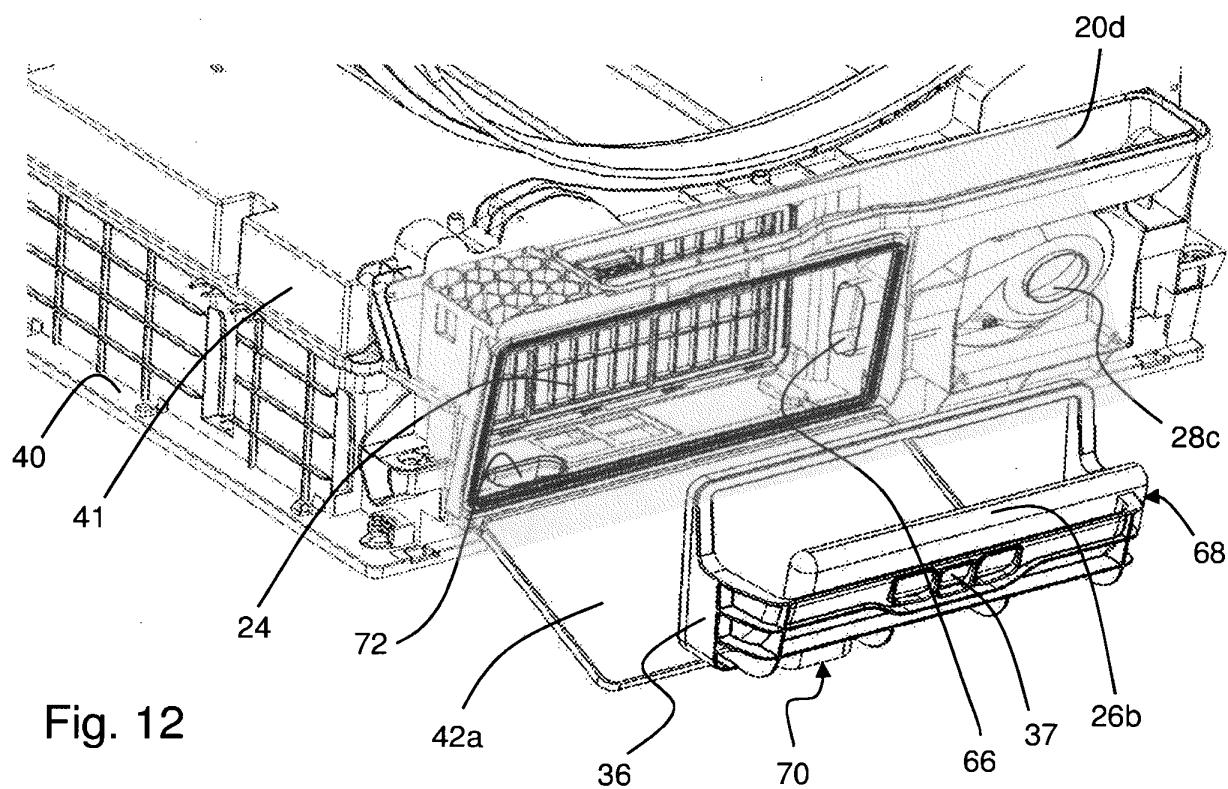


Fig. 12

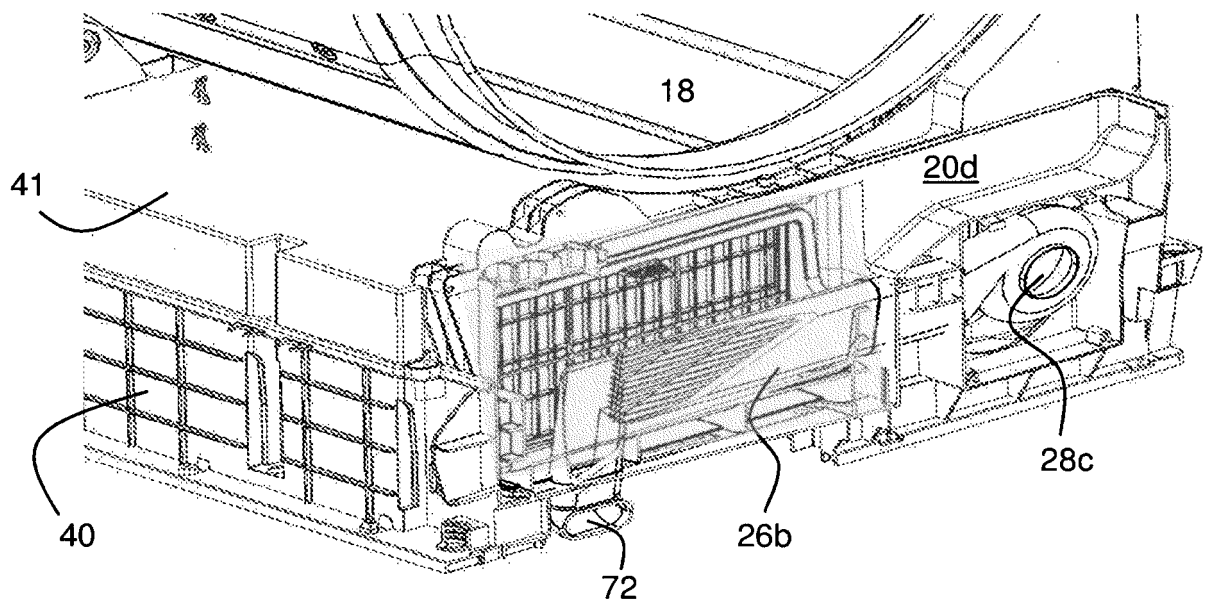
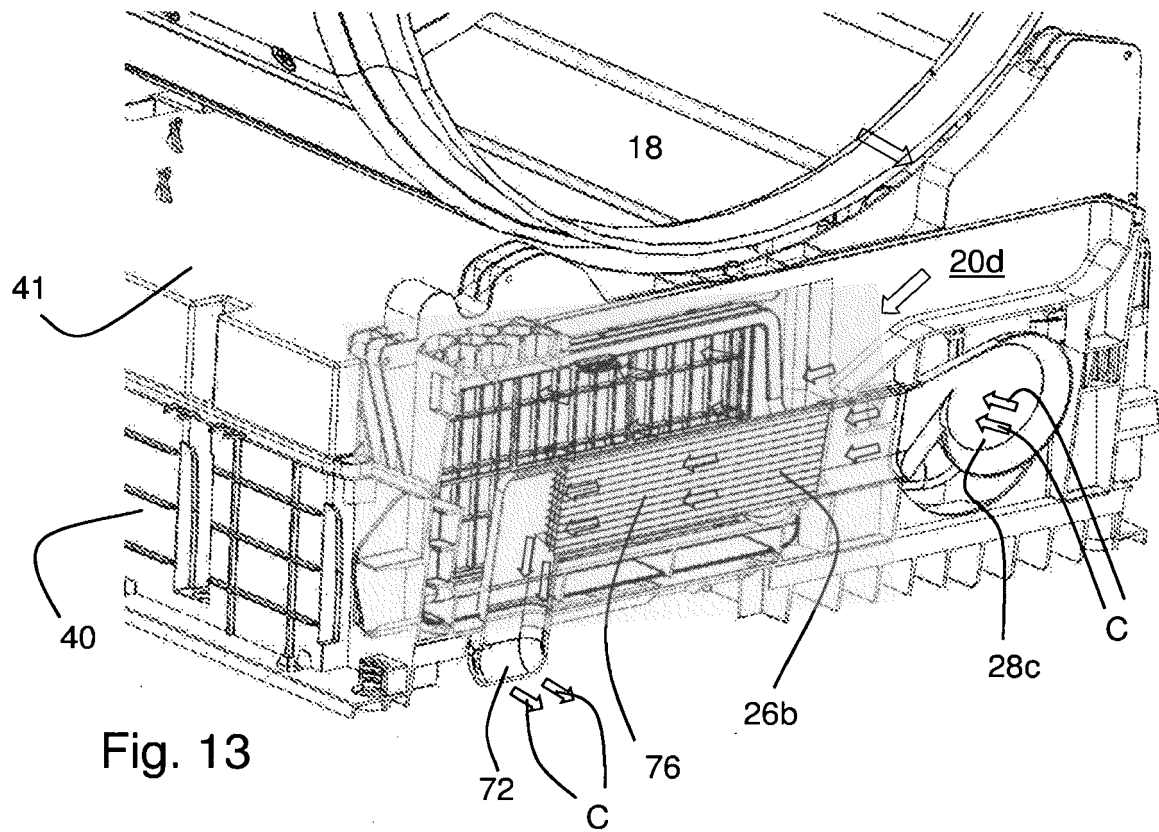


Fig. 15

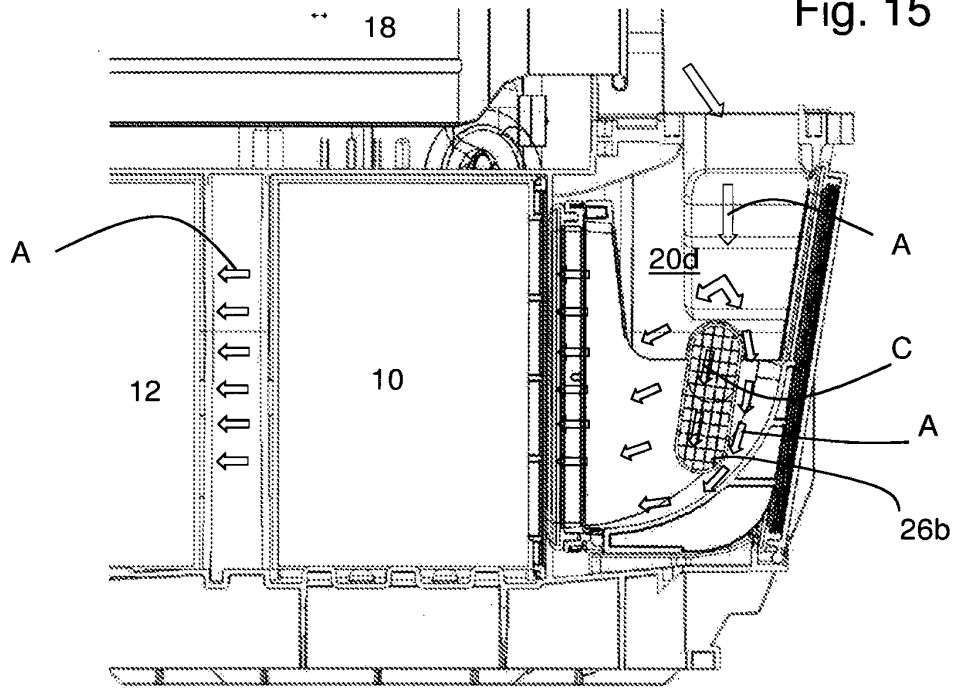
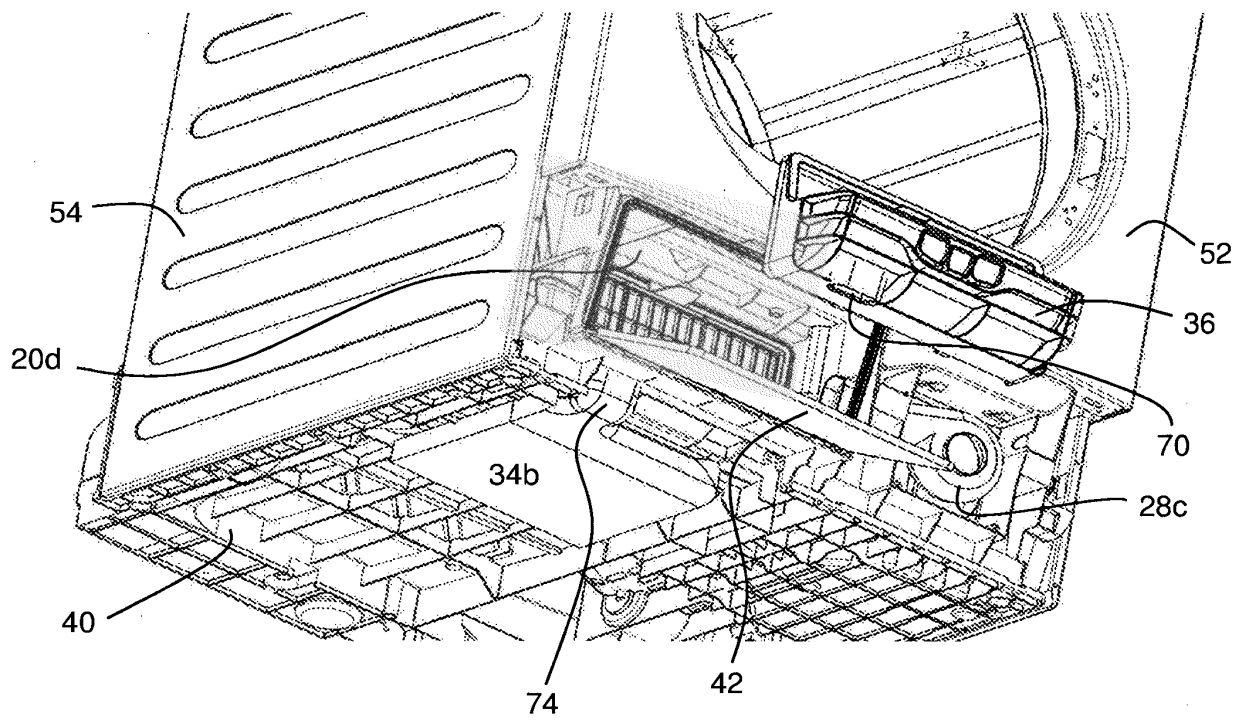
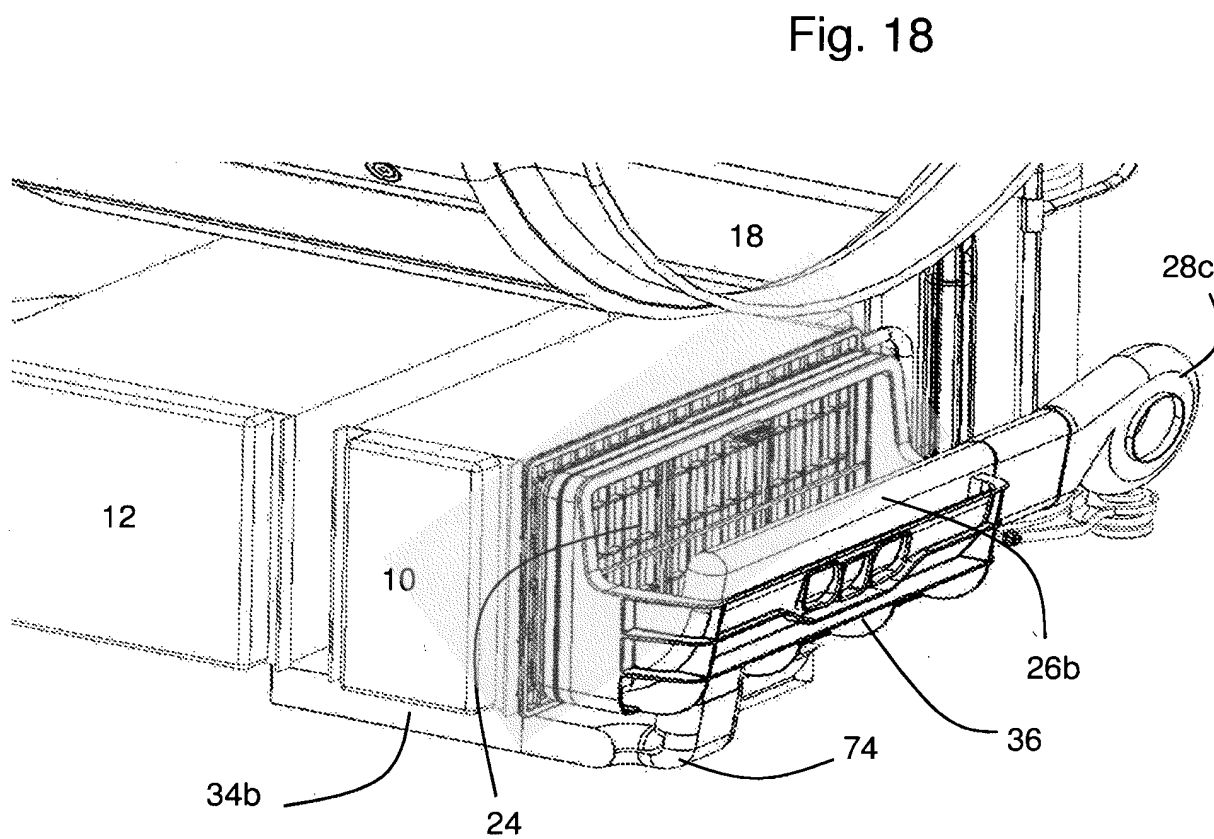
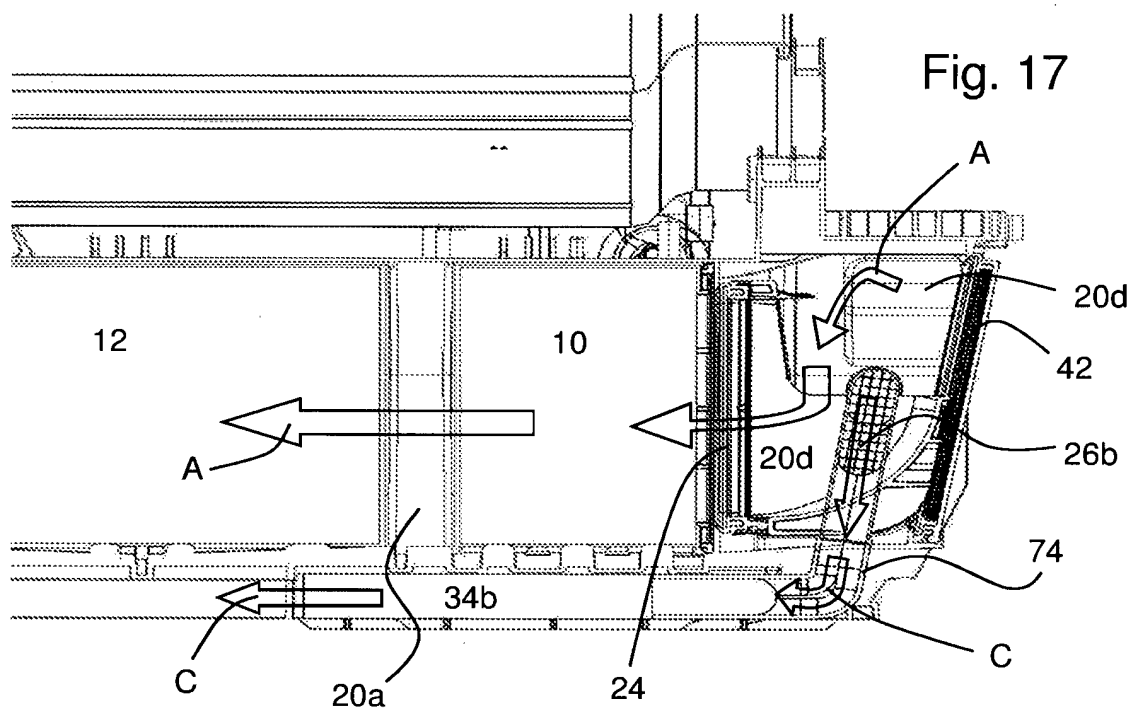


Fig. 16





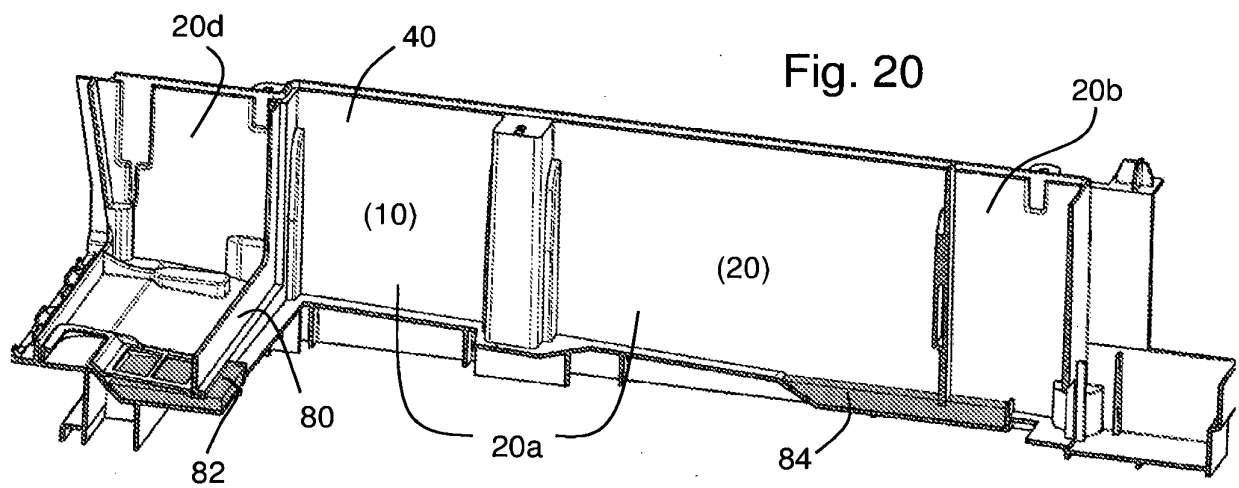
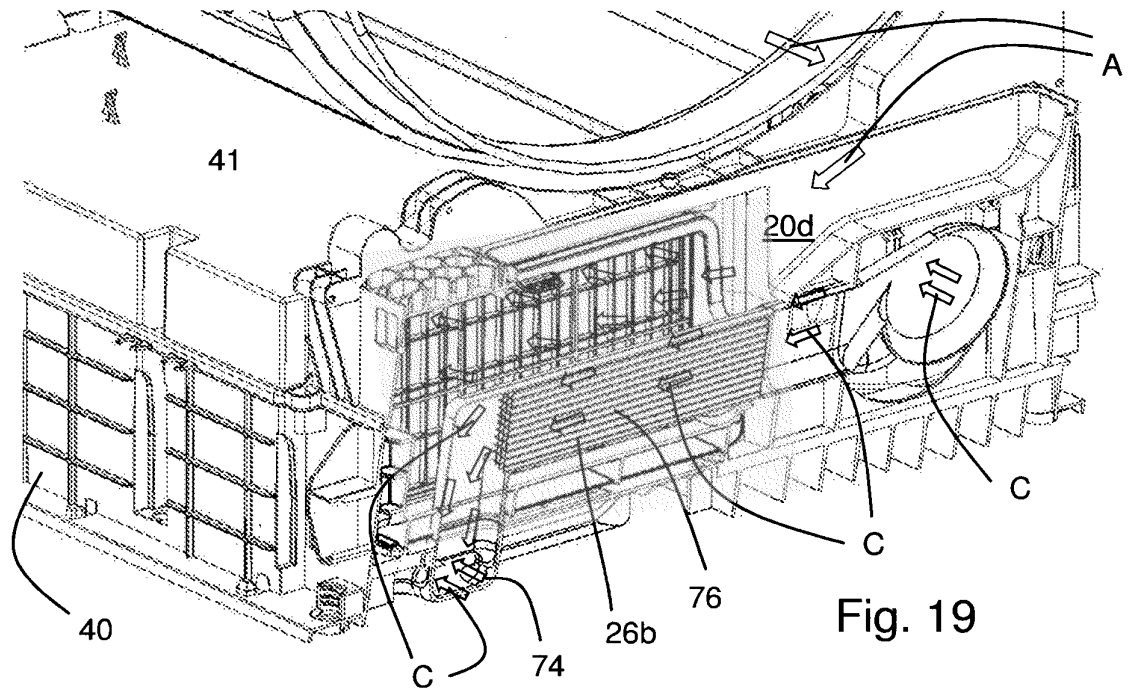


Fig. 21

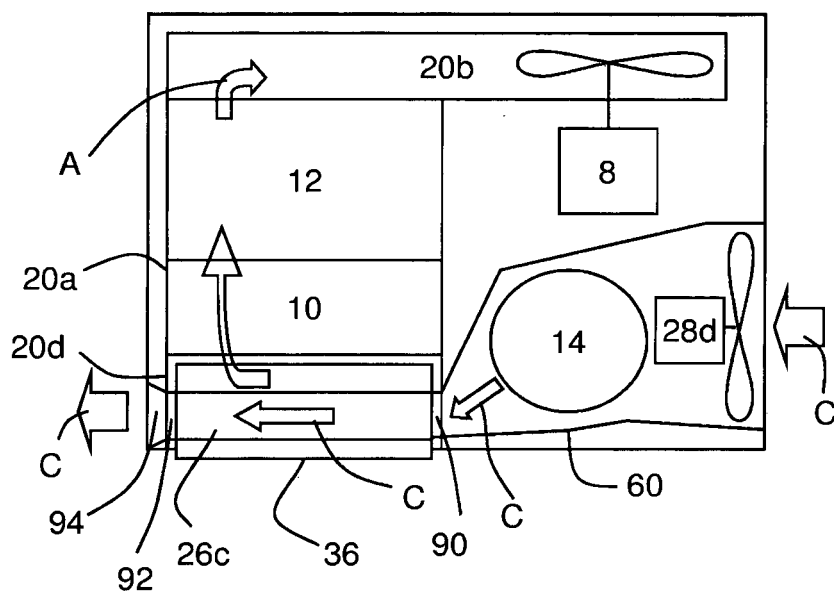
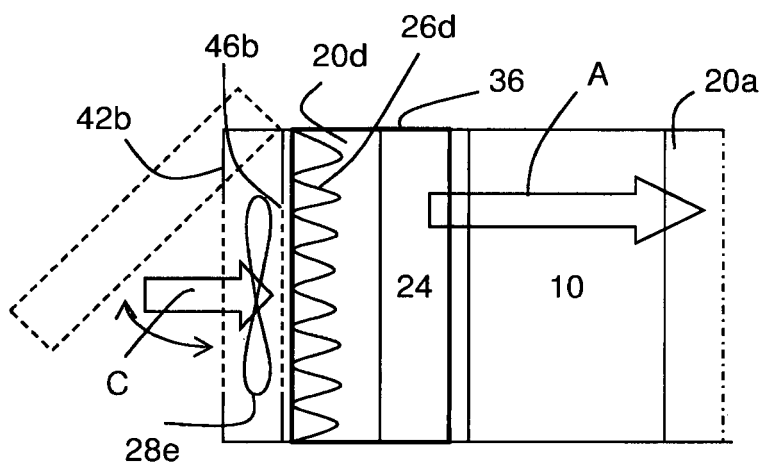


Fig. 22



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 0197132 B1 [0003]
- JP 2007082586 A [0004]
- WO 2008086933 A [0005]
- DE 102007027866 A1 [0006]
- EP 2123823 A1 [0007]
- EP 2333149 A1 [0008]
- EP 1790769 A1 [0009]