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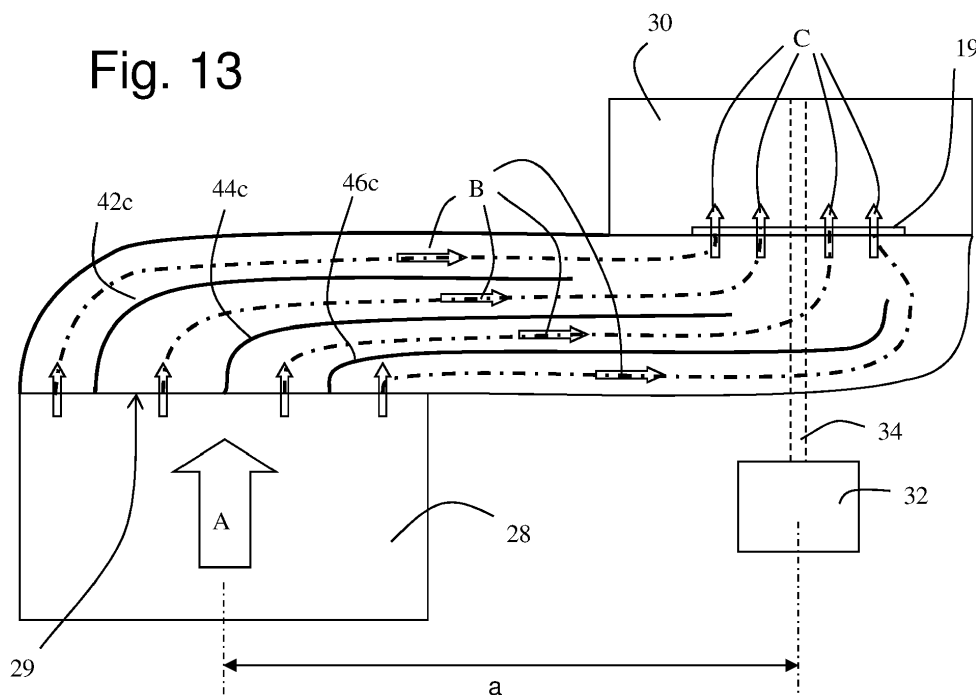
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(54) **Laundry treatment machine with heat exchanger and process air channel**

(57) The invention relates to a laundry treatment machine, in particular dryer or washing machine having drying function, comprising: a laundry storing compartment; a heat exchanger (28) adapted to transfer heat between a refrigerant contained within the heat exchanger and process air passing through the heat exchanger, wherein the heat exchanger has an outlet (29) where the process air exits the heat exchanger; a blower (30) adapted to convey the process air in a loop through the laundry storing compartment and the heat exchanger (28), wherein

the blower has a suction inlet (19) and is arranged downstream the heat exchanger with respect to the process air flow direction; an air channel (16) adapted to guide the process air from the heat exchanger outlet (29) to the blower suction inlet (19); and a flow guiding and partition unit (40) arranged within the air channel (16) and comprising at least one flow partition wall (42, 44, 46). Preferably a front edge of at least one of the flow partition walls or of each flow partition wall (42, 44, 46) is arranged facing and close to or intersecting the area of the heat exchanger outlet (29).

Fig. 13



Description

[0001] The invention relates to a laundry treatment machine, like a dryer or washing machine having dryer function, with an air channel section in which air guiding units are arranged to direct partial air flows along an intended direction.

[0002] DE 81 25 929 U1 suggests a compact basement of a condenser dryer. The dryer has an ambient air/process air heat exchanger where ambient air is used to cool the process air for air humidity condensation. The ambient cooling air is sucked in by a blower through a front opening. The cooling air conveyed by the blower is guided in a channel to a higher level in the basement where the heat exchanger is arranged. After heat exchanging the cooling air exits the heat exchanger and is passed downward to a cooling air outlet. In the channel section close to the air outlet blades are arranged to exhaust the cooling air in a direction away from the cooling air inlet to avoid a short-circuit of the cooling air flow. In the channel section between the blower and the heat exchanger guiding blades are arranged that direct the ambient cooling air flow towards an opening that connects the lower to the upper level of the dryer basement.

[0003] From EP 1 550 763 A2 a condenser-type dryer is known using ambient air for removing heat and humidity from a closed loop process air circuit. For preventing process air leakage at the rear side of the dryer, an air guide is provided partially surrounding a blower at the exit side. The air guide assists in directing the process air flow towards a heater arranged in a channel downstream the blower.

[0004] It is an object of the invention to provide a laundry treatment machine having a heat exchanger and a blower in which the energy efficiency is improved, in which in particular the heat change rate efficiency of the heat exchanger and/or the conveyance efficiency of the blower is improved.

[0005] The invention is defined in claim 1. Particular embodiments of the invention are set out in the dependent claims.

[0006] In a conventional flow system where air is passed through a heat exchanger, the air exiting the heat exchanger is guided in an air channel having edges and deflections. Due to the edges and deflections downstream the outlet of the heat exchanger turbulences are induced which result in an uneven flow distribution with respect to the flow rate per unit area at the heat exchanger outlet. Moreover even in case of a laminar flow there is a parabolic air flow speed distribution over the outlet cross section. This normally results in lower flow speeds at outer regions and higher flow speeds at inner regions of the heat exchanger relating to the cross section perpendicular to the main flow direction through the heat exchanger. Thereby the heat exchange rate between the passing air and the heat exchanger surfaces is non-homogeneous over the cross section. The heat exchangers efficiency would be improved, if a more homogeneous flow distribution could be achieved. This is one problem to be addressed with the present invention.

[0007] Further the blower efficiency, more precisely the flow rate at constant blower power, is reduced, if in a channel section, where the air is conveyed through by the blower activity, turbulences, eddy flows or back flows occur. I.e. when the regime of laminar unidirectional flow through the channel is left. The tendency to non-laminar flow increases at edges or at deflections in flow direction. Preferably the solution according to the invention addresses both problems.

[0008] According to claim 1 a laundry treatment machine is provided, in particular a laundry dryer or washing machine having drying function. The dryer may be a condenser-type dryer like a condenser dryer using ambient air for cooling and thus dehumidifying the process air, or a heat pump dryer. The washing machine having dryer function also may use this type of drying arrangement. The laundry machine has a process air loop in which the process air is circulated through a laundry storing compartment, a heat exchanger for cooling or heating the process air, a blower for conveying the process air and a process air channel section guiding the process air between the outlet of the heat exchanger and the inlet of the blower. Preferably the laundry storing compartment is a laundry drum and more preferably a horizontally rotating drum or drum having its rotation axis inclined in a range up to 30° to the horizontal plane.

[0009] The heat exchanger exchanges heat with the process air passing through the heat exchanger. In case the heat exchanger is an ambient or external air/process air heat exchanger, heat from the process air is transferred to the ambient or external air. A heater may be arranged in the channel section between the heat exchanger outlet and the blower inlet and/or downstream the blower and upstream the laundry storing compartment. In case the heat exchanger is the refrigerant cooler of a heat pump system, heat is transferred from the refrigerant to the process air to heat it after being cooled in a refrigerant heater of the heat pump system.

[0010] The blower conveys the process air and has a suction inlet which is the outlet of the process air channel section coming from the heat exchanger. This process air channel section is also denoted as 'air channel' for simplicity. The terms 'upstream' and 'downstream' herein refers to the location of a component with respect to the process air main flow. Seen from outside, the air channel guides the process air from the heat exchanger outlet to the blower inlet. The air channel preferably provides at least one deflection and/or at least one cross section change (e.g. a cross section reduction) at the flow path of the process air from the heat exchanger outlet to the blower inlet. The air channel inlet is the heat exchanger outlet.

[0011] A flow guiding and partition unit is arranged within the air channel and comprises at least one flow partition wall. The flow partition wall spans at least a portion of a section through the cross section of the air channel, wherein this cross section is perpendicular to the main flow direction through the air channel. The flow partition wall divides an air flow in the channel into partial flows, one is on one side of the wall and the other is at the other side of the wall. The

partition wall has thus guiding function as it also represents a partition element which constricts the two partial flows at least at one side along the partial flow path along the partition wall. The partition wall prevents air exchange or flow between the two partial flows and thus reduces the likelihood of backflow or turbulences. In particular the two process air partial flows are prevented from mixing or mutually influencing between the front edge and the rear edge of the partition wall, preferably along a section of the partition wall having at least one air flow deflection. Each partial flow is confined by the partition wall and another or several other partition walls and/or the inner walls of the air channel.

[0012] Thus by the invention, turbulences and/or backflow at the flow path along the partition wall(s) from the outlet of the heat exchanger to the inlet of the blower are reduced. Also by this the suction force of the blower is distributed more evenly from the blower suction inlet towards the outlet of the heat exchanger. As the suction force of the blower is acting more evenly distributed over the outlet area, the flow speed and thus the flow rate is distributed more evenly over the heat exchanger cross section (which is perpendicular to the process air main direction).

[0013] According to an embodiment, a front edge of at least one of the flow partition walls or of each of the flow partition walls is arranged facing and close to or intersecting the area of the heat exchanger outlet. Preferably the front edge of the at least one flow partition walls is in front of the heat exchanger outlet or even contacting the fins of heat exchanger. Thus the air flow coming out of the heat exchanger is immediately split into partial flows. The outlet area of the heat exchanger is intersected into sectors forming the inlets of the respective partial flows. There is no or only minimal air flow exchange of mating partial flows coming from the heat exchanger outlet and entering the mapping sector inlet.

[0014] In an embodiment at least some of the partition walls are deflection walls, preferably the partition walls having a top-down or vertical extension have deflection function. In addition to the partition wall or walls providing deflection function one or more partition walls may be provided which are or which are essentially planar or flat. For example the (essentially) planar/flat partition wall(s) have or essentially have no curvature or bending along their course in flow direction. Preferably one or more horizontally extending partition walls are (essentially) planar or flat, e.g. have (essentially) no curvature or bending with respect to the horizontal plane. The one or more non-deflecting partition walls may be arranged with vertical or horizontal extension. Generally a partition wall with horizontal extension may be considered as forming an intermediate bottom and/or ceiling element.

[0015] Preferably the flow guiding and partition unit is arranged between the inner walls of the air channel, preferably between the vertical side walls of the air channel. In the preferred embodiment the laundry treatment machine has a basement unit in which the heat exchanger, the air channel and the blower are arranged, wherein the air channel fluidly connects the heat exchanger outlet to the blower inlet. Preferably the heat exchanger with its outlet is arranged at or in the region of a first side of the basement unit and the blower suction inlet is arranged at or in the region of a second side of the basement unit such that the air channel runs from the first to the second side. The two sides can also be located diagonally displaced to each other in the basement unit. Preferably the heat exchanger is a condenser and part of a heat pump system where the evaporator is arranged together with the condenser in a battery channel. The first side may be the right (and/or front) side and the second side may be the left (and/or rear) side of the basement unit - or vice versa. Using the flow guiding and partitioning unit in a deflecting air channel (which has at least one process air flow deflection) is particular useful in enforcing flow homogeneity through the heat exchanger. For example when the blower suction inlet is arranged not in line with or offset to or under an angle with a process air main flow axis of the process air flow passing the heat exchanger. Then the air channel deflects the process air at least one time between the heat exchanger outlet and the blower suction inlet. And by providing at least one partition wall element that deflects the partial flows in correspondence or matching to the deflection of the air channel reduces the tendency of turbulences or inhomogeneous flow distribution through the deflection section of the air channel significantly.

[0016] Generally and in an embodiment, when the guiding and partitioning unit has at least one of the or each of the flow partition walls with at least one deflection in its course between its front edge and its rear edge, the flow resistance along the partial flow path that is guided by the at least one deflecting partition wall may be adjusted (increased or reduced - depending on the flow behavior if the respective flow partition wall would not be provided). Thereby the flow resistances of the partial flows may be balanced to each other such that the (averaged and weighted by area) flow rate of the partial flows is more homogeneous.

[0017] In an embodiment the rear edge of the or of each flow partition wall is arranged in the deflecting air channel intersecting the cross section of the deflecting air channel or is arranged intersecting the area of the blower suction inlet. Alternatively the rear edges of a portion of partition walls are within the air channel spaced from the blower suction inlet and the rear edges of a portion of partition walls intersect the area of the blower suction inlet. Thus at least one of the partial flows may be guided by the partition wall from the heat exchanger sector outlet to the blower suction sector inlet such that the suction capacity of the blower at that sector is transferred from the sector outlet to the sector inlet without interference by another partial flow.

[0018] Preferably at least a wall section of at least one, two or more of the partition walls is arranged perpendicular or at an angle in a range of 80 to 100° or 70 to 110° with respect to the main flow direction through the heat exchanger. In other words the wall section(s) of the at least one, two or more partition walls are running parallel or essentially parallel (e.g. within a range of $\pm 5^\circ$, $\pm 10^\circ$ or $\pm 20^\circ$) to the plane of the heat exchanger outlet. Alternatively or additionally the

wall section of the at least one, two or more of the partition walls is arranged such that it is facing a section of the heat exchanger outlet in direct line of sight. For example, if seen from front side of the laundry treatment machine, a projection of a portion of the heat exchanger outlet towards the rear side falls on the corresponding wall section of the at least one partition wall and/or there is no obstacle between the wall section of the at least one partition wall and a corresponding (projected) section at the heat exchanger outlet.

[0019] This means the wall section is in opposition and/or is substantially perpendicular to a section of the heat exchanger outlet such that flow coming from the corresponding portion of the heat exchanger outlet is deflected at least by this wall section. For the deflection no interference with other partial flows leaving the heat exchanger at other sectors exists and trend to turbulences or mutual suppression of flows (e.g. due to increased flow resistance) is significantly reduced.

[0020] In an embodiment the front edges of the flow partition wall or flow partition walls divide the cross section of the heat exchanger outlet into partial flow inlet sectors, wherein the partial flow entering one of the partial flow inlet sectors has a first flow direction and after deflection of the partial flow by or at the at least one deflection of the partition wall the flow has a second flow direction, wherein the first direction and the second direction are inclined to each other at an angle between 40 to 140°, 50 to 130°, 60 to 120°, 70 to 110° or 80 to 100°. In particular the or each flow partition wall divides the cross section of the heat exchanger outlet and the cross section of the deflecting air channel (or the blower suction inlet) into sectors, wherein each sector has an inlet and an outlet at the rear edge of the partition wall, wherein the direction of the air-flow at the inlet and the direction of the air-flow at the outlet form an angle of between 40 to 140°, 50 to 130°, 60 to 120°, 70 to 110° or 80 to 100°. Normally or preferably the direction of the air-flow at the inlet of each sector is parallel to the direction of the airflow at the outlet of heat exchanger or to the direction of the main air flow through the heat exchanger. Here, if a partial flow has two rear edges of two guiding (and deflecting) partition walls at its end, the rear edge which has shorter partial flow path length and/or the rear edge which is closer to the heat exchanger outlet is the sector outlet considered here.

[0021] If the guiding and partitioning unit comprises at least two flow partition walls, preferably the rear edge of a first flow partition wall is arranged with a larger distance from the blower suction inlet or from a blower center line or shaft in longitudinal or flow direction of the deflecting air channel than the rear edge of a second flow partition wall. By this design the flow resistances and/or average flow path lengths of the partial flows can be balanced or adjusted to each other so that the normalized flow rate (or flow rate per unit area) is more homogeneous. In an embodiment the flow partition walls divide the cross section of the heat exchanger outlet into sectors, wherein a first distance between the center of a first sector and the center of the blower suction inlet or a blower center line or shaft is shorter than a second distance between the center of a second sector and the center of the blower suction inlet or center line or shaft of the blower. Then preferably the flow partition wall is designed such that the flow path length of the flow passing the first sector is extended with respect to a direct flow path length from the outlet of the heat exchanger facing the sector (or the center of the sector) to the center of the blower suction inlet. Alternatively or additionally for at least two flow partition walls the rear edges of the flow partition walls are arranged in a staggered manner with respect to the longitudinal or flow direction of the deflecting air channel.

[0022] In an embodiment the flow partition wall or the flow partition walls divide the cross section of the heat exchanger outlet into sectors, wherein the cross section of the partial flow starting at the sector air inlet is reduced or is tapering towards or is reduced at the outlet of the respective partial flow. By tapering the cross section along the partial flow path starting at the sector inlet the flow resistance along this flow path is increased and can thereby be adapted to the flow resistance that partial flows undergo when starting at another sector inlet. Thus the normalized flow rate at the inlet sectors is homogenized resulting in a more homogenous flow distribution through the heat exchanger. Preferably the cross section area at the sector inlet at the heat exchanger outlet is reduced at least by 50%, 60%, 70% or 80% at the respective partial flow outlet or in the course of the partial flow entering this sector inlet. Alternatively or additionally the flow partition walls divide the cross section of the heat exchanger outlet into sectors and the course of the flow partition walls within the deflecting air channel is such that for each sector the average or normalized flow resistance of the flow between the heat exchanger outlet (sector inlet) and the sector outlet (at the rear edge of the partition wall or at the blower suction inlet) is the same or essentially the same. Alternatively or additionally the flow partition walls divide the cross section of the heat exchanger outlet into sectors and the flow resistance for a partial flow between the associated sector inlet and the associated sector outlet is different for at least two of the sectors, and the course of the partition element is designed such that for each sector the ratio of suction force of the blower acting at the sector inlet divided by the area of the sector is the same or essentially the same for each sector.

[0023] Preferably the base unit of the laundry treatment machine comprises a bottom shell and a cover shell which support or house several components of the machine, in particular in case the treatment machine comprises a heat pump system. Preferably the heat exchanger is arranged in a process air channel section that is formed by the bottom shell and the cover shell. More preferably the refrigerant heating and cooling heat exchangers are arranged in a battery channel formed by the bottom and cover shells. Alternatively or additionally the flow guiding and partition unit or the at least one of or all of the flow partition walls thereof are arranged between the bottom shell and the cover shell which are

forming the air channel. The flow guiding and partition unit may be a separate and/or self-supporting unit that is arranged as a prefabricated unit in the air channel during mounting. In another embodiment at least one of or all of the flow partition walls of the flow guiding and partition unit are fixed to or are integrally or monolithically formed at a bottom shell or a cover shell or partially at the bottom shell and partially at the cover shell.

[0024] Preferably at least one of the flow partition walls, a portion of the partition walls or all of the flow partition walls have a vertical extension and/or a horizontal extension within the air channel. Vertical and horizontal refer to an orientation when the laundry treatment apparatus is installed in its operational orientation. Therein it can be provided that a portion of the vertically and/or of the horizontally aligned flow partition walls provide a deflection and/or flow path extending and/or flow resistance increasing function for the respective partial air flow.

[0025] In a combination the flow guiding and partition unit may comprise at least one partition wall which is vertically or substantially vertically extending and comprises at least one horizontal partition wall that is horizontally extending or extending in a range of ± 5 or ± 10 with respect to the horizontal. Preferably the at least one (substantially) vertical partition wall and the at least one (substantially) horizontal partition wall have at least a region of common extension along the flow path of the process air. More preferably at least one of the horizontal partition wall(s) is arranged at the side wall of one of the partition walls. In an embodiment thereof the at least one partition wall has a front edge and a rear edge and the at least one horizontal partition wall extends only a portion of the total length between the front edge to the rear edge of the partition wall in horizontal direction. Alternatively or additionally the flow guiding and partition unit comprises at least two of said horizontal partition walls which are arranged at one of the partition walls and which are horizontally offset to each other with respect to the flow direction of the process air along the partition wall. Using horizontally and vertically extending partition walls further suppress turbulences and improve flow homogeneity through the heat exchanger.

[0026] In an embodiment a first side cover, a second side cover or a first and second side cover is arranged at the at least one or at all of the flow partition walls. The side cover(s) preferably run at least partially along a longitudinal edge of the at least one or all of the partition elements. Preferably the side covers are provided at the upper and lower side edge of at least one partition element which is vertically oriented. The side cover(s) may assist in providing mechanical stability to the flow guiding and partition unit such that it can be placed as a pre-assembled component. Alternatively the flow guiding and partition unit comprises at least one reinforcement element that is connecting at least one of the flow partition walls to another flow partition wall, to a first and/or second side cover, or to a bottom and/or cover shell of the channel, such as to mechanically stabilize the position of the at least one flow partition wall. Again the reinforcement element may assist the stability of the pre-assembled flow guiding and partition unit and/or prevents flapping of the partition walls caused by air flow or apparatus vibrations.

[0027] Reference is made in detail to preferred embodiments of the invention, example of which are illustrated in the accompanying figures, which show:

- Fig. 1 a perspective exploded view of a basement unit for a heat pump dryer with a bottom shell and a cover shell lifted,
- Fig. 2 the bottom shell with an evaporator and a condenser arranged in the battery channel lower portion,
- Fig. 3 the bottom shell with a flow guiding unit elevated over a rear channel,
- Fig. 4 the flow guiding unit in perspective front view
- Fig. 5 a rear section of the basement unit in top view showing the flow guiding unit inserted in the back channel,
- Fig. 6 the rear section with a horizontal section through the flow guiding unit,
- Fig. 7 a rear view of the basement unit with a vertical section through the back channel,
- Fig. 8 a perspective view to the basement unit with a flow guiding unit according to a second embodiment inserted in the rear channel,
- Fig. 9 a rear section of the basement unit in top view showing the flow guiding unit of Fig 8 in horizontal section,
- Fig. 10 the flow guiding unit of Fig. 8 in perspective front view,
- Fig. 11 the flow guiding unit of Fig. 8 in perspective rear view,
- Fig. 12 a rear view of the basement unit with a vertical section through the back channel, and

Fig. 13 a schematic drawing of the rear channel between the condenser and the blower with a flow guiding unit according to a third embodiment.

[0028] Fig. 1 shows a perspective exploded view of a basement 2 of a heat pump type dryer, the basement being formed by a bottom shell 4 and a cover shell 6. The bottom shell 4 supports or houses main components of the heat pump system and forms the lower portions of process air channel sections. The lower portions of the channel sections formed in the bottom shell are:

- A battery channel 8 in which the evaporator 26 is arranged in an evaporator compartment 12 and the condenser 28 arranged in a condenser compartment 14 (compare Fig. 2).
- A filter compartment 10 in which a fluff filter (not shown) is arranged and which deflects the process air flow coming vertically down from a laundry drum through a channel interface opening 11 to a horizontal direction towards the inlet of the evaporator 26.
- A rear channel 16 which guides the process air exhausted at a condenser outlet 29 to an inlet 19 of a blower 30 (Fig. 5).
- A blower compartment 18 which is arranged at the backside of the dryer (backside of bottom shell 4).

[0029] The bottom shell has a motor console 20 where a blower and drum drive motor 32 is mounted as shown in Fig. 5. Further the bottom shell provides a component mounting space 22 for mounting further components of the heat pump system, like a compressor, refrigerant piping, an expansion valve and an ambient cooling air blower. At the backside of the rear channel 16 a condensate unit 24 is arranged, which collects condensate water formed at the evaporator during a laundry drying process. As can be seen from the top view in Fig. 5, the blower 30 is connected via a shaft 34 to the blower and drum drive motor 32. As the blower 30 is arranged in coaxial line with the motor axis to be driven by the shaft 34, the blower inlet 19 is arranged horizontally offset to or spaced from the condenser outlet 29 by a distance a (see Fig. 13). Thus the shaft passes through the rear channel 16.

[0030] In Fig. 1 the cover shell 6 is lifted from the bottom shell 4. At its lower side the cover shell has formed thereon the upper portions of the process air channel with the upper battery channel 8a having the upper evaporator compartment 12a and the upper condenser compartment 14a, the upper filter compartment 10a, the upper rear channel 16a and the upper blower compartment 18a. At the upper side of the cover shell 6 structures are provided for roller supports for rollers that support the rotatable drum.

[0031] Within the rear channel, which is formed by the lower rear channel 16 and the upper rear channel 16a, a flow guiding unit 40 is arranged between a backside outer wall 41a (Fig. 6) of the rear channel and a frontside wall 41b of the rear channel 16. The flow guiding unit 40 has a first, second and third partition wall 42, 44, 46 that are formed by vertical wall elements that are horizontally spaced and extend from the condenser outlet 29 in flow direction along the flow path in the rear channel 16. As can be seen in more detail in Fig. 4, the partition walls are fixed at their upper edges at an upper plate 48 and are fixed at their lower edges at a lower plate 50. The lower plate 50 has alignment pins 52 protruding at the lower surface of the lower plate 50 which are used to align and horizontally fix the flow guiding unit 40 at respective receptacles arranged mating with the pin positions in the bottom wall of the rear channel 16. The flow guiding unit 40 is a self supporting structure that is placed and aligned by the pins 52 in the lower portion 16 of the rear channel during the dryer assembling procedure and is finally fixed when the cover shell 6 is placed over the bottom shell 4 and fastened to each other. Fastening or mounting to each other may be made using releasable or permanent fastening means; like screws, snap-fits, point or line welding, gluing or a combination thereof.

[0032] Fig. 2 shows the bottom shell 4 with the evaporator 26 and the condenser 28 placed in their respective receptacle positions of the lower part battery channel 8. At the rear outlet 29 of the condenser 28 the air flow exits the condenser and thus the battery channel and enters in this plane into the rear channel 16. Facing to the outlet of the condenser and close to the rear edge of the condenser fins the front edges of the partition walls 42, 44 and 46 are arranged. Due to this edge-facing arrangement of condenser fins and partition walls, the air flow exiting the condenser is split into partial air flows at the junction from the battery channel to the rear channel. Fig. 3 gives a perspective view to the bottom shell 4 with the flow guiding unit 40 elevated over the rear channel so that the inlet sectors II and III of the guiding unit can be seen (Fig. 4).

[0033] Fig. 4 shows the perspective front view of the flow guiding unit 40 taken out of the rear channel. The three front edges of the partition walls 42, 44, 46 vertically split the condenser outlet area (the rear channel inlet area) into the four inlet sectors I, II, III, IV, wherein sectors I and IV are indicated in dotted lines. The left vertical wall that limits the partial flow entering sector I is restricted and thus guided by the rear channel outer wall 41a (Fig. 6) at the left side and by partition wall 42 on the right side, while the partial flow that enters sector IV is restricted and guided by the rear channel inner wall 41b on the right side and by partition wall 46 on the left side.

[0034] Fig. 5 is a top view to the rear section of the basement unit 2 with the flow guiding unit 40 inserted in the back channel 16 formed in the bottom shell 4. The upper plate 48 can be seen from top side. At the back side of unit 40, in particular at the back side of the first partition wall 42, the first partition channel 54 (Fig. 6) is formed between the rear

channel outer wall 41a and the first partition wall 42. The first partial flow enters the first partition channel 54 at sector I. At the front side of unit 40, in particular at the front side of the third partition wall 46 the fourth partition channel 60 (Fig. 6) is formed between the rear channel inner wall 41b and the third partition wall 46, where the fourth partial flow enters at sector IV.

[0035] Fig. 6 shows the rear section of the bottom shell 4 with a horizontal section vertically midway through the flow guiding unit 40. Between the first and second partition walls 42, 44 a second partial flow (which enters at sector II) is guided in a second partial channel 56. Between the second and third partition walls 44, 46 a third partial flow (which enters at sector III) is guided in a third partial channel 58. The first partial flow merges with the second partial flow at the exit of the second partial flow which is at the rear edge of the first partition wall 42. The third partial flow merges with the merged first and second partial flows at the exit of the third partial flow which is at the rear edge of the second partition wall 44. The fourth partial flow exits at the rear edge of the third partition wall 46. The third partition wall 46 is guided close up to the blower shaft 34. In this embodiment the unit 40 does not interfere with shaft 34 such that unit 40 and the blower 30 / motor 32 / shaft 34 can be installed independent of one another. The third partition wall 46 is longer than any of the other partition walls and significantly extends the flow path length through the fourth partial channel 60 as compared to a direct line of view between the fourth sector IV and the blower inlet 19. Thus the partial flow coming from the fourth sector is guided mostly along the rear channel inner wall 41b to a left side of the blower inlet 19. This avoids that the fourth partial flow disturbs the flow characteristic of the first to third partial flows which would increase their flow resistance and would reduce the flow rate of the first to third partial flows. This correspondingly applies to the "guided" flow paths among the first to third partial flows.

[0036] Along the flow path in rear channel 16 the rear edges of the partition walls 42, 44, 46 are arranged in a staggered manner. Further the partition walls 42, 44, 46 provide a 90° deflection in the rear channel with respect to the normal to the condenser outlet plane and the main extension direction of the rear channel or the main flow direction in the center region of the rear channel. In Fig. 13 the hollow arrows indicate the flow directions in flow direction first at the condenser outlet 29 (direction A), in the center region (direction B) of rear channel 16 and at the blower suction inlet 19 (direction C). At least the first deflection of the partial flows after entering the sector inlets at outlet 29 is provided and guided by the partition walls so that turbulence and mutual competition is avoided (what would be the case without the partition walls).

[0037] Fig. 7 is the rear view of the bottom shell 4 with a vertical section through the back channel 16 such that the unit 40 can be seen from backside. The horizontal ranges of the sector inlets I, II, III, IV are indicated and the arrows Ia, IIa, IIIa and IVa indicate the sector outlets corresponding to the inlets.

[0038] Fig. 8 is a perspective view to the bottom shell 4 with a flow guiding unit 40b according to a second embodiment which is inserted in the rear channel 16. Corresponding to Fig. 6, Fig. 9 is the rear section of the bottom shell 4 in top view showing the flow guiding unit 40b of Fig 8 in horizontal section. The difference between the first embodiment unit 40 and the second embodiment flow guiding unit 40b can be best seen by comparing the perspective front views of Figs. 4 and 10. In addition to the vertical partition walls 42, 44, 46, the unit 40b has first, second, third, fourth and fifth horizontal partition plates 64, 66, 68, 72 and 74 that divide the process air flow horizontally into partial flows at the top side and bottom side of the horizontal plates. Horizontal plates 64, 66 and 68 have their front edges in the area or plane of the condenser outlet 29. Horizontal plates 64 and 66 are arranged at the outer or rear side of vertical partition wall 42 and further divide inlet sector I of the first embodiment into sub-sectors I1, I2 and I3 as shown in Fig. 10.

[0039] Horizontal plate 68 is arranged at the inner or front side of the partition wall 46 and has its front edge intersecting the inlet sector IV into sub-sectors IV1 and IV2. To vertically stabilize the third horizontal plate 68, a strut 70 supports the plate 68 versus the bottom or lower plate 50 of the unit 40b. Horizontal plates 72 and 74 are arranged at the outer or rear side of partition wall 46, extend only a portion of the total length between the front edge to the rear edge of wall 46 in horizontal direction. As can be seen in the top view of Fig. 9 for plate 74, the horizontal plates 72, 74 horizontally extend in the direction perpendicular to their supporting third partition wall 46 with a dimension such that the outer lateral edges abut against the inner wall of the rear channel outer wall 41a. Thus the horizontal plates 72, 74 align the flow guiding unit 40b within the rear channel 16. Also the first and second horizontal plates 64, 66 have a horizontally extension from the first partition wall 42 such that their outer edges abut the inner wall of rear channel outer wall 41a when the flow guiding unit 40b is inserted in channel 16. The outer edges of plates 64, 66 abut in a curved section of the outer wall 41a such that they align unit 40b in two directions within channel 16.

[0040] On the opposite side of the partition wall 46 with respect to plates 72, 74, strut 70 which has an L-shaped horizontal cross-section (90° profile) serves as an alignment element with respect to an edge at the inner wall 41b of rear channel 16 formed adjacent the condenser outlet 29. Strut 70 not only laterally fixes the flow guiding unit 40b, but also fixed it in longitudinal direction along the rear channel 16. Further, the third horizontal plate 68 horizontally extends towards the inner wall of rear channel inner wall 41b such that the lateral edge of plate 68 abuts at the inner wall 41b. Thus the horizontal alignment of the flow guiding unit 40b within rear channel 16 is provided by strut 70 and the horizontal plates 64, 66, 68, 72 and 74 laterally abutting at the vertical walls 41a, 41b while spanning the cross-section of channel 16 in horizontal direction. Moreover the plates 72 and 74 are horizontally offset to each other with respect to the flow direction (compare Fig. 12 showing a rear view of the bottom shell 4 with a vertical section through the back channel).

The perspective rear view of the second embodiment flow guiding unit 40b is shown in Fig. 11.

[0041] Fig. 13 schematically depicts in horizontal cross section the rear channel 16 between the condenser 28 and the blower 30 with a flow guiding unit 40c according to a third embodiment. As compared to the vertical partition walls 42, 44, 46 of the first and second embodiment, the length of first, second and third partition walls 42c, 44c, 46c of the unit 40c are further extended towards the blower inlet 19. In particular the rear edge of the third partition wall 46c is guided beyond the center or shaft 34 of the blower 30. Thereby the fourth partial flow between wall 46c and inner wall 41b is guided to the outer rightmost area of inlet 19 thus further reducing interference with the other three partial flows. The center lines of the partial flows between walls 41a, 42, 44, 46 and 41b are indicated by the dashed-dotted lines to illustrate the guidance within the partial channels (corresponding to 54, 56, 58, 60 - but extended in downstream direction in channel 16) and the spatial split or distribution over the inlet area of inlet 19. In this embodiment the mutual interference between the partial flows is further suppressed as compared to the previous embodiments and the third and fourth partial flows are additionally deflected by a 90° deflection at the end of and by the fourth partition wall 46c.

[0042] Thereby it is illustrated that multiple deflection for at least one, a portion of or all partial flows may be provided by the partition walls along the inner path of a process air channel like rear channel 16. By the arrow with length a between the center of the condenser 28 and the center of the blower 30 it is indicated that condenser outlet and blower inlet are spatially offset to each other. Thus process air deflection is required although the normal to the outlet 29 is parallel to the normal to the inlet 19. It is readily understood that the basic principle of providing at least one partition wall that is forming partial flows at the front edge which intersect the outlet (of the condenser) and which deflect the partial flows can be applied to other geometric configurations of the process air channel. For example if the normal to the outlet 29 and the normal to the inlet 19 have an angle to each other - e.g. a 90° angle.

Reference Numeral List:

[0043]

2	basement
4	bottom shell
6	cover shell
8	battery channel
8a	upper part battery channel
10	filter/deflection compartment
10a	upper part filter compartment
11	channel interface
12	evaporator compartment
12a	upper part evaporator compartment
14	condenser compartment
14a	upper part condenser compartment
16	rear channel
16a	upper part rear channel
18	blower compartment
18a	upper part blower compartment
19	blower inlet
20	motor console
22	component mounting space
24	condensate unit
26	evaporator
28	condenser
29	condenser outlet
30	blower
32	blower motor
34	shaft
40, 40b, 40c	flow guiding unit
41a	rear channel outer wall
41b	rear channel inner wall
42, 42c	first partition wall
44, 44c	second partition wall
46, 46c	third partition wall
48	upper plate

50	lower plate
52	aligning pin
54	first partial channel
56	second partial channel
58	third partial channel
60	fourth partial channel
64	first horizontal plate
66	second horizontal plate
68	third horizontal plate
70	strut
72	fourth horizontal plate
74	fifth horizontal plate
I, I1, I2, I3	first section inlet
II	second section inlet
III	third section inlet
IV, IV1, IV2	section inlet
a	displacement
Ia, IIa, IIIa, IVa	section outlet
A, B, C	air flow direction

Claims

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

a laundry storing compartment;
a heat exchanger (28) adapted to exchange heat with process air passing through the heat exchanger, wherein the heat exchanger has an outlet (29) where the process air exits the heat exchanger;
a blower (30) adapted to convey the process air in a loop through the laundry storing compartment and the heat exchanger (28), wherein the blower has a suction inlet (19) and is arranged downstream the heat exchanger with respect to the process air flow direction;
an air channel (16) adapted to guide the process air from the heat exchanger outlet (29) to the blower suction inlet (19); and
a flow guiding and partition unit (40, 40b, 40c) arranged within the air channel (16) and comprising at least one flow partition wall (42, 42c, 44, 44c, 46, 46c, 64, 66, 68).

2. Laundry treatment machine according to claim 1, wherein a front edge of at least one of the flow partition walls or of each flow partition wall (42, 42c, 44, 44c, 46, 46c, 64, 66, 68) is arranged facing and close to or intersecting the area of the heat exchanger outlet (29).

3. Laundry treatment machine according to claim 1 or 2, wherein the flow partition wall or flow partition walls (42, 42c, 44, 44c, 46, 46c, 64, 66, 68) divide the cross section of the heat exchanger outlet (29) into partial flow inlet sectors (I, I1-I3, II, III, IV, IV1, IV2), wherein the partial flow entering one of the partial flow inlet sectors has a first flow direction (A) and after deflection of the partial flow at or by at least one of the partition walls (42, 42c, 44, 44c, 46, 46c) the flow has a second flow direction (B), wherein the first direction (A) and the second direction (B) are inclined to each other at an angle between 40 to 140°, 50 to 130°, 60 to 120°, 70 to 110° or 80 to 100°.

4. Laundry treatment machine according to claim 1, 2 or 3, wherein the flow guiding and partition unit (40, 40b, 40c) is arranged between a first wall (41a) and a second wall (41b) of the air channel (16).

5. Laundry treatment machine according to any of the previous claims, wherein the blower suction inlet (19) is arranged not in line with or offset to a process air main flow axis (A) of the process air flow passing the heat exchanger (28) such that the air channel (16) is deflecting the process air at least one time between the heat exchanger outlet (29) and the blower suction inlet (19).

6. Laundry treatment machine according to any of the previous claims, wherein at least one of the or each of the flow partition walls (42, 42c, 44, 44c, 46, 46c) comprises a front edge and a rear edge and in its course between its front edge and its rear edge provides at least one deflection, such that the deflecting flow partition wall guides on each

of its sides one process air partial flow along the at least one deflection.

7. Laundry treatment machine according to any of the previous claims, comprising at least two flow partition walls (42, 42c, 44, 44c, 46, 46c, 64, 66, 68), wherein the rear edge or outlet of a first flow partition wall (42) is arranged with a larger distance from the blower suction inlet (19) or from a blower center line or shaft (34) than the rear edge or outlet of a second flow partition wall (44, 46).
8. Laundry treatment machine according to any of the previous claims, wherein the flow partition wall (46) having its front edge defining a sector (IV) border is designed such that the flow path length of the flow passing this sector (IV) is extended with respect to a direct flow path length from the heat exchanger outlet (29) facing or at the sector (IV) inlet to the center of the blower suction inlet (19).
9. Laundry treatment machine according to any of the previous claims, comprising at least two flow partition walls (42, 42c, 44, 44c, 46, 46c) wherein the rear edges of the flow partition walls are arranged in a staggered manner with respect to the longitudinal or flow direction of the air channel (16).
10. Laundry treatment machine according to any of the previous claims, wherein the flow partition wall or the flow partition walls (42, 42c, 44, 44c, 46, 46c, 64, 66, 68) divide the cross section of the heat exchanger outlet (29) into sectors (I, I1-I3, II, III, IV, IV1, IV2) and wherein the cross section of at least one partial flow starting at the sector air inlet is reduced or is tapering towards or is reduced at the outlet for the respective partial flow.
11. Laundry treatment machine according to any of the previous claims, wherein at least a wall section of at least one, two or more of the partition walls (42, 42c, 44, 44c, 46, 46c) is arranged perpendicular or at an angle in a range of 80 to 100° or 70 to 110° with respect to the main flow direction (A) through the heat exchanger (28) or which is facing a section of the heat exchanger outlet (29) in direct line of sight.
12. Laundry treatment machine according to any of the previous claims, wherein the heat exchanger (28) is a condenser or refrigerant cooler in a heat pump system and the heat pump system further comprises an evaporator (26) or refrigerant heater arranged upstream of the condenser or refrigerant cooler.
13. Laundry treatment machine according to any of the previous claims, wherein the heat exchanger (28) is arranged in a process air channel section (8) that is formed by a bottom shell (4) and a cover shell (6).
14. Laundry treatment machine according to any of the previous claims, wherein the at least one of or all of the flow partition walls (42, 42c, 44, 44c, 46, 46c, 64, 66, 68) are arranged between a bottom shell (4) and a cover shell (6) which are forming the air channel (16).
15. Laundry treatment machine according to any of the previous claims, wherein at least one of or all of the flow partition walls (42, 42c, 44, 44c, 46, 46c, 64, 66, 68) are fixed to or are integrally or monolithically formed at a bottom shell (4) or a cover shell (6) or partially at the bottom shell and partially at the cover shell.
16. Laundry treatment machine according to any of the previous claims, wherein at least one of the or all of the flow partition walls (42, 42c, 44, 44c, 46, 46c, 64, 66, 68) has(have) a first cross section extension, a second cross section extension, or a portion thereof has a first cross section extension and a portion thereof has a second cross section extension with respect to the cross section perpendicular to the main air flow direction in the air channel (16).
17. Laundry treatment machine according to claim 16, wherein at least one of the or all of the flow partition walls (42, 42c, 44, 44c, 46, 46c, 64, 66, 68) has(have) a vertical extension, a horizontal extension or an extension within a range of $\pm 5^\circ$, $\pm 10^\circ$ or $\pm 15^\circ$ relative to the horizontal extension, or a portion thereof (42, 42c, 44, 44c, 46, 46c) has a vertical extension and a second portion thereof (64, 66, 68) has a horizontal extension within the air channel (16).
18. Laundry treatment machine according to any of the previous claims, wherein a first side cover (48), a second side cover (50) or a first and second side cover (48, 50) is arranged at the at least one or at all of the flow partition walls (42, 42c, 44, 44c, 46, 46c, 64, 66, 68), wherein the side cover(s) run(s) at least partially along a longitudinal edge of the at least one or all of the partition elements (42, 42c, 44, 44c, 46, 46c).
19. Laundry treatment machine according to any of the previous claims, comprising at least one reinforcement element (70) that is connecting at least one of the flow partition walls (68) to another flow partition wall, to a first or second

side cover (48), or to a bottom or cover shell of the channel, such as to mechanically stabilize the position of the at least one flow partition wall (68).

20. Laundry treatment machine according to any of the previous claims,
 wherein the flow guiding and partition unit (40, 40b, 40c) comprises at least one partition wall (46) which is vertically or essentially vertically extending and comprises at least one horizontal partition wall (72, 74) that is horizontally extending or extending in a range of $\pm 5^\circ$ or $\pm 10^\circ$ with respect to the horizontal, and
 wherein the at least one horizontal partition wall (72, 74) is arranged at the side wall of one of the partition walls (46).

21. Laundry treatment machine according to claim 20,
 wherein the at least one partition wall (46) has a front edge and a rear edge and the at least one horizontal partition wall (72, 74) extends only a portion of the total length between the front edge to the rear edge of the partition wall (46) in horizontal direction, or
 wherein the flow guiding and partition unit (40, 40b, 40c) comprises at least two of said horizontal partition walls (72, 74) arranged at one of the partition walls (46) and the two horizontal partition walls (72, 74) are horizontally offset to each other with respect to the flow direction of the process air along the partition wall (46).

Fig. 1

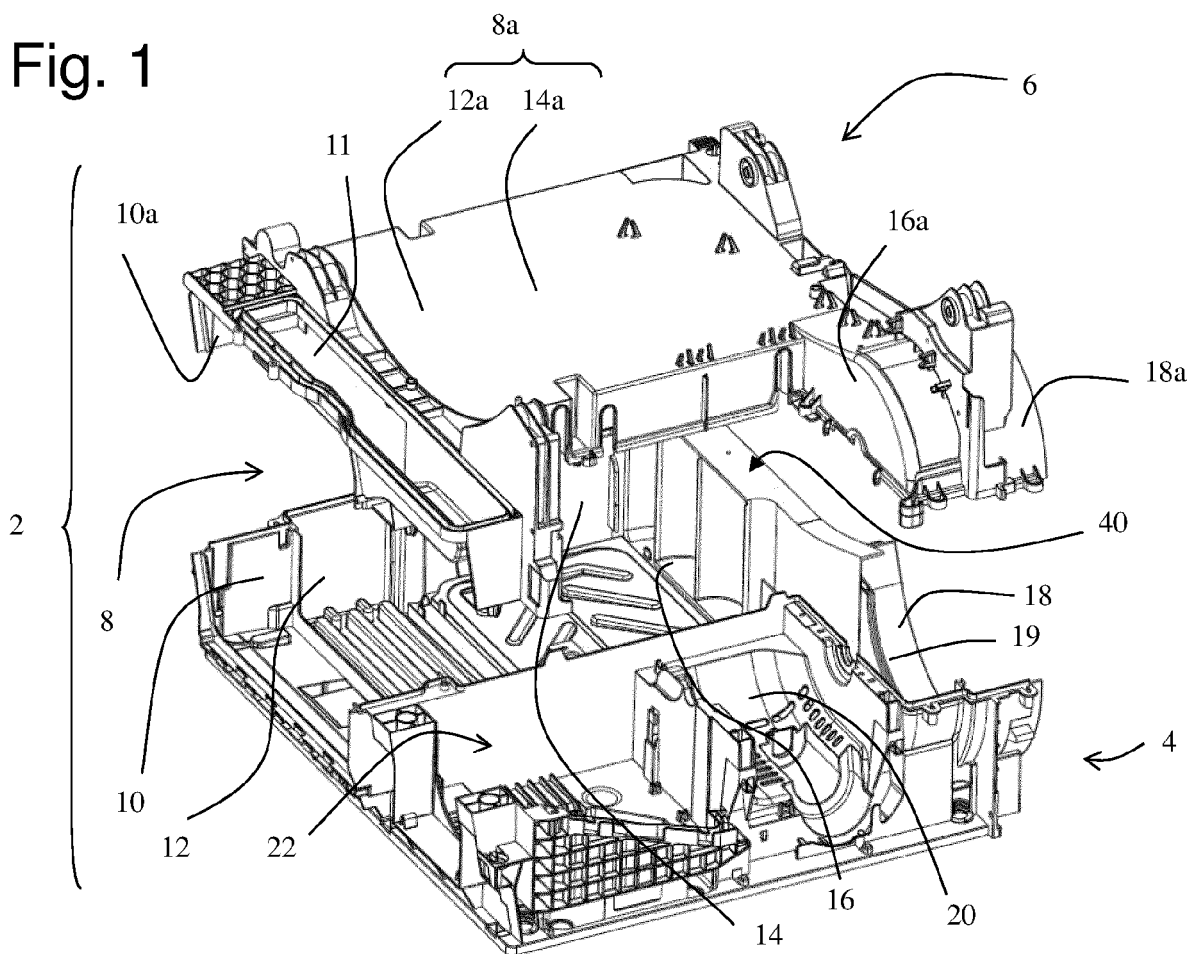


Fig. 2

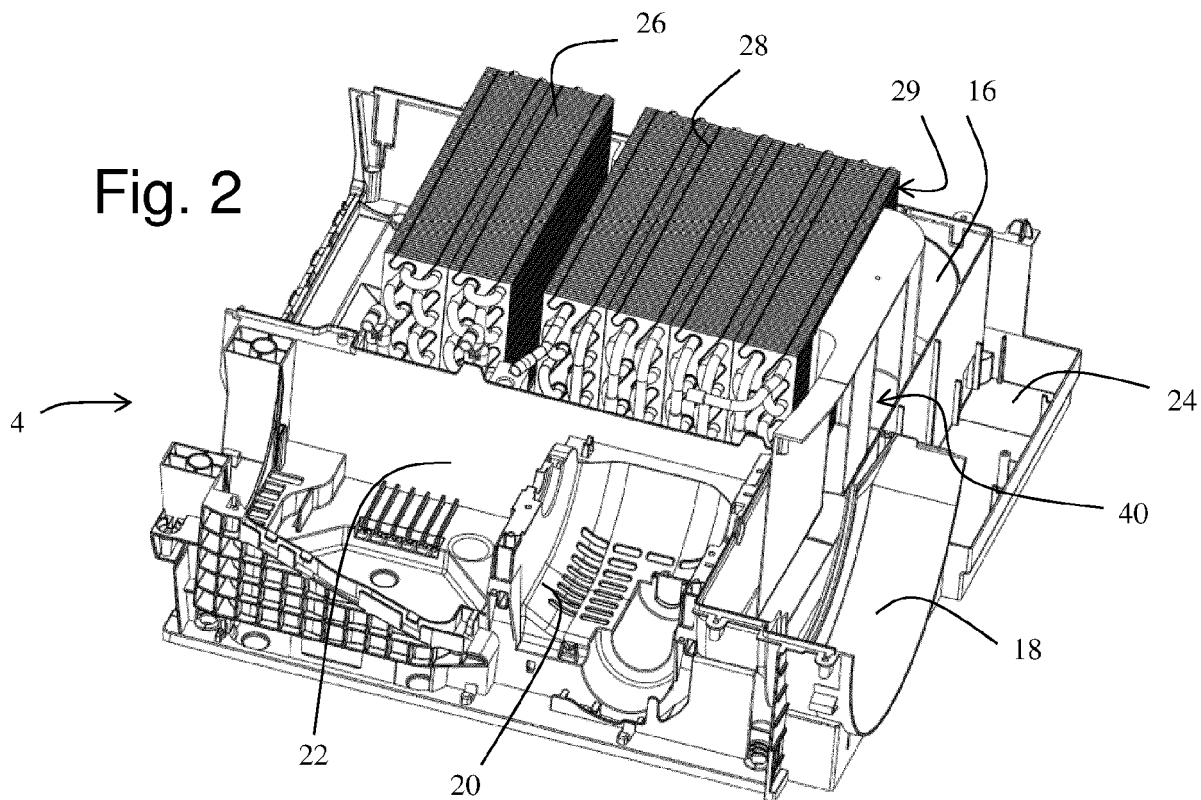


Fig. 3

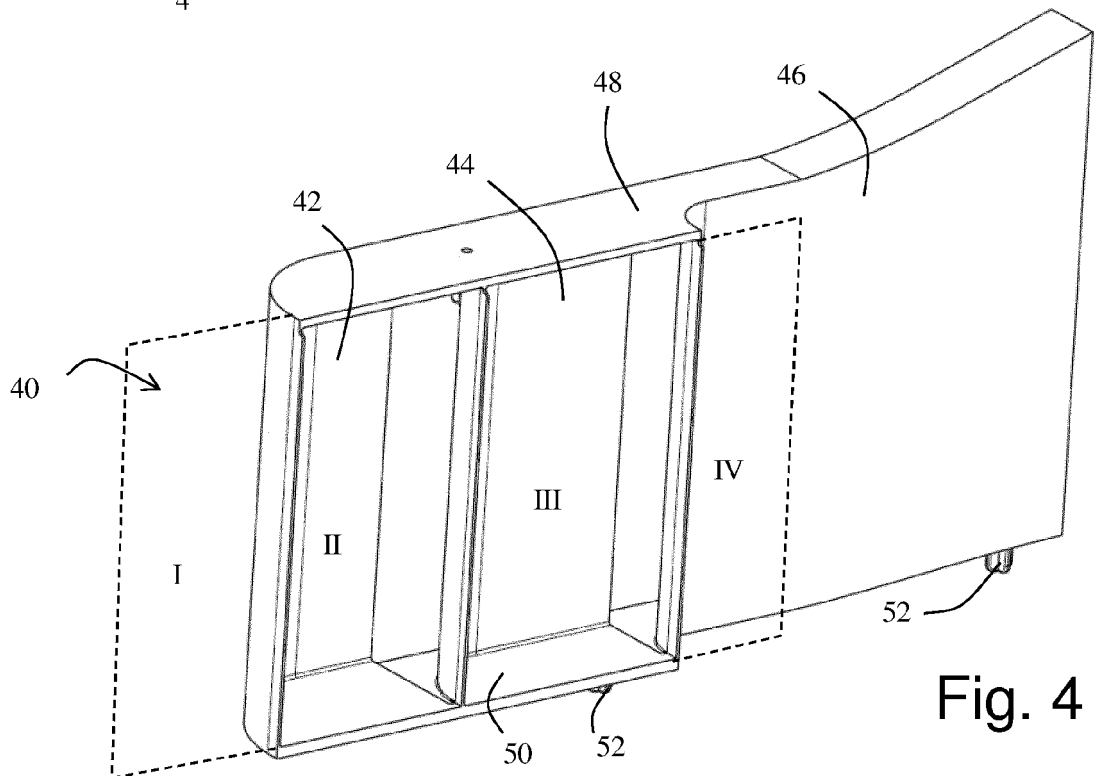
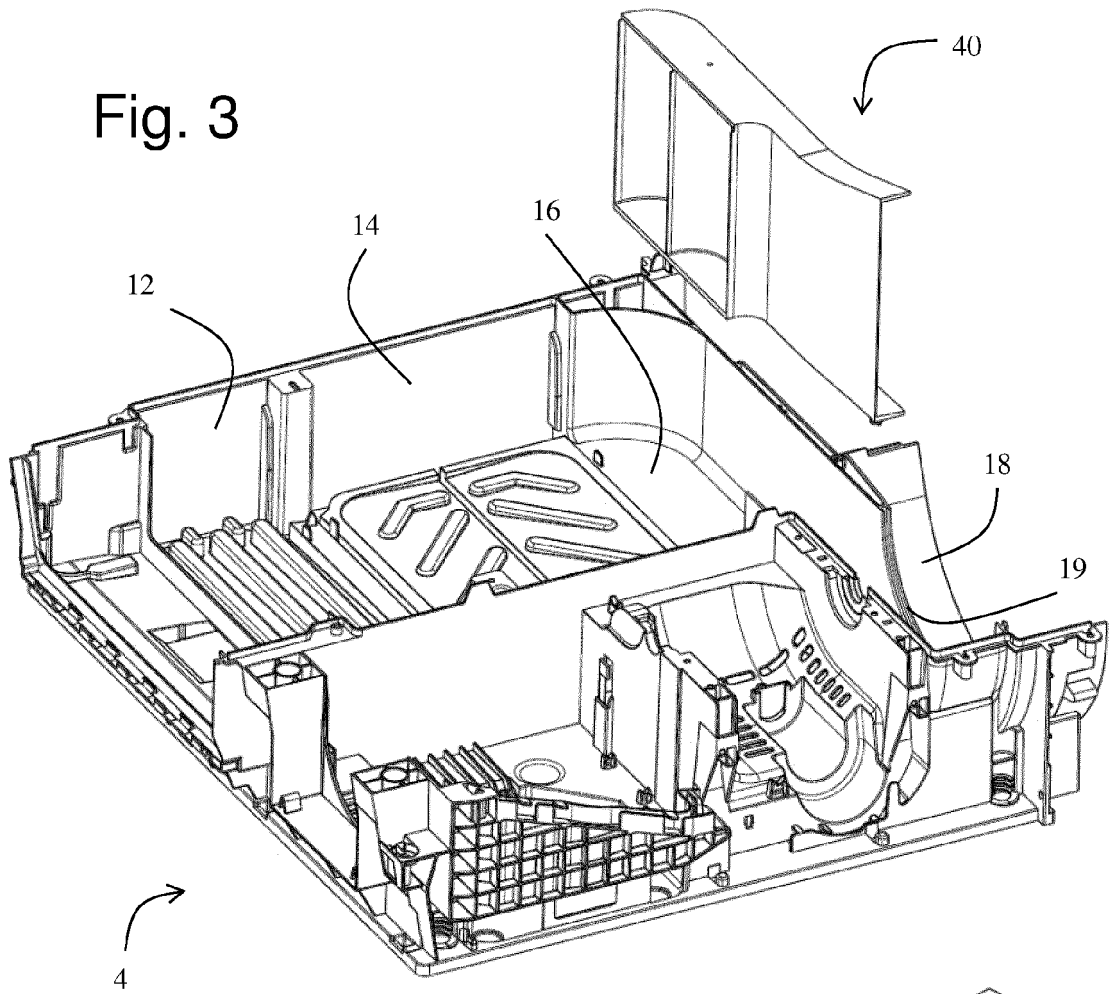


Fig. 4

Fig. 5

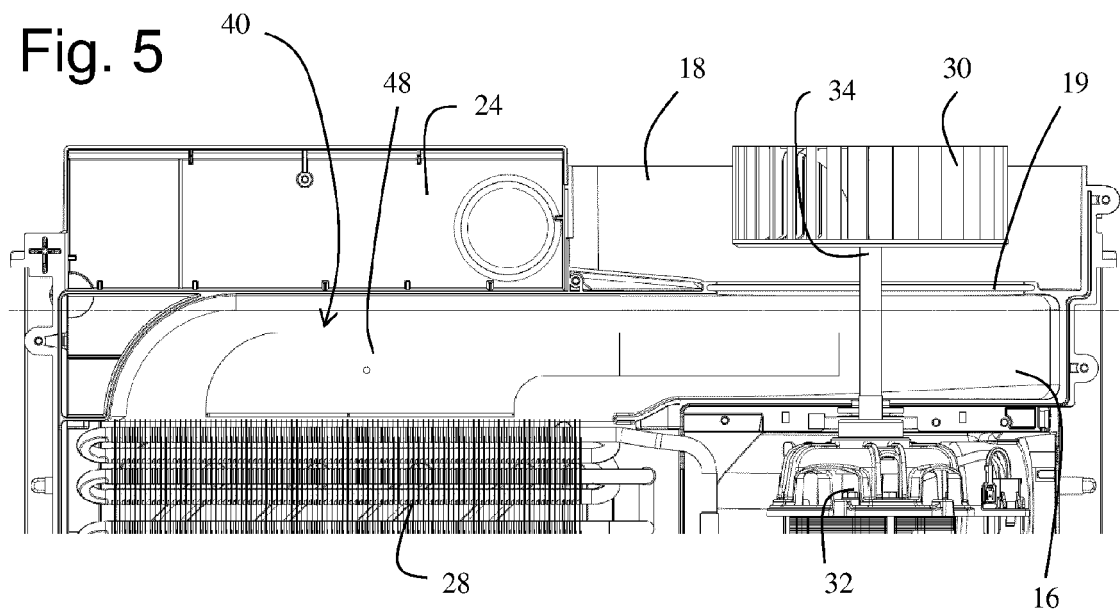


Fig. 6

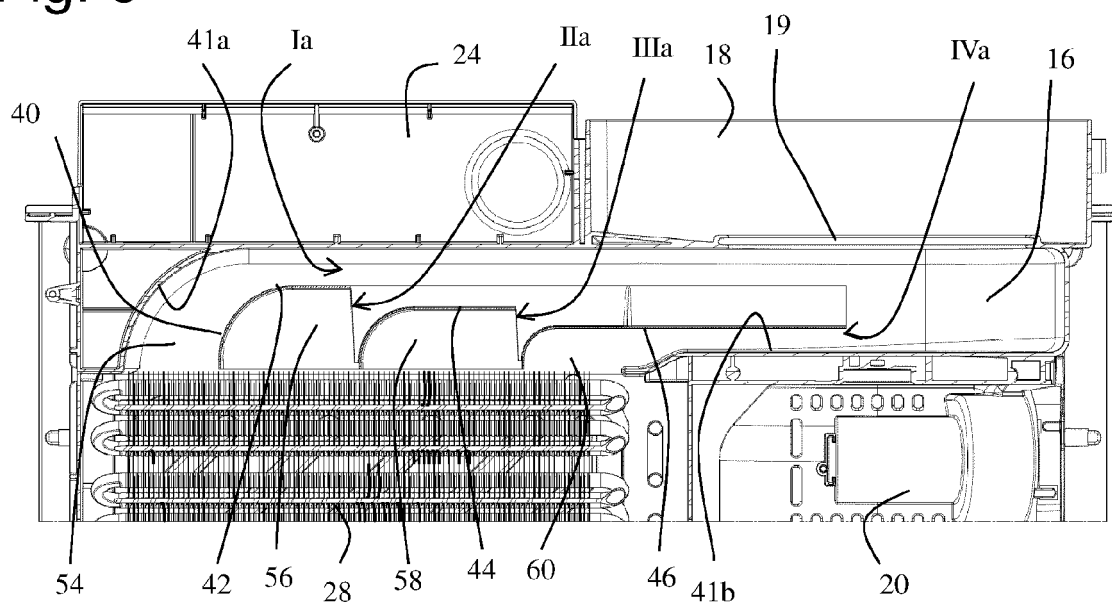
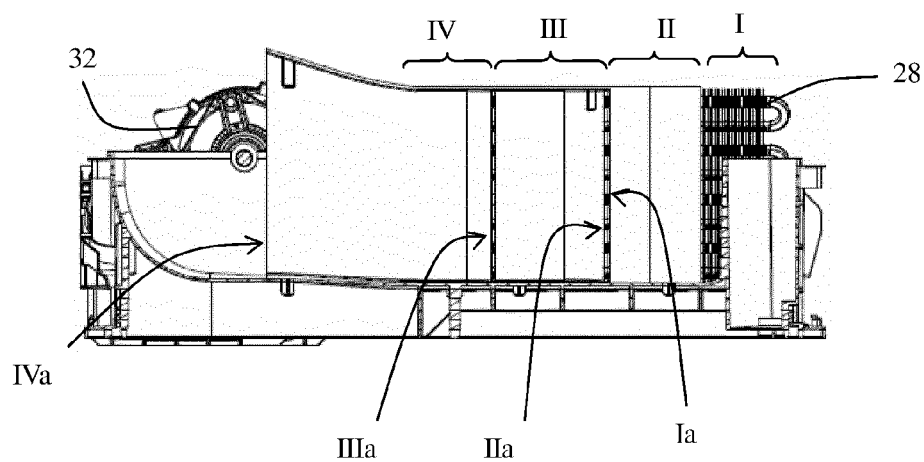


Fig. 7



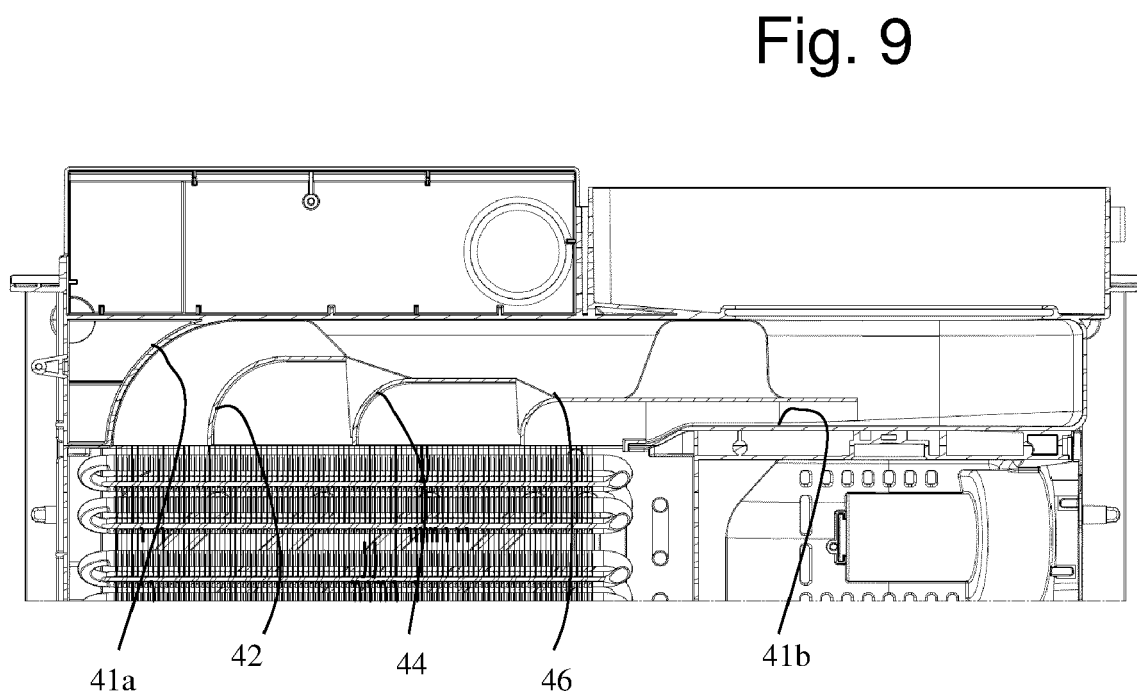
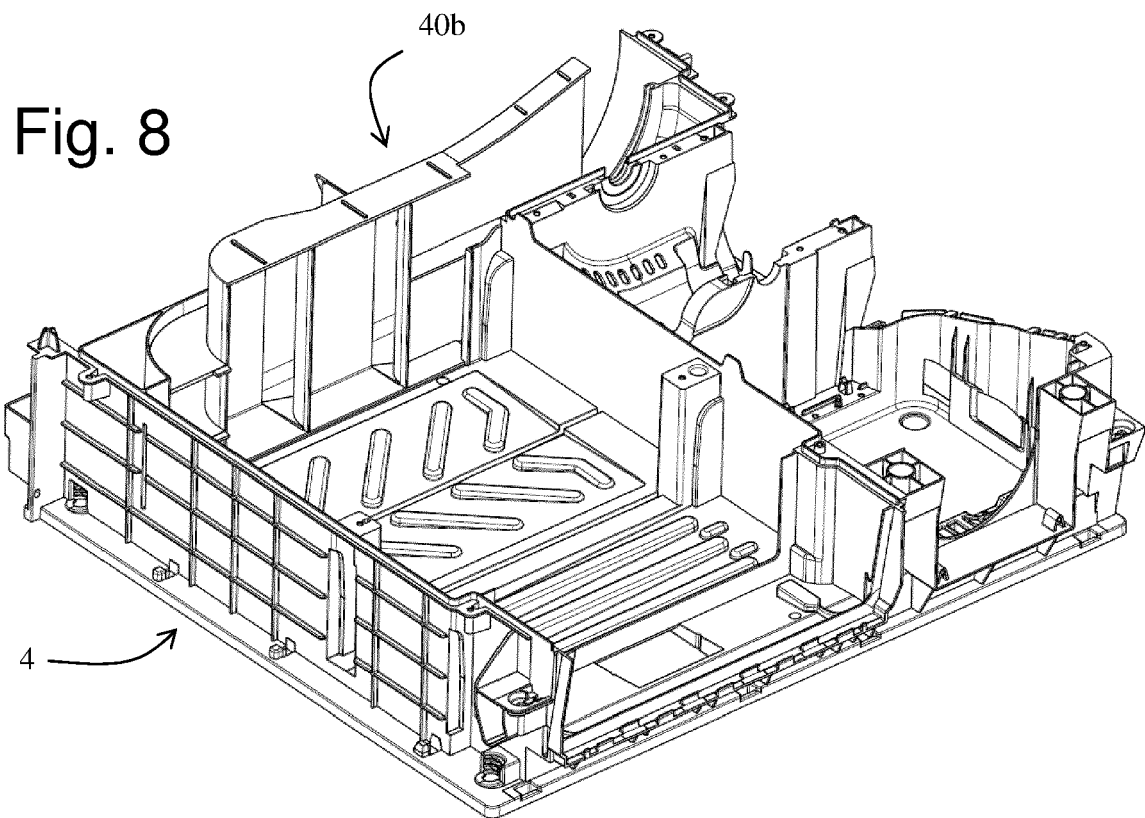


Fig. 10

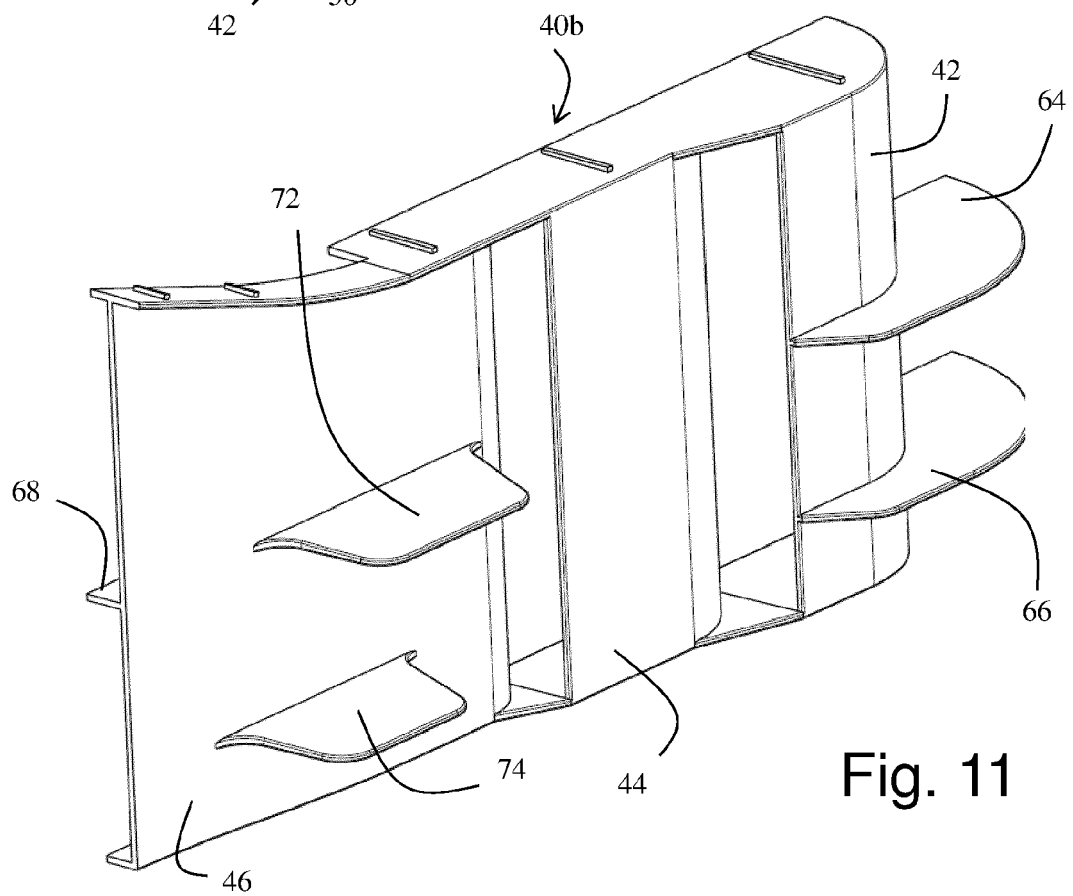
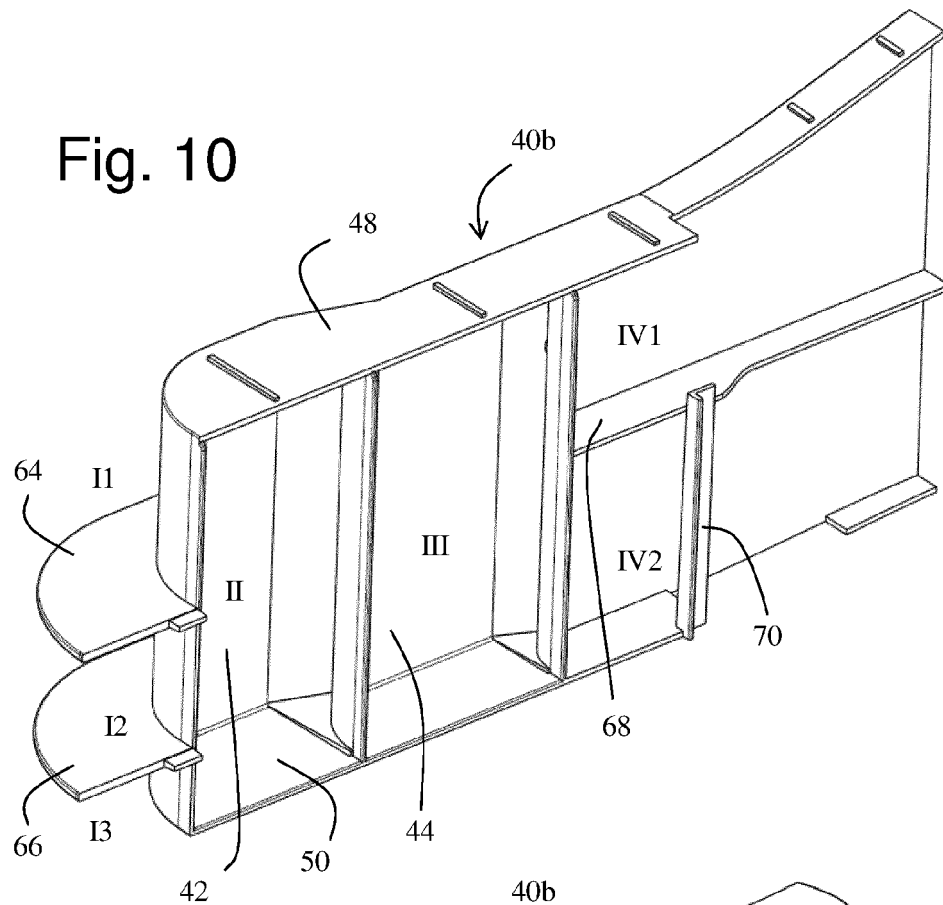


Fig. 11

Fig. 12

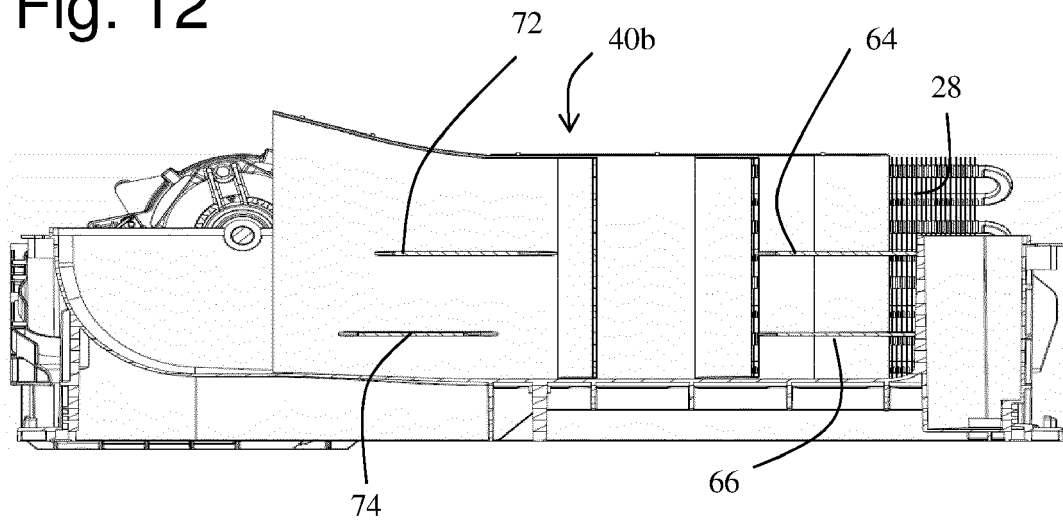
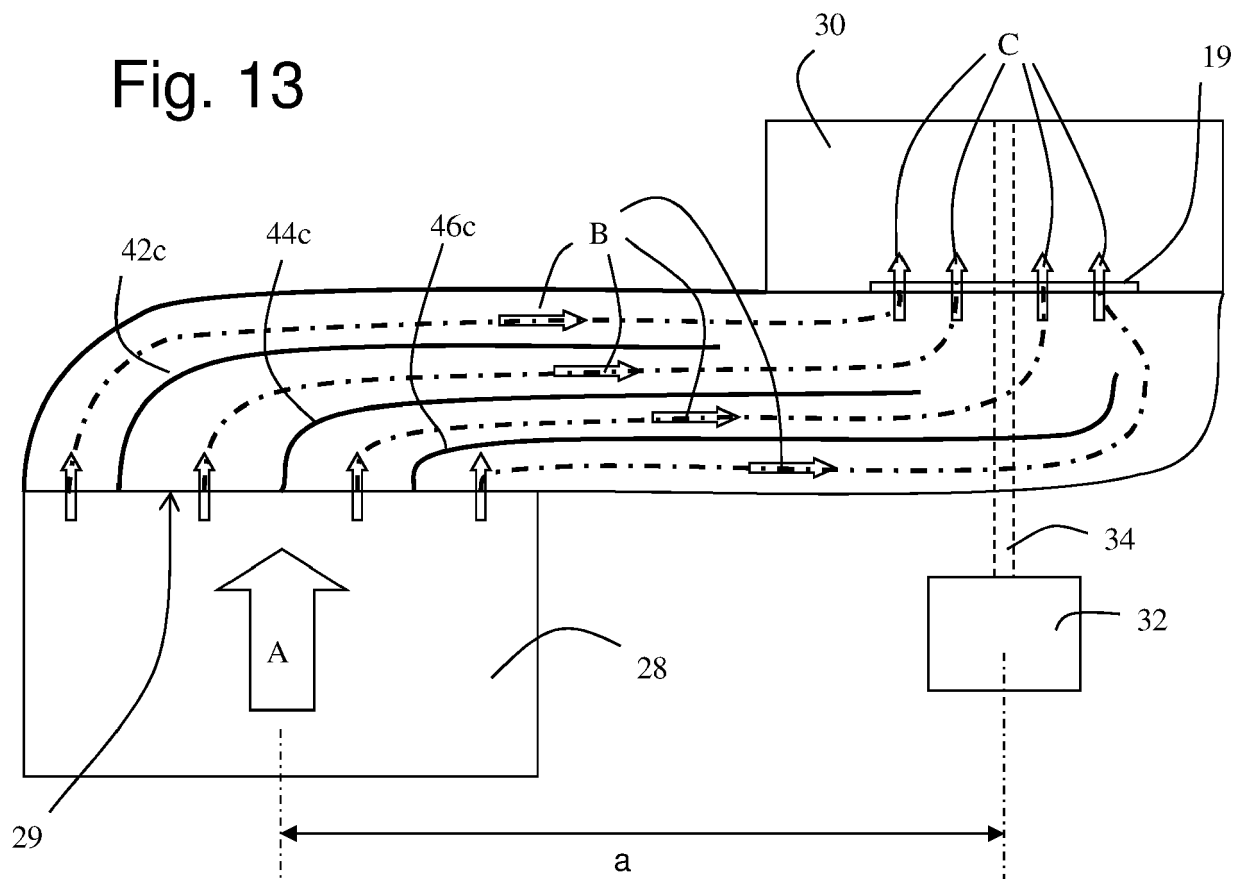


Fig. 13





EUROPEAN SEARCH REPORT

Application Number
EP 12 15 6152

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 30 July 2012	Examiner Stroppa, Giovanni
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EP 12 15 6152

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30-07-2012

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