

(19)



(11)

EP 3 511 636 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

17.07.2019 Bulletin 2019/29

(21) Application number: **19151848.9**

(22) Date of filing: **15.01.2019**

(51) Int Cl.:

F24F 1/0067 ^(2019.01)

F28D 1/047 ^(2006.01)

F28D 1/02 ^(2006.01)

F24F 13/30 ^(2006.01)

F28D 1/04 ^(2006.01)

F28F 1/32 ^(2006.01)

F24F 1/0063 ^(2019.01)

F28D 21/00 ^(2006.01)

(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**

Designated Extension States:

BA ME

Designated Validation States:

KH MA MD TN

(30) Priority: **15.01.2018 SE 1850041**

(71) Applicant: **Lindab AB**

269 82 Båstad (SE)

(72) Inventors:

• **HULTMARK, Göran**
41268 GÖTEBORG (SE)

• **DOHNAL, Miroslav**
21467 MALMÖ (SE)

(74) Representative: **Zacco Sweden AB**

P.O. Box 5581

114 85 Stockholm (SE)

(54) AIR CONDITIONING DEVICE

(57) The present invention relates to a cooling battery (1) for conditioning of air in a direction of air flow (FA) through an air channel (6) in the cooling battery comprising a first and a second air conditioning module (10, 20), wherein each module comprises a first (70A) and a sec-

ond end plate (70B), a core of one or more heat-exchange plates (70) arranged between the first and the second end plate and a channel (16, 26) for conditioning fluid (30) comprising an inlet (4) and an outlet (5).

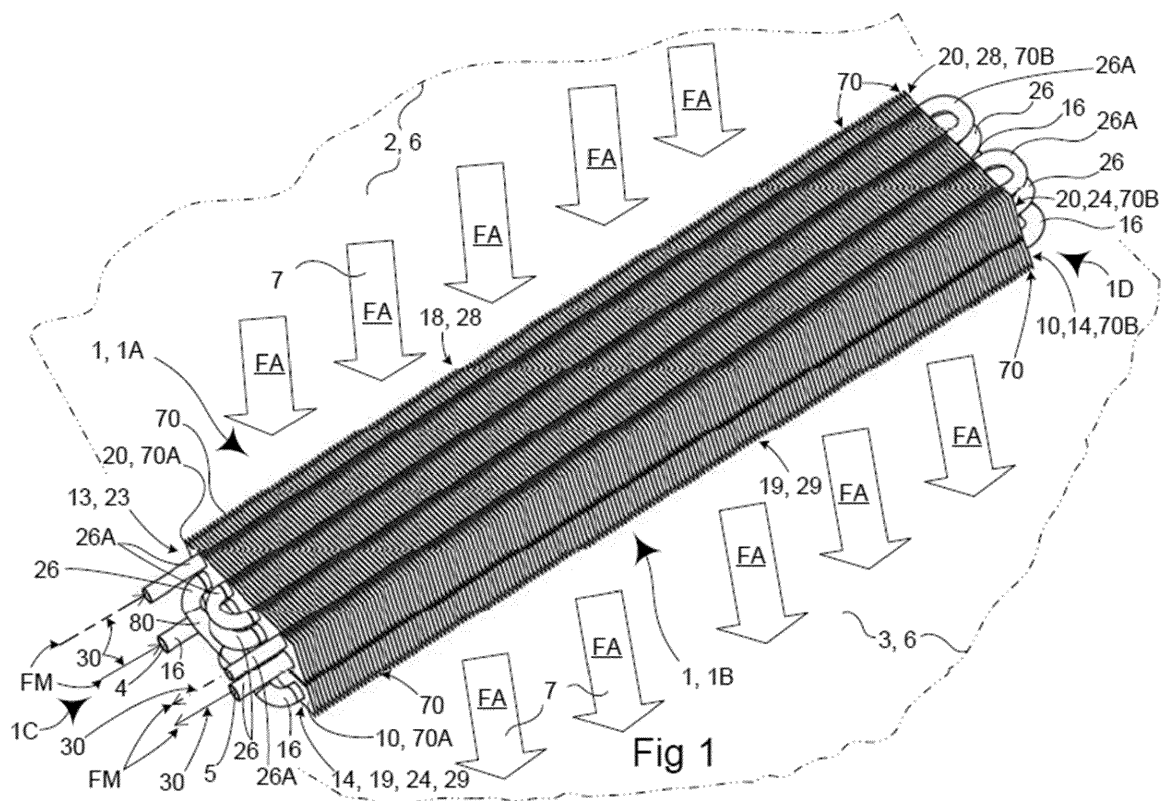


Fig 1

EP 3 511 636 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a device or system for conditioning/temperating of ventilation air by means of a cooling/heating battery.

BACKGROUND

[0002] The demand for increased energy efficiency with respect to treatment of air in dwellings and offices and industrial buildings is expected to increase in the future. At the same time there is an increase in demand for low/lower energy losses for buildings, which means that the heat requirement in dwellings and offices decreases and makes possible combined heating and ventilating systems instead of separate systems. There is also a cooling requirement in both offices and dwellings, at least during hot seasons, and future predictions also indicate a scenario of increasing temperatures locally, meaning an increased requirement for cooling of ventilation air, in particular supply air.

[0003] An example of a known air conditioning device for the above application is described in US 5 181 392. This air conditioning device is arranged to blow out hot air and comprises inter alia two parallel heat exchangers, which are connected in series and isolated thermally from one another by for example a gap. The cooling medium passes the air to be conditioned in countercurrent.

SUMMARY OF THE INVENTION

[0004] One object of the invention is to provide an air conditioning device in the form of a cooling and/or heating battery that solves or at least lessens the aforementioned problem.

[0005] Another object of the invention is to provide an air conditioning device that cools and/or heats ventilation air effectively by means of small temperature differences.

[0006] A further object of the invention is to provide an air conditioning device that cools ventilation air effectively by utilizing small temperature differences.

Yet another object of the invention is to provide an air conditioning device that cools and/or heats ventilation air effectively by means of small temperature differences with feed of a certain amount of fresh air.

[0007] A further object of the invention is to provide an air conditioning device in the form of a cooling and/or heating battery of the countercurrent type with countercurrent coupling over its entire active air receiving surface/volume/width/length, which increases its efficiency by utilizing small temperature differences during cooling and/or heating of air.

[0008] Yet another object of the invention is to provide an air conditioning device in the form of a divided cooling and/or heating battery of the countercurrent type with countercurrent coupling over its entire air receiving sur-

face/volume/width, which allows a temperature difference to develop over its entire air receiving surface/volume/width/length and therefore along the entire route of flow of the conditioning medium through the battery, which increases its efficiency by utilizing small temperature differences during cooling and/or heating of air.

[0009] Another object of the invention is to provide an air conditioning device in the form of a cooling and/or heating battery of the countercurrent type with countercurrent coupling over its entire air receiving surface/volume/width, whereby a temperature difference is produced over its entire air receiving surface/volume/width/length that increases its efficiency by utilizing small temperature differences during cooling and/or heating of air.

[0010] A further object of the invention is to provide an air conditioning device in the form of a cooling and/or heating battery of the countercurrent type with countercurrent coupling over its entire width with a temperature difference over its entire air receiving surface/volume and/or width/length and increased efficiency by utilizing small temperature differences during cooling and/or heating of air comprising a configuration with cooling medium channels through plates or laminae for heat exchange between the cooling medium and the air where at least one cooling medium channel through the plates/laminae is arranged as offset or eccentrically relative to the other cooling medium channels through the plates/laminae for better utilization of the surface area of the plates/laminae and for reducing/optimizing flow losses through the battery for both the air flowing through and the cooling medium.

[0011] Yet another object of the invention is to provide an air conditioning device in the form of a cooling and/or heating battery of the countercurrent type with countercurrent coupling over its entire width with a temperature difference over its entire air receiving surface and/or volume and/or width and increased efficiency with small temperature differences in cooling/heating of air comprising a configuration with cooling medium channels through laminae for heat exchange between cooling medium and air where at least two cooling medium channels are arranged serially/are connected in series viewed in the direction of flow of the air through the battery and arranged in line with and/or behind and/or in front of one another so that their projection/envelope surfaces substantially coincide viewed in the direction of flow of the air through the battery for reducing and/or at least optimizing air flow losses past these channels and through the battery.

[0012] Yet another object of the invention is to provide an air conditioning device in the form of a cooling and/or heating battery of the countercurrent type with countercurrent coupling over its entire width with a temperature difference over its entire air receiving surface and/or volume and/or width and increased efficiency with small temperature differences in cooling/heating of air. This battery is obtained by an arrangement with cooling me-

dium channels through plates or laminae for heat exchange between cooling medium and air where the laminae are arranged serially/are connected in series viewed in the direction of flow of the air through the battery and with the cooling medium channels arranged with the plane of their extension substantially across the air flow with an increasing number of plates/laminae per unit surface area/length/width in the battery in the downstream direction relative to the direction of air flow through the battery. This provides even more effective heat exchange and/or at least optimization of the efficiency of the battery and efficiency or heat exchange capacity the longer the air enters the battery and the closer the air is to the air outlet from the battery and the inlet of cooling medium into the battery and the longer the air is from the outlet of the cooling medium from the battery, whereby small temperature differences in the battery are utilized more effectively.

[0013] A further object of the invention is to provide an air conditioning device in the form of a cooling and/or heating battery of the countercurrent type with countercurrent coupling over its entire width with a temperature difference over its entire air receiving surface and/or volume and/or width and increased efficiency with small temperature differences in cooling/heating of air. This battery is provided in a configuration with plates/laminae for heat exchange between cooling medium in cooling medium channels and air where the laminae are arranged serially/are connected in series in modules viewed in the direction of flow of the air through the battery where the plate/lamina modules are arranged with their plane of extension substantially parallel to the air flow with increasing number of plates/laminae per unit surface area/length/width in the battery in the downstream direction relative to air flow through the battery. This is achieved by having a falling or decreasing plate/lamina width for each set of plates/laminae/modules viewed along the downstream direction of the air flow. This provides more effective heat exchange and/or at least optimization of the efficiency of the battery and efficiency or heat exchange capacity the longer air enters the battery and the closer the air comes to the air outlet from the battery and the inlet of cooling medium into the first module of the battery and the longer the air is from the outlet of the cooling medium from the battery. With this configuration according to the invention, small temperature differences in the battery are utilized more effectively, i.e. per unit length of the battery, viewed downstream in the direction of air flow. This configuration of the battery according to the invention means that the plate/lamina module with cooling medium channel that first encounters/meets the air flow has plates/laminae of greater width or length viewed in the direction of air flow and therefore also larger surface as the air "sweeps past" than the plates or laminae in the subsequent heat exchange modules viewed in the downstream direction of the air flow through the battery, which means that a greater temperature difference over the heat exchange mod-

ule "encountered" first by the air is utilized and that decreasing temperature differences over subsequent heat exchange modules are also utilized, all more effectively.

[0014] A further object of the invention is to provide an air conditioning device in the form of a cooling and/or heating battery of the countercurrent type with the cooling medium channel placed eccentrically downstream in the direction of the air flow over the plates/laminae in order to produce greater cooling.

[0015] The aforementioned effective cooling and/or heating of ventilation air by means of the battery according to the invention relates in particular to air supply but also has other applications. Where appropriate, the medium for heat exchange with the air is called conditioning fluid in the following and corresponds to a suitable cooling medium that either cools or heats the air. Moreover, the aforementioned air conditioning device is called cooling battery in the following but functions in other applications as a heating battery or a combined cooling and heating battery. Furthermore, two or more such batteries according to the invention can be used in series and/or parallel coupling depending on the desired heating and/or cooling requirement.

[0016] One or more of the above objects are achieved by means of a cooling battery according to the appended independent claims, with preferred variants defined in the dependent claims.

[0017] One aspect of the invention relates to a cooling battery for conditioning of air in a direction of air flow through an air channel comprising at least one first and one second air conditioning module. Each module comprises a first and a second end plate, a core of one or more heat-exchange plates arranged between the first and the second end plate and a channel for conditioning fluid comprising inlet and outlet, wherein the respective heat-exchange plate and end plate have a first, a second, a third and a fourth end, wherein the first end is arranged opposite the second end and the third end is arranged opposite the fourth end, wherein the first plate end and the second plate end are arranged substantially parallel to the direction of air flow, wherein the third plate end and the fourth plate end are arranged substantially perpendicular to the direction of air flow, wherein the fluid channel extends to and fro between the first and the second end plate substantially perpendicular to the heat-exchange plates in the core and the direction of air flow and from the first to the second end of the heat-exchange plates, wherein the first air conditioning module is placed downstream of the second air conditioning module in the direction of air flow, and wherein the first plate end and the second plate end in the first air conditioning module is shorter than the first plate end and the second plate end in the second air conditioning module. This results in a cooling battery with a larger and a smaller air conditioning module, with respect to the width of the modules in the direction of air flow. The larger air conditioning module is the module that is the first to come into contact with the air flow and therefore affects the air temperature first.

[0018] According to one aspect, the direction of air flow through the whole cooling battery is directed substantially opposite to or is directed opposite to the direction of flow of the conditioning fluid flowing through the cooling battery. This results in countercurrent coupling in the cooling battery between the air flow and the direction of flow of the conditioning fluid, which is an effective way of affecting the air temperature even with small temperature differences.

[0019] According to one aspect, at least the second air conditioning module further comprises a row of openings arranged for flow of conditioning fluid that heats the air through the cooling battery. This results in a cooling battery that can both cool and heat the air flow without having to alter the cooling battery, for example by changing the conditioning fluid.

[0020] According to one aspect, the first and the second air conditioning modules are arranged in the air channel with the first and the third plate end of the first and the second end plate in a respective air conditioning module arranged in the same direction so that the fluid channel extends to and fro between the first and the second end plate in a corresponding manner in the first and the second air conditioning modules. This results in countercurrent coupling over the full width of the air conditioning module, which means that the cooling battery has good efficiency even with small temperature differences over the whole width.

[0021] According to one aspect, the inlet of the fluid channel is arranged at the first end of the first or the second end plate and the outlet of the fluid channel is arranged at the second end of the first or the second end plate, wherein the inlet in the first air conditioning module is arranged to be connected to a flow source in order to receive a flow of conditioning fluid, and the outlet in the first air conditioning module is connected fluidically to the inlet in the second air conditioning module.

[0022] According to one aspect, the cooling battery comprises a connection side that extends between its first and second end at least between the first and second ends of each end plate, said connection side comprising a main inlet for conditioning fluid corresponding to the inlet to the first air conditioning module and to the fluid channel and/or a main outlet for conditioning fluid corresponding to the outlet from the second air conditioning module and from the fluid channel.

[0023] According to one aspect, each end plate comprises at least one opening nearest the first plate end that forms an inlet for inflow of conditioning fluid to each module.

[0024] According to one aspect, each end plate comprises at least one opening nearest the second plate end that forms an outlet for outflow of conditioning fluid from each module.

[0025] According to one aspect, the main inlet of conditioning fluid is arranged nearest the first end of the cooling battery and the main outlet of conditioning fluid is arranged nearest its other end.

[0026] According to one aspect, each end plate comprises openings, each of said openings nearest the first plate end coinciding with each inlet for inflow of conditioning fluid into each module.

5 **[0027]** According to one aspect, each end plate comprises openings, each of said openings nearest the second plate end coinciding with each outlet for outflow of conditioning fluid from each module.

10 **[0028]** According to one aspect, each plate comprises openings and each opening in each plate in the first air conditioning module coincides with each opening in each plate in the second air conditioning module viewed in the direction of air flow.

15 **[0029]** According to one aspect, the openings in at least one air conditioning module are arranged for flow of conditioning fluid that cools the air through the cooling battery.

20 **[0030]** According to one aspect, at least one or more air conditioning modules are placed between the first air conditioning module and the second air conditioning module. This results in a cooling battery that can be adapted to the volumes that it is to condition by increasing or reducing the number of air conditioning modules from 2 and upwards.

25 **[0031]** According to one aspect, each air conditioning module comprises two or more stacked plates, wherein each plate comprises two or more rows of openings, which are separated by one or more first thermal separators, and are connected materially. This results in several modules from one and the same plate at the same time as the various modules are isolated and function as two separate modules.

30 **[0032]** According to one aspect, at least one other thermal separator is arranged between each module opening and extends substantially perpendicularly or perpendicularly to each first thermal separator. This prevents heat being propagated in the direction of the module's width, resulting in improved efficiency of the cooling battery and also meaning that it can function with small temperature differences.

35 **[0033]** According to one aspect, each air conditioning module comprises two or more stacked plates and each plate comprises at least one row of openings positioned eccentrically on the plate. The fact that the openings are positioned eccentrically means that the temperature differences between the air flow and the cooling battery become relatively large even when the air cools down somewhat. This gives better efficiency for the cooling battery.

40 **[0034]** According to one aspect, the channel for conditioning fluid that cools the air through the cooling battery in the second air conditioning module is arranged downstream in the direction of air flow in relation to the openings that are arranged for flow of conditioning fluid that heats the air through the cooling battery. The fact that the channels are arranged eccentrically on the plate means that the temperature differences between the air flow and the cooling battery become relatively large even

when the air cools down somewhat. This gives better efficiency for the cooling battery both when it cools and when it heats the air flow.

[0035] According to one aspect, the channel for conditioning fluid that cools the air through the cooling battery in the second air conditioning module is arranged eccentrically in the direction of air flow downstream over the plates, which gives corresponding effects as above.

[0036] According to one aspect, the cooling battery comprises several air conditioning modules per unit length of the cooling battery, longer downstream viewed in the direction of air flow than the corresponding number of air conditioning modules upstream per unit length of the cooling battery. This results in a cooling battery with higher efficiency when the larger modules are arranged to come into contact with the air flow first.

DESCRIPTION OF THE FIGURES

[0037] The invention will be described in more detail below, referring to the appended figures, shown as examples of existing preferred embodiments of the invention.

Fig. 1 is a perspective view of an air conditioning device according to one embodiment of the invention.

Fig. 2 is an enlarged perspective view of one end of the air conditioning device according to Fig. 1 according to one embodiment of the invention.

Fig. 3 is an enlarged perspective view of the other end of the air conditioning device in Fig. 1 according to one embodiment of the invention.

Fig. 4 shows a plan view from the side of the air conditioning device in Fig. 1 according to one embodiment of the invention.

Fig. 5 shows a plan view from above of the air conditioning device in Figs. 1 and 4 according to one embodiment of the invention.

Fig. 4A shows a plan view from above of the air conditioning device according to another embodiment of the invention.

Fig. 5A shows a plan view from above of the air conditioning device according to another embodiment of the invention.

Fig. 6 shows a plan view from the side of a component part of the air conditioning device according to one embodiment of the invention.

Fig. 7 shows an upper plan view from above of the component part of the air conditioning device in Fig.

6 and, in an intermediate plan view, a cross-section along line AA-AA of the same part and, in a bottom plan view, a cross-section along line Y-Y of the same part.

Figs. 8, 10, 11 and 11A show plan views of the end of the air conditioning device in Figs. 1 and 2 in various embodiments of the invention.

Fig. 9 shows a plan view of the other end of the air conditioning device according to Figs. 1 and 3 in one embodiment of the invention.

Figs. 12 to 15 show enlarged plan views from the side of details of the component part of the air conditioning device in Fig. 6 according to marks AJ, AH, V and W in Fig. 6.

DESCRIPTION OF EMBODIMENTS

[0038] The present invention shown in Figs. 1- 15 relates to a device for conditioning, i.e. tempering of ventilation air 7 by means of a cooling and/or heating battery 1 (hereinafter described as a cooling battery 1 even if it can both cool and heat the air) as a ventilation unit of the countercurrent type. The cooling battery 1 comprises series-connected pipe coils 16, 26, 46 provided with laminae/plates for a cooling medium 30 (see Figs. 10, 11 and 11A) that extend through openings 15, 15A, 15B, 25, 25A, 25B, 45, 45A, 45B in the laminae/plates. The ventilation air 7 is treated, i.e. is cooled or heated, but is preferably cooled via the cooling battery 1 in at least two steps, i.e. at least by a first pipe coil 26 placed upstream in the direction of the air flow FA and then by at least one second pipe coil 16 placed downstream in the direction of the air flow FA after the first pipe coil, before the ventilation air 7 is led out of the battery, see Figs. 10 and 11.

[0039] The cooling battery 1 is arranged for conditioning air 7 in a direction of air flow FA through an air channel 6. The cooling battery comprises at least one first and one second air conditioning module 10, 20, 40. Each module 10, 20, 40 comprises a first 70A and a second end plate 70B, a core of one or more heat-exchange plates 70 arranged between the first and the second end plate and a channel 16, 26, 26A, 46 for conditioning fluid 30 comprising an inlet 4 and an outlet 5.

[0040] Heat-exchange plate 70 and end plate 70A, 70B have a first end 13, 23, a second end 14, 24, a third end 18, 28 and a fourth end 19, 29. The first end is arranged opposite the second end and the third end is arranged opposite the fourth end. The first plate end 13, 23 and the second plate end 14, 24 are arranged substantially parallel to the direction of air flow FA. The third plate end 18, 28 and the fourth plate end 19, 29 are arranged substantially perpendicular to the direction of air flow FA. The fluid channel 16, 26, 26A, 46 extends to and fro between the first and the second end plate 70A, 70B sub-

stantially perpendicular to the heat-exchange plates 70 in the core and the direction of air flow FA and from the first 13, 23 to the second end 14, 24 of the heat-exchange plates. The first air conditioning module 10 is placed downstream of the second air conditioning module 20, 40 in the direction of air flow FA. The first plate end 13 and the second plate end 14 in the first air conditioning module 10 are shorter than the first plate end 23 and the second plate end 24 in the second air conditioning module 20, 40, i.e. the second air conditioning module is wider than the first air conditioning module. The plates in the second air conditioning module are wider than the plates in the first air conditioning module.

[0041] According to one aspect, the direction of air flow FA through the whole cooling battery 1 is directed substantially opposite to or is directed opposite to the direction of flow FM of the flow of conditioning fluid 30 through the cooling battery 1 in order to produce countercurrent coupling.

[0042] Fig. 11A shows three pipe coils 16, 26, 46 where the third pipe coil 46 is a pipe coil located between the first 26 and the second pipe coil 16 that extends through openings in the plate 45, 45A, 45B mainly according to the same principle as in Figs. 10 and 11. The cooling medium 30 is led or flows in a direction FM (shown with arrows inside and outside the pipe, in certain cases with dashed arrows and in certain cases with continuous arrows) via a main/primary inlet 4 into the cooling battery 1 and through the whole cooling battery to a main/primary outlet 5 out of the cooling battery that is mainly or substantially opposite the direction of air flow FA. This is shown inter alia in Figs. 8 and 10-11A in that the main outlet 5 of the cooling medium out of the cooling battery 1 is placed nearest the air inlet 2 and in that the main inlet 4 of the cooling medium into the cooling battery 1 is placed nearest the air outlet 3. In certain aspects the cooling battery 1 comprises series-connected pipe coils 26A provided with laminae, that extend through openings in the plate 17, 17A, 17B, 27, 27A, 27B for the cooling medium 30 for the purpose of heating the ventilation air 7 (see Figs. 1-9 and 12-13) besides the pipe coils 16, 26 and 46, whose preferred purpose is air cooling.

[0043] The flow source for the cooling medium 30 is a suitable pump/compressor, depending on the properties of the medium or fluid, which brings about its flow through the pipe coils of the battery but is not shown in the figures as such a flow source is elementary knowledge for a person skilled in the art, the same applies to other equipment, e.g. air dampers, valves, measuring devices, control units, power supply and moreover air channels 6 and/or external pipework and other components, including for the cooling medium 30, that are needed for normal operation of the cooling battery 1 when treating ventilation air 7 and are not explained in more detail.

[0044] The aforementioned pipe coils 16, 26, 26A, 46 are arranged to be run through each of the modules 10, 20, 40 separately and/or integrated with one another formed by stacked plates 70, 70A, 70B made of sheet

metal that form so-called laminae in this type of cooling battery. The laminae/plates 70, 70A, 70B are placed side by side and flat against one another with a space between them so that the air 7 can flow past them across the plane of extension of the laminae/plates. The air flows in an air channel 6 that is formed by the plates 70, 70A, 70B through the battery.

[0045] Fig. 1 illustrates the cooling battery according to the invention. The cooling battery 1 is included in ventilation systems of a commonly occurring type in various properties, which comprises a ventilation channel 6 with inlet 2 and outlet 3 for the air 7, with a number of ventilation dampers (not shown) connected to said channel. The ventilation damper may be arranged in various positions along the ventilation channel 6 in which an air flow 7 flows. Ventilation channel 6 in Figs. 1, 2 and 3 may have one or a number of branches to which one or more ventilation dampers and air distributors (not shown) may be connected. The ventilation system usually comprises a blower (not shown). The blower is arranged to generate a pressure in the ventilation system, so that forced ventilation may be obtained. The ventilation system with cooling battery 1 according to the invention may be installed in properties, e.g. in dwellings, and the ventilation channel 6 may extend over several different spaces for ventilation of these spaces. It may be ingoing air ventilation or exhaust air ventilation or used air ventilation, i.e. air ventilation between different rooms and/or properties.

[0046] The cooling battery 1 has a main function of conditioning/temperating the ventilation air 7 by cooling and/or heating the air. The cooling battery 1 is a so-called battery for treating air in a direction of air flow FA through one or more air channels 6 in and/or through the battery. The battery 1 is a cooling and/or heating battery 1 divided functionally and/or thermally and/or physically into at least two, three or more parts or modules 10, 20, 40 as a ventilation unit of the countercurrent type.

[0047] The cooling battery 1 comprises at least one channel 16, 26, 26A, 46 provided with laminae, in the form of at least one pipe coil for the cooling medium 30. The channel 16, 26, 26A, 46, i.e. the pipe coil 16, 26, 26A, 46 is formed by one or more channels or pipes that are connected in series to a continuous, sealed pipe coil through which the cooling medium 30 flows along the whole battery 1. The pipe coils 16, 26, 26A, 46 are arranged above one another in the vertical direction and/or after/beside one another in the horizontal direction depending on the application/orientation of the battery, e.g. if it is positioned lying or standing on end or obliquely, the orientation of the battery in the figures may be considered to be lying when the battery has a smaller height than width but may also be placed upright, i.e. with a greater height than width in the figures but this is irrelevant for the invention, the dimensions also depend on how many modules 10, 20, 40 the battery 1 consists of. The pipe coils 16, 26, 26A, 46 are connected together fluidically via pipes 80 between the respective outlet on

one module 10 and the inlet on the next module 20 or 40 for cooling medium 30.

[0048] Figs. 1 to 5 show an aspect of the cooling battery 1 according to the invention with the pipe coils 16, 26, 26A, 46 connected together fluidically via pipes 80 between the respective outlet 12 on the first module 10 and the inlet 21 on the next module 20 or 40 for the cooling medium 30 with pipes 80 and the main inlet 4 and the main outlet 5 for the cooling medium 30 on the same side or end or the connection side 1C of the cooling battery, i.e. on the left in Figs. 1-3 with the air flow FA and the air 7 flowing in from the top of the cooling battery and on the right in Figs. 4-5 with the air flow FA and the air 7 flowing in from the underside of the cooling battery. In Figs. 1-5 there are pipes 80 on end 1D of the cooling battery 1 opposite its connection side 1C.

[0049] Figs. 4A and 5A show an aspect of the cooling battery 1 according to the invention comprising the pipe coils 16, 26, 26A, 46 connected together fluidically via pipes 80 between the respective outlet 12 on the first module 10 and the inlet 21 on the next module 20 or 40 for the cooling medium 30 but on the opposite side 1D instead of on the connection side 1C as in Figs. 1-5. Here, pipes 80 are also on the other side 1D so that the inlet 11 of the first module is on the connection side 1C but its outlet 12 is on the opposite end 1D and the inlet 21 of the second module 20 is on the opposite end 1D while its outlet 22 is on the connection side 1C. Accordingly the main inlet 4 and the main outlet 5 for the cooling medium 30 and the pipe 80 that connects the modules 10 and 20 together are arranged on different sides or ends 1C and 1D of the cooling battery. The pipe 80 that conveys the cooling medium 30 from the first module 10 to the next module 20, 40 is on the left in Figs. 4A and 5A on the opposite end 1D in relation to the connection side 1C while the main inlet 4 and the main outlet 5 for the cooling medium 30 are arranged on the other end of the cooling battery 1, i.e. on the connection side 1C on the right in Figs. 4A and 5A just as in Figs. 4 and 5.

[0050] In partial sections nearer the middle of the cooling battery 1 in Figs. 4 and 4A and in the lower parts thereof in Figs. 5 and 5A, it is shown in which directions FM the cooling medium 30 flows in the pipe coils 16, 26 and/or 26A (the pipe coils 26A in Figs. 4 and 5 (absent in Figs. 4A and 5A) are intended for warming the air 7 and are optional, i.e. it is not necessary to equip the battery with them, but it is beneficial in certain aspects of the invention). The direction of flow FM for the cooling medium 30 in the heating coil 26A may flow in either of two opposite directions shown with a dashed two-way arrow in Fig. 4. The directions of flow FM for the cooling medium 30 in the at least two necessary pipe coils 16 and 26 in the cooling battery 1 are the same in Figs. 4 and 5 and are shown with dashed arrows pointing to the right, i.e. pointing towards the connection side 1C in the cooling battery 1, i.e. the cooling medium 30 in the pipe coils 16, 26 of both modules 10 and 20 nearest the lower part of the cooling battery 1 in Fig. 5, i.e. for the cut-out

part shown, flows in a direction towards the connection side 1C. The directions of flow FM for the cooling medium 30 in the at least two necessary pipe coils 16 and 26 in the cooling battery 1 are however in the opposite direction in Figs. 4A and 5A and are shown with dashed arrows pointing to the left in the first module 10 with the pipe coil 16, i.e. pointing towards the side 1D opposite the connection side 1C of the cooling battery, so that the cooling medium 30 flows from right to left in Fig. 4A, i.e. from the connection side 1C in pipe coil 16 nearest the lower part of the cooling battery 1 in Fig. 5A, i.e. in the cut-out part shown, while the flow of cooling medium in the second module 20 with the pipe coil 26 flows from left to right in Fig. 4A, i.e. flows towards the connection side 1C in pipe coil 26 nearest the lower part of the cooling battery 1 in Fig. 5A, i.e. in the cut-out part shown.

[0051] The laminae that surround the coils are formed of plates or sheets 70, 70A, 70B. The plates 70, 70A, 70B are either completely separate from one another in the vertical direction, i.e. separated by an air gap 50, 60 (see Figs. 10-11A for physically completely separate plates with separator 60 and Figs. 8-9, 12-15 for at least partially separate plates with grooves/slots 50), or consist of a common lamina/sheet with openings/holes 15, 15A, 15B, 25, 25A, 25B, 27, 45, 45A, 45B, which reduce the common plate surface area (Figs. 8, 9, 12-15). The openings 15, 15A, 15B, 25, 25A, 25B, 17, 17A, 17B, 27, 27A, 27B, 45, 45A, 45B may be punched from each plate/sheet or formed therein in some other way.

[0052] Figs. 12 to 15 show enlargements of some aspects of the cooling battery 1 with different configurations of thermal separators 50, 60 according to marks AJ, AH, V and W in Fig. 6. In Fig. 15 corresponding marking AJ in Fig. 6 shows a first thermal separator 50 that extends substantially parallel to the first 13, 23 and the second ends 14, 24 of plates 70, 70A, 70B between a row of openings for distinguishing them with the aim of reducing heat transfer between openings and associated pipe coils in a direction in the plane of extension of each module and substantially perpendicular to the direction of air flow FA. In Fig. 15, however, the openings of the plates are not completely separated purely physically but are at least partially connected materially. In a further aspect of the cooling battery 1, each air conditioning module 10, 20, 40 comprises two or more stacked plates 70, 70A, 70B, wherein each plate comprises two or more rows of openings 15, 15A, 15B, 25, 25A, 25B, 45, 45A, 45B, 17, 27, which are separated by one or more first thermal separators 50 or 60. However, each opening is at least partly connected materially with at least one further opening since the plate is in principle only provided with grooves or slots that go through its sheet or part material in the plate with thermal insulating properties that forms the thermal separators 50, 60. A second separator 60 extends substantially perpendicularly or perpendicularly to the first 13, 23 and the second ends 14, 24 of the plates 70, 70A, 70B between a row of openings for distinguishing them with the aim of reducing heat transfer between

openings and associated pipe coils in a direction substantially transverse to the plane of extension of each module and substantially parallel to the direction of air flow FA. In yet another aspect of the cooling battery 1, at least one first thermal separator 50 is arranged between each module opening and extends substantially perpendicularly or perpendicularly to each second thermal separator 60.

[0053] The air 7 is cooled and/or heated in at least two steps through the battery 1 before the air is led out through the battery. The direction of air flow through the battery 1 is visualized with arrows and the designation FA in Figs. 1, 2, 3, 4, 4A, 8-11A, among others. The air 7 is cooled or heated first by a pipe coil 26 or 26A placed upstream in the direction of the air flow FA with plates 70-70B and is then cooled or heated further by a second pipe coil 16 or 46 placed downstream in the direction of the air flow FA after the first pipe coil 26 or 26A. In operation, the battery 1 comprises a cooling medium 30 that flows into the battery in a mainly/substantially opposite direction FM to the direction of air flow FA. The cooling medium 30 flows into a first end 1A of the battery 1 and out of the battery through its other end 1B that is placed upstream of the first end 1A of the battery viewed in the direction of air flow FA.

[0054] The cooling battery 1 comprises at least one first and one second air conditioning module 10, 20. The cooling battery 1 comprises at least one first air conditioning module 10, a second air conditioning module 20 and a third air conditioning module 40. The third or more air conditioning modules 40 may be arranged between the first air conditioning module 10 and the second air conditioning module 20. The two- or three- or multi-step cooling of the cooling battery 1 or alternatively two- or three- or multi-step cooling and two- or three- or multi-step heating takes place by means of either the first air conditioning module 10 or the second air conditioning module 20 or by the interaction of both modules or by means of either the first air conditioning module 10 or the second air conditioning module 20 or the third or more air conditioning modules 40 or by the interaction of the three or more air conditioning modules. The first air conditioning module 10 may either heat or cool the air 7. The second air conditioning module 20 may either heat or cool the air 7. The further/third air conditioning module 40 may either heat or cool the air 7. The air channel 6 comprises a first end with an inlet 2 for the air 7 and a second end with an outlet 3 for the air. The air conditioning modules 10, 20, 40 extend in their plane, usually mainly perpendicularly/orthogonally/at an angle to the direction of air flow FA or perpendicularly/orthogonally/at an angle to the direction of air flow FA.

[0055] Each module 10, 20, 40 comprises at least one plate 70-70B with a width b, b', B (defined as extending mainly/substantially parallel to or parallel to the direction of air flow FA) comprising at least one row of openings 15-15B, 25-25B, 17, 17A, 17B, 27, 27A, 27B, 45, 45A, 45B, all of which are arranged so as to allow/admit flow

of cooling medium 30 in the direction FM, which is the same in each module from the same one end in a direction towards the same second end of the cooling battery 1. Each module 10, 20, 40 comprises at least one plate 70-70B comprising at least one row of openings 15-15B, 25-25B, 17, 17A, 17B, 27, 27A, 27B, 45, 45A, 45B through which the pipes 16, 26, 26A, 46 are run, said pipes being in thermal contact with the openings. This means that the laminae, i.e. the plates 70-70B allow heat exchange between the cooling medium 30 that flows through the pipes and between the plates. The flow of cooling medium 30 in the direction FM through the pipes 16, 26, 26A, 46 may be the same in each module 10, 20, 40 or the flow of cooling medium 30 in the direction FM through pipe 16 in the first module 10 may be at least partially directed opposite the flow of cooling medium 30 in the direction FM through pipe 26 in the second module 20 or the flow of cooling medium 30 in the direction FM through pipe 16 in the first module 10 may be at least partially directed opposite the flow of cooling medium 30 in the direction FM through pipe 26 in the second module 20 or may be at least partially directed opposite the flow of cooling medium 30 in the direction FM through pipe 46 in further modules 40 or the third module 40. The basic principle is that the cooling medium 30 flows through the whole battery 1 in the direction from its main inlet 4 in the same end 1C of the cooling battery 1 to its main outlet 5 and out of the same end 1C of the cooling battery.

[0056] Either modules 10 or 20 or 40 are arranged with a further row of openings 17, 17A, 17B, 27, 27A, 27B in their plates 70-70B in addition to the first row of openings 15-15B or 25-25B or 45-45B where the cooling medium 30 is arranged so as to flow in another channel 26A with the aim of heating, i.e. not cooling the air 7. Both modules 10 and 20 may optionally comprise this further row of openings 17-17B, 27-27B in their plates 70-70B in addition to their first row of openings 15-15B or 25-25B where the cooling medium 30 is arranged so as to flow in the further channel 26A for heating and not cooling the air 7 (see Figs. 6, 7, 12, 13). At least two or more or all the modules 10, 20 and 40 may comprise a further row of openings 17-17B, 27-27B in their plates 70-70B in addition to their first row of openings 15-15B or 25-25B or 45-45B where the cooling medium 30 is arranged so as to flow in the further channel 26A for heating and not cooling the air 7. The flow of cooling medium 30 in the direction FM through pipe 26A for air heating may be the same in each module 10, 20, 40 or the flow of cooling medium 30 in the direction FM through pipe 26A in the first module 10 may be at least partially directed opposite the flow of cooling medium 30 in the direction FM through pipe 26A in the second module 20 and/or may be at least partially directed opposite the flow of cooling medium 30 in the direction FM through pipe 26A in the further or third module 40 for warming the air 7.

[0057] Each module 10, 20 and 40 has a plate 70A, 70B in each end. Each module 10, 20 and 40 has a plate 70A, 70B in each end and at least one plate 70 between

its end plates. Each end plate 70A, 70B in the battery 1 according to one embodiment is arranged in such a way that openings of each said openings 15A, 25A, 45A nearest the first plate end 13, 23 coincide with each inlet 4, 11, 21, 41 for inflow of conditioning fluid 30 into each module 10, 20, 40. Each end plate 70A, 70B in the battery 1 according to one embodiment (Figs. 6, 7, 12) is arranged so that each opening 15A, 25A, 45A nearest the first plate end 13, 23 has a central axis that coincides with the central axis for each inlet 4, 11, 21, 41 for inflow of cooling fluid 30 into each module 10, 20, 40.

[0058] Each end plate 70A, 70B in the battery 1 may have a form that is the same as the plates 70 between the end plates 70A, 70B.

[0059] According to one embodiment (Figs. 6, 7, 12, 13), each end plate 70A, 70B in the battery 1 is arranged so that openings, of which each opening 15B, 25B, 45B nearest the second plate end 14, 24 coincides with each outlet 5, 12, 22, 42 for outflow of cooling fluid 30 from each module 10, 20, 40. According to another embodiment, each end plate 70A, 70B in the battery 1 is arranged with openings, of which each opening 15B, 25B, 45B nearest the second plate end 14, 24 has a central axis that coincides with the central axis for each outlet 5, 12, 22, 42 for outflow of cooling fluid 30 from each module 10, 20, 40.

[0060] Each plate 70, 70A, 70B in the battery 1 according to one embodiment (Figs. 6, 7, 12, 13) comprises each opening 15, 15A, 15B in each plate in the first air conditioning module 10 coinciding with each opening 25, 25A, 25B in each plate in the second air conditioning module 20 viewed in the direction of air flow FA and/or forming a row of openings that runs substantially parallel to or parallel to each first plate end 13, 23 and/or second plate end 14, 24 and/or runs substantially perpendicular to or perpendicular to the third plate end 18, 28 and/or the fourth plate end 19, 29 of each plate. According to another aspect (Figs. 6, 7, 12, 13), each plate 70, 70A, 70B in the battery 1 comprises each opening 15, 15A, 15B for cooling medium and each opening 17, 17A, 17B for heating medium 30 in each plate in the first air conditioning module 10 and each opening 25, 25A, 25B for cooling medium 30 and each opening 27, 27A, 27B in each plate in the second air conditioning module 20 coinciding and/or forming a row of openings that runs substantially parallel to or parallel to each first plate end 13, 23 and/or second plate end 14, 24 and/or runs substantially perpendicular to or perpendicular to the third plate end 18, 28 and/or fourth plate end 19, 29 of each plate. According to a further embodiment (Figs. 6, 7, 12, 13), each plate 70, 70A, 70B in the battery 1 comprises each opening 15, 15A, 15B in each plate in the first air conditioning module 10 and/or each opening 25, 25A, 25B in each plate in the second air conditioning module 20 viewed in the direction of air flow FA coinciding with each opening 45, 45A, 45B in the further/third air conditioning module 40 and/or forming a row of openings that runs substantially parallel to or parallel to each first plate end

13, 23 and/or second plate end 14, 24 and/or runs substantially perpendicular to or perpendicular to the third plate end 18, 28 and/or the fourth plate end 19, 29 of each plate.

[0061] According to one embodiment (Figs. 6, 7, 12), each plate 70, 70A, 70B in the battery 1 comprises each opening 15, 15A, 15B in each plate in the first air conditioning module 10 having a central axis that coincides with the central axis for each opening 25, 25A, 25B in each plate in the second air conditioning module 20 viewed in the direction of air flow FA and/or the central axes of the openings run substantially parallel to or parallel to the first 13, 23 and/or second plate end 14, 24 of each plate and/or runs substantially perpendicular to or perpendicular to the third 18, 28 and/or fourth plate end 19, 29 of each plate. According to another embodiment, each plate 70, 70A, 70B in the battery 1 comprises openings and each opening 15, 15A, 15B for cooling medium 30 and/or each opening 17, 17A, 17B for heating medium 30 in each plate in the first air conditioning module 10 has a central axis that coincides with the central axis for each opening 25, 25A, 25B for the cooling medium 30 and/or each opening 27, 27A, 27B for heating medium 30 in each plate in the second air conditioning module 20 viewed in the direction of air flow FA and/or all the central axes of the openings run substantially parallel to or parallel to the first 13, 23 and/or second plate end 14, 24 of each plate and/or run substantially perpendicular to or perpendicular to the third 18, 28 and/or fourth plate end 19, 29 of each plate. The same configuration is applicable for openings 45, 45A, 45B in the third and further air conditioning modules 40.

[0062] According to one embodiment (Figs. 6, 7, 12, 13), each plate 70, 70A, 70B in the battery 1 is arranged so that each opening 15, 15A, 15B for cooling medium 30 and/or each opening 17, 17A, 17B for heating medium 30 in each plate in the first air conditioning module 10 coincide with one another along the third 18, 28 and/or fourth plate end 19, 29 of each plate and/or all the openings in the first air conditioning module 10 form a row and/or have central axes that run substantially parallel to or parallel to the third 18, 28 and/or fourth plate end 19, 29 of each plate and/or run substantially perpendicular to or perpendicular to the first 13, 23 and/or second plate end 14, 24 of each plate. The first 13, 23 and second plate end 14, 24 of each plate have the width b, b', B while the third 18, 28 and fourth plate end 19, 29 of each plate have a length defined as extending mainly/substantially perpendicular to or perpendicular to the direction of air flow FA, but this dimension is not stated with any reference designation.

[0063] According to one embodiment (Figs. 6 and 7), each plate 70, 70A, 70B in the battery 1 is arranged in such a way that each opening 25, 25A, 25B for cooling medium 30 and/or each opening 27, 27A, 27B for heating medium 30 in each plate in the second air conditioning module 20 coincide with one another in a direction along the third 18, 28 and/or fourth plate end 19, 29 of each

plate and/or all the openings in the second air conditioning module 20 form a row and/or have central axes that run substantially parallel to or parallel to the third 18, 28 and/or fourth plate end 19, 29 of each plate and/or run substantially perpendicular to or perpendicular to the first 13, 23 and/or second plate end 14, 24 of each plate.

[0064] According to one embodiment, each plate 70, 70A, 70B in the battery 1 is arranged so that each opening 15, 15A, 15B, 17 in each plate in the first air conditioning module 10 forms a first straight row of openings with central axes of the openings that coincide and each opening 25, 25A, 25B in each plate in the second air conditioning module 20 forms a second straight row of openings with central axes of the openings that coincide. In a further embodiment, the first straight row of openings 15, 15A, 15B in each plate in the first air conditioning module 10 extends in a direction substantially parallel to or parallel to the second straight row of openings 25, 25A, 25B in each plate in the second air conditioning module 20. This direction is substantially parallel to or parallel to the third 18, 28 and/or fourth plate end 19, 29 of each plate and/or is substantially perpendicular to or perpendicular to the first 13, 23 and/or second plate end 14, 24 of each plate.

[0065] According to one aspect, each air conditioning module 10, 20, 40 comprises two or more stacked plates 70, 70A, 70B and each plate comprises at least one row of openings 15, 15A, 15B, 25, 25A, 25B, 45, 45A, 45B positioned eccentrically on the plate. Here, "eccentrically" means that the openings are arranged closer to one side of the plate than the opposite side. According to one aspect, the eccentrically placed openings 15, 15A, 15B, 25, 25A, 25B, 45, 45A, 45B are placed closer to the edge on the plate that is directed downstream in the direction of air flow FA.

[0066] According to one aspect, the channel 16, 26, 26A, 46 for conditioning fluid 30 that cools the air through the cooling battery 1 in the second air conditioning module 20, 40 is arranged downstream in the direction of air flow FA relative to openings 17, 27 that are arranged for flow of conditioning fluid 30 that heats the air through the cooling battery 1.

[0067] According to one aspect, the channel 16, 26, 26A, 46 for conditioning fluid 30 that cools the air through the cooling battery 1 in the second air conditioning module 20, 40 is arranged eccentrically in the direction of air flow FA downstream over the plates 70, 70A, 70B.

[0068] According to one aspect, the cooling battery 1 comprises several air conditioning modules 10, 40 per unit length of the cooling battery longer downstream viewed in the direction of air flow FA than the corresponding number of air conditioning modules 20 upstream per unit length of the cooling battery.

[0069] According to one aspect, a cooling battery 1 for conditioning of air 7 in a direction of air flow FA through an air channel 6 in the cooling battery comprising a first and a second air conditioning module 10, 20, 40, where each module comprises a first 70A and a second end plate 70B, a core of one or more heat-exchange plates

70 arranged between the first and the second end plate and a channel 16, 26, 26A, 46 for conditioning fluid 30 comprising inlet 4 and outlet 5, wherein the respective heat-exchange plate 70 and end plate 70A, 70B have a first 13, 23, a second 14, 24, a third 18, 28 and a fourth end 19, 29, wherein the first end is arranged opposite the second end and the third end is arranged opposite the fourth end, wherein the first plate end 13, 23 and the second plate end 14, 24 are arranged substantially parallel to the direction of air flow FA, wherein the third 18, 28 and fourth plate end 19, 29 are arranged substantially perpendicular to the direction of air flow FA, wherein the inlet of the fluid channel 4 is arranged at the first end 13, 23 of the first or the second end plate 70A, 70B and the outlet of the fluid channel 5 is arranged at the second end 14, 24 of the first or the second end plate, wherein the fluid channel 16, 26, 26A, 46 extends to and fro between the first and the second end plate 70A, 70B is substantially perpendicular to the heat-exchange plates 70 in the core and the direction of air flow FA and from the first 13, 23 to the second end 14, 24 of the heat-exchange plates, wherein the first and the second air conditioning modules 10, 20, 40 are arranged in the air channel 6 with the first 13, 23 and the third plate end 18, 28 of the first and the second end plate 70A, 70B in a respective air conditioning module arranged in the same direction, wherein the first air conditioning module 10 is placed downstream of the second air conditioning module 20, 40 in the direction of air flow FA, wherein the inlet 4, 11 in the first air conditioning module 10 is arranged to be connected to a flow source in order to receive a flow FM of conditioning fluid 30, and the outlet 12 in the first air conditioning module 10 is connected fluidically to the inlet 21, 41 in the second air conditioning module 20, 40.

[0070] According to one aspect, the cooling battery 1 is as above, wherein the cooling battery 1 comprises a connection side 1C that extends between its first 1A and second end 1B at least between the first 13, 23 and second end 14, 24 of each end plate 70A, 70B, said connection side comprising a main inlet 4 for the conditioning fluid 30 corresponding to the inlet 11 to the first air conditioning module 10 and to the fluid channel 16, 26, 26A and/or a main outlet 5 for conditioning fluid corresponding to the outlet 22 from the second air conditioning module 20 and from the fluid channel 16, 26, 26A.

[0071] According to one aspect, the cooling battery 1 is as above, wherein each end plate 70A, 70B comprises at least one opening 15A, 25A, 45A nearest the first plate end 13, 23 that forms inlet 4, 11, 21, 41 for inflow of conditioning fluid 30 to each module 10, 20, 40. According to one aspect, the cooling battery 1 is as above, wherein each end plate 70A, 70B comprises at least one opening 15B, 25B, 45B nearest the second plate end 14, 24 that forms outlet 5, 12, 22, 42 for outflow of conditioning fluid 30 from each module 10, 20, 40. According to one aspect, the main inlet of conditioning fluid 4, 11 is arranged nearest the first end 1A of the cooling battery 1 and the main

outlet of conditioning fluid 5, 22 is arranged nearest its other end 1B.

[0072] According to one aspect, the cooling battery 1 is according to some of the preceding aspects, wherein each end plate 70A, 70B comprises openings, with each opening 15A, 25A, 45A nearest the first plate end 13, 23 coinciding with each inlet 4, 11, 21, 41 for inflow of conditioning fluid 30 into each module 10, 20, 40. According to one aspect, each end plate 70A, 70B comprises openings, with each opening 15B, 25B, 45B nearest the second plate end 14, 24 coinciding with each outlet 5, 12, 22, 42 for outflow of conditioning fluid 30 from each module 10, 20, 40. According to one aspect, the cooling battery 1 is according to some of the preceding aspects, wherein each plate 70, 70A, 70B comprises openings and each opening 15, 15A, 15B in each plate in the first air conditioning module 10 coincides with each opening 25, 25A, 25B, 45, 45A, 45B in each plate in the second air conditioning module 20, 40 viewed in the direction of air flow FA. According to one aspect, the direction of air flow FA through the whole cooling battery 1 is directed substantially opposite to or is directed opposite to the direction of flow FM of the conditioning fluid 30 flowing through the cooling battery 1. According to one aspect, the openings 15, 15A, 15B, 25, 25A, 25B, 45, 45A, 45B in at least one air conditioning module 10, 20, 40 are arranged for flow of conditioning fluid 30 that cools the air through the cooling battery 1. According to one aspect, the cooling battery 1 is according to some of the preceding aspects, wherein at least one air conditioning module 10, 20, 40 further comprises a row of openings 17, 27 arranged for flow of conditioning fluid 30 that heats the air through the cooling battery 1. According to one aspect, one or more air conditioning modules 40 are placed between the first air conditioning module 10 and the second air conditioning module 20. According to one aspect, the cooling battery 1 is according to some of the preceding aspects, wherein each air conditioning module 10, 20, 40 comprises two or more stacked plates 70, 70A, 70B, wherein each plate comprises two or more rows of openings 15, 15A, 15B, 25, 25A, 25B, 45, 45A, 45B, which are separated by one or more first thermal separators 50, and are connected materially. According to one aspect, the cooling battery 1 is as above, wherein at least one other thermal separator 60 is arranged between each module opening 15, 15A, 15B, 25, 25A, 25B, 45, 45A, 45B and extends substantially perpendicularly or perpendicularly to each first thermal separator 50. According to one aspect, the cooling battery 1 is as above, where each opening in the further row of openings 17, 27 for thermal flow of conditioning fluid 30 is smaller in size than the other openings 15, 15A, 15B, 25, 25A, 25B, 45, 45A, 45B for air cooling. According to one aspect, the cooling battery 1 is according to some of the preceding aspects, wherein each air conditioning module 10, 20, 40 comprises two or more stacked plates 70, 70A, 70B and each plate comprises at least one row of openings 15, 15A, 15B, 25, 25A, 25B, 45, 45A, 45B positioned eccentrically

on the plate. According to one aspect, the cooling battery 1 is according to some of the preceding aspects, wherein at least one air conditioning module 10 comprises more stacked plates 70, 70A, 70B than any air conditioning module 20, 40 that is placed upstream of the at least one air conditioning module 10 viewed in the direction of air flow (FA).

[0073] According to one aspect, the channel 16, 26, 26A, 46 for conditioning fluid 30 that cools the air through the cooling battery 1 in the second air conditioning module 20, 40 is arranged downstream in the direction of air flow FA relative to the openings 17, 27 that are arranged for flow of conditioning fluid 30 that heats the air through the cooling battery 1. The channel 16, 26, 26A, 46 for conditioning fluid 30 is thus located closer to the edge of the plates 70, 70A, 70B that are located the most downstream in the direction of air flow and therefore better cooling of the air flow is obtained.

[0074] According to one aspect, the channel 16, 26, 26A, 46 for conditioning fluid 30 that cools the air through the cooling battery 1 in the second air conditioning module 20, 40 is arranged eccentrically in the direction of air flow FA downstream over the plates 70, 70A, 70B. The channel 16, 26, 26A, 46 for conditioning fluid 30 is thus located closer to the edge of the plates 70, 70A, 70B that are located the most downstream in the direction of air flow and therefore better cooling of the air flow is obtained.

REFERENCE SYMBOLS

[0075]

1: Heating/Cooling device/system/battery for air treatment/conditioning. 1A: First end of the air conditioning device. 1B: Second end of the air conditioning device. 1C: Connection side of the air conditioning device. 2: Inlet for air into the heating/cooling battery. 3: Outlet for air to the heating/cooling battery. 4: Main/primary inlet for conditioning/cooling medium. 5: Main/primary outlet for conditioning/cooling medium. 6: Air channel. 7: Air.

10: The first conditioning/heating/cooling battery module. 11: Inlet for cooling medium in the first battery module. 12: Outlet for cooling medium in the first battery module.

13: First end in the first air conditioning battery module. 14: Second end in the first air conditioning battery module. 15: Plate opening in the first battery module for cooling medium. 15A: Plate opening in the first battery module nearest the first end on the connection side for inflow of cooling medium. 15B: Plate opening in the first battery module nearest the second end on the connection side for outflow of cooling medium. 16: Channel/Pipe/Pipe Coil in the first air conditioning battery module.

17: Plate opening in the first battery module for heating medium. 17A: Plate opening in the first battery

module nearest the first end on the connection side for inflow of heating medium. 17B: Plate opening in the first battery module nearest the second end on the connection side for outflow of heating medium. 18: Third end in the first air conditioning battery module. 19: Fourth end in the first air conditioning battery module. 20: Second air conditioning/heating/cooling battery module. 21: inlet for conditioning fluid in the second air conditioning battery module. 22: Outlet for conditioning fluid in the second air conditioning battery module. 23: First end in the second air conditioning battery module. 24: Second end in the second air conditioning battery module. 25: Plate opening in the second battery module. 25A: Plate opening in the second battery module nearest the first end on the connection side for inflow of conditioning fluid. 25B: Plate opening in the second battery module nearest the second end on the connection side for outflow of cooling medium. 26: Channel/Pipe in the second battery module. 26A: Channel/Pipe for heating medium. 27: Plate opening in the second battery module for heating medium. 27A: Opening in the second battery module nearest the first end on the connection side for inflow of heating medium. 27B: Opening in the second battery module nearest the second end on the connection side for outflow of heating medium. 28: Third end in the second air conditioning battery module. 29: Fourth end in the second air conditioning battery module. 30: Conditioning/Cooling/Heating medium. 40: Intermediate heating/cooling battery module. 45: Plate opening in intermediate battery module. 45A: Plate opening in the intermediate battery module nearest the first end on the connection side for inflow of cooling fluid. 45B: Plate opening in the intermediate battery module nearest the second end on the connection side for outflow of cooling medium. 46: Channel/Pipe in intermediate battery module. 50: Thermal separator/separation/isolation perpendicular to the plane of the battery module. 60: Thermal separator/separation/isolation parallel to the plane of the battery module. 70: Lamina/Plate/Sheet for increased heat exchange surface and stack forming each module. 70A: First end lamina/plate/sheet in each module. 70B: Second end lamina/plate/sheet in each module. 80: Intermediate pipe for fluidic coupling of cooling medium from one battery module to another. FA: Direction of flow for air. FM: Direction of flow for conditioning fluid/cooling/heating medium. B, b, b', B: Width/Length/Depth at the first 13, 23 and second 14, 24 plate ends.

Claims

1. Cooling battery (1) for conditioning of air (7) in a direction of air flow (FA) through an air channel (6) comprising at least one first and one second air conditioning module (10, 20, 40), where each module comprises a first (70A) and a second end plate (70B), a core of one or more heat-exchange plates (70) arranged between the first and the second end plate and a channel (16, 26, 26A, 46) for conditioning fluid (30) comprising inlet (4) and outlet (5), wherein the respective heat-exchange plate (70) and end plate (70A, 70B) have a first (13, 23), a second (14, 24), a third (18, 28) and a fourth end (19, 29), wherein the first end is arranged opposite the second end and the third end is arranged opposite the fourth end, wherein the first (13, 23) and the second plate end (14, 24) are arranged substantially parallel to the direction of air flow (FA), wherein the third (18, 28) and the fourth plate end (19, 29) are arranged substantially perpendicular to the direction of air flow (FA), wherein the fluid channel (16, 26, 26A, 46) extends to and fro between the first and the second end plate (70A, 70B) substantially perpendicular to the heat-exchange plates (70) in the core and the direction of air flow (FA) and from the first (13, 23) to the second end (14, 24) of the heat-exchange plates, wherein the first air conditioning module (10) is placed downstream of the second air conditioning module (20, 40) in the direction of air flow (FA), and wherein the first (13) and the second plate end (14) in the first air conditioning module (10) are shorter than the first (23) and the second plate end (24) in the second air conditioning module (20, 40).
2. Cooling battery (1) according to claim 1, wherein the direction of air flow (FA) through the whole cooling battery (1) is substantially directed opposite or directed opposite to the direction of flow (FM) of the conditioning fluid (30) flowing through the cooling battery (1).
3. Cooling battery (1) according to claim 1 or 2, wherein at least the second air conditioning module (20, 40) further comprises a row of openings (17, 27) arranged for flow of conditioning fluid (30) that heats the air through the cooling battery (1).
4. Cooling battery (1) according to any one of the preceding claims, wherein the first and the second air conditioning modules (10, 20, 40) are arranged in the air channel (6) with the first (13, 23) and third plate end (18, 28) of the first and the second end plate (70A, 70B) in a respective air conditioning module arranged in the same direction so that the fluid channel (16, 26, 26A, 46) extends to and fro between

the first and the second end plate (70A, 70B) in a corresponding manner in the first and the second air conditioning modules (10, 20, 40).

5. Cooling battery (1) according to any one of the preceding claims, wherein the inlet of the fluid channel (4) is arranged at the first end (13, 23) of the first or the second end plate (70A, 70B) and the outlet of the fluid channel (5) is arranged at the second end (14, 24) of the first or the second end plate, wherein the inlet (4, 11) in the first air conditioning module (10) is arranged to be connected to a flow source in order to receive a flow (FM) of conditioning fluid (30), and the outlet (12) in the first air conditioning module (10) is connected fluidically to the inlet (21, 41) in the second air conditioning module (20, 40). 5
6. Cooling battery (1) according to claim 5, wherein the cooling battery (1) comprises a connection side (1C) that extends between its first (1A) and second end (1B) at least between the first (13, 23) and the second end (14, 24) of each end plate (70A, 70B), said connection side comprising a main inlet (4) for the conditioning fluid (30) corresponding to the inlet (11) to the first air conditioning module (10) and to the fluid channel (16, 26, 26A) and/or a main outlet (5) for conditioning fluid corresponding to the outlet (22) from the second air conditioning module (20) and from the fluid channel (16, 26, 26A). 10
7. Cooling battery (1) according to claim 6, wherein each end plate (70A, 70B) comprises at least one opening (15A, 25A, 45A) nearest the first plate end (13, 23) that forms inlet (4, 11, 21, 41) for inflow of conditioning fluid (30) to each module (10, 20, 40). 15
8. Cooling battery (1) according to claim 6, wherein each end plate (70A, 70B) comprises at least one opening (15B, 25B, 45B) nearest the second plate end (14, 24) that forms outlet (5, 12, 22, 42) for outflow of conditioning fluid (30) from each module (10, 20, 40). 20
9. Cooling battery (1) according to any one of claims 6 to 8, wherein the main inlet of conditioning fluid (4, 11) is arranged nearest the first end (1A) of the cooling battery (1) and the main outlet of conditioning fluid (5, 22) is arranged nearest its other end (1B). 25
10. Cooling battery (1) according to any one of the preceding claims, wherein each end plate (70A, 70B) comprises openings, with each opening (15A, 25A, 45A) nearest the first plate end (13, 23) coinciding with each inlet (4, 11, 21, 41) for inflow of conditioning fluid (30) in each module (10, 20, 40). 30
11. Cooling battery (1) according to any one of the preceding claims, wherein each end plate (70A, 70B) 35

comprises openings, with each opening (15B, 25B, 45B) nearest the second plate end (14, 24) coinciding with each outlet (5, 12, 22, 42) for outflow of conditioning fluid (30) from each module (10, 20, 40).

12. Cooling battery (1) according to any one of the preceding claims, wherein each plate (70, 70A, 70B) comprises openings and each opening (15, 15A, 15B) in each plate in the first air conditioning module (10) coincides with each opening (25, 25A, 25B, 45, 45A, 45B) in each plate in the second air conditioning module (20, 40) viewed in the direction of air flow (FA). 40
13. Cooling battery (1) according to any one of the preceding claims, wherein the openings (15, 15A, 15B, 25, 25A, 25B, 45, 45A, 45B) in at least one air conditioning module (10, 20, 40) are arranged for flow of conditioning fluid (30) that cools the air through the cooling battery (1). 45
14. Cooling battery (1) according to any one of the preceding claims, wherein at least one or more air conditioning modules (40) are placed between the first air conditioning module (10) and the second air conditioning module (20). 50
15. Cooling battery (1) according to any one of the preceding claims, wherein each air conditioning module (10, 20, 40) comprises two or more stacked plates (70, 70A, 70B), wherein each plate comprises two or more rows of openings (15, 15A, 15B, 25, 25A, 25B, 45, 45A, 45B), which are separated by one or more first thermal separators (60), and are connected materially. 55
16. Cooling battery (1) according to claim 15, wherein at least one other thermal separator (50) is arranged between each module opening (15, 15A, 15B, 25, 25A, 25B, 45, 45A, 45B) and extends substantially perpendicularly or perpendicularly to each first thermal separator (60).
17. Cooling battery (1) according to any one of the preceding claims, wherein each air conditioning module (10, 20, 40) comprises two or more stacked plates (70, 70A, 70B) and each plate comprises at least one row of openings (15, 15A, 15B, 25, 25A, 25B, 45, 45A, 45B) positioned eccentrically on the plate.
18. Cooling battery (1) according to any one of claims 3-17, wherein the channel (16, 26, 26A, 46) for conditioning fluid (30) that cools the air through the cooling battery (1) in the second air conditioning module (20, 40) is arranged downstream in the direction of air flow (FA) in relation to the openings (17, 27) that are arranged for flow of conditioning fluid (30) that heats the air through the cooling battery (1).

19. Cooling battery (1) according to any one of the preceding claims, wherein the channel (16, 26, 26A, 46) for conditioning fluid (30) that cools the air through the cooling battery (1) in the second air conditioning module (20, 40) is arranged eccentrically in the direction of air flow (FA) downstream over the plates (70, 70A, 70B). 5
20. Cooling battery (1) according to any one of the preceding claims, which comprises more air conditioning modules (10, 40) per unit length of the cooling battery longer downstream viewed in the direction of air flow (FA) than the corresponding number of air conditioning modules (20) upstream per unit length of the cooling battery. 10 15

20

25

30

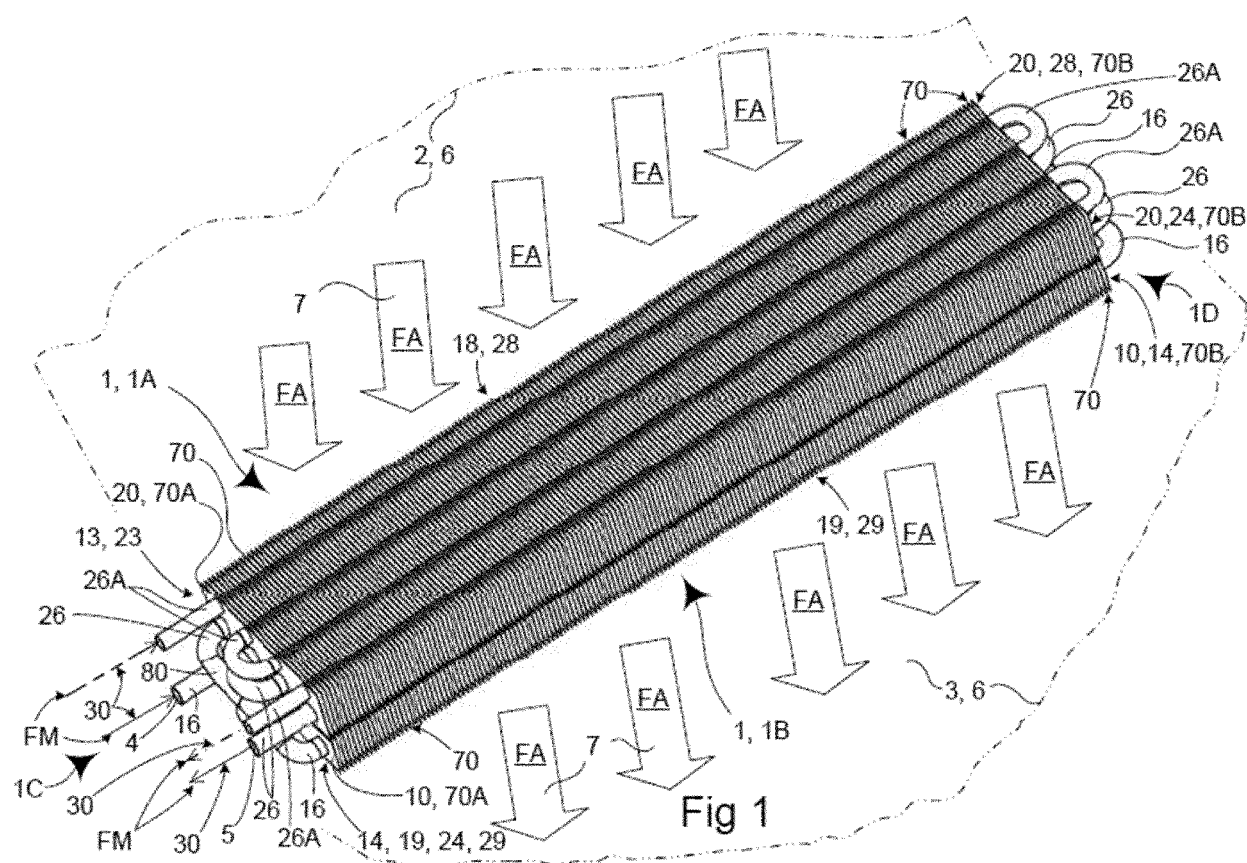
35

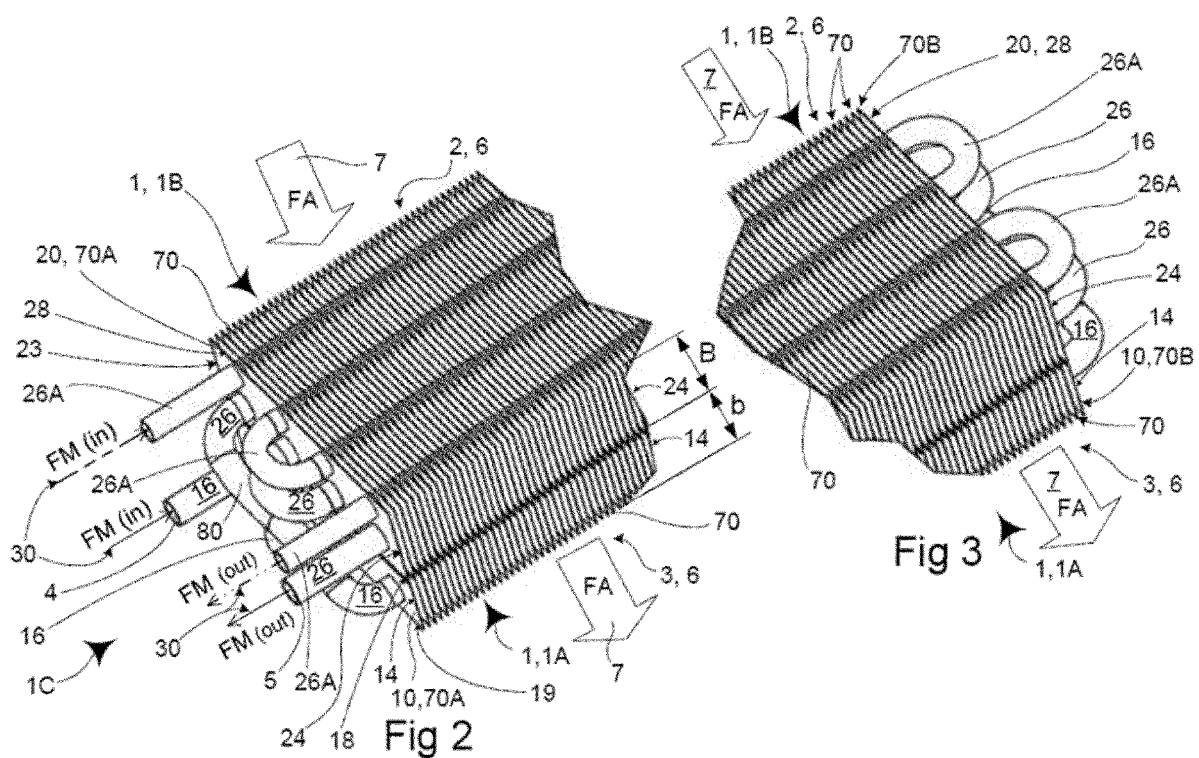
40

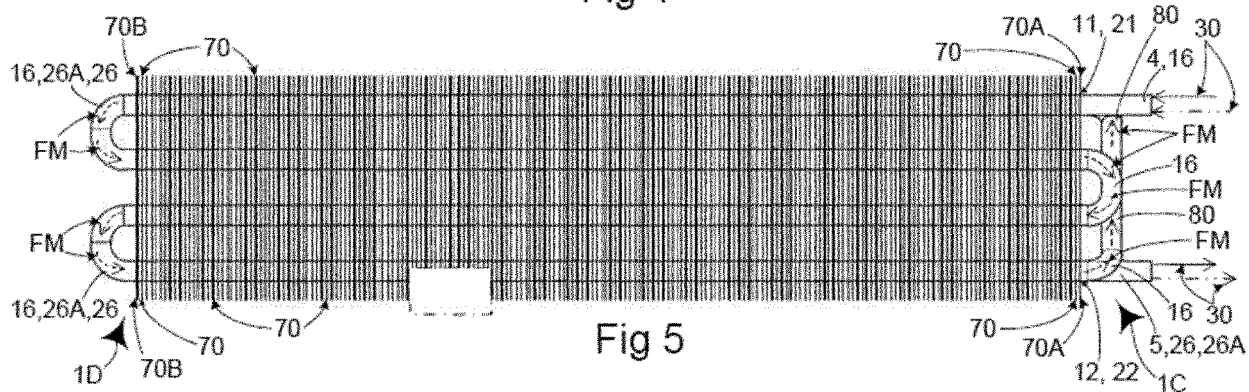
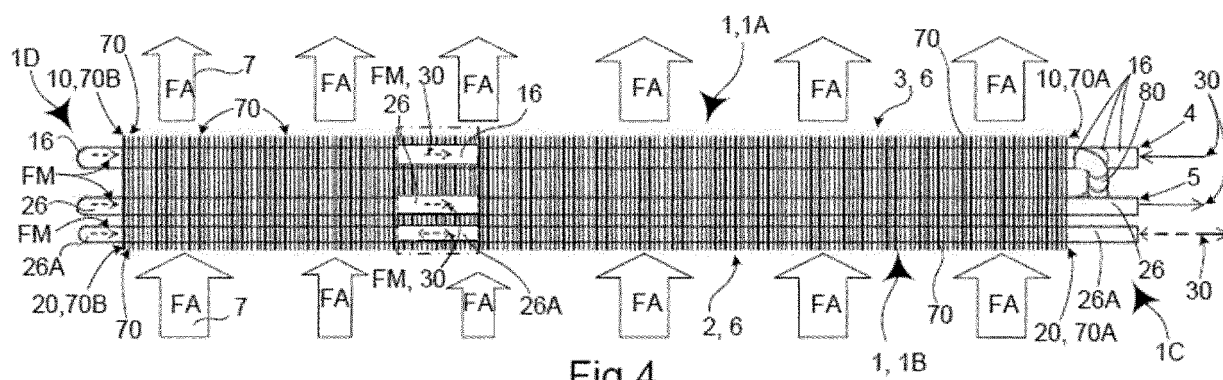
45

50

55







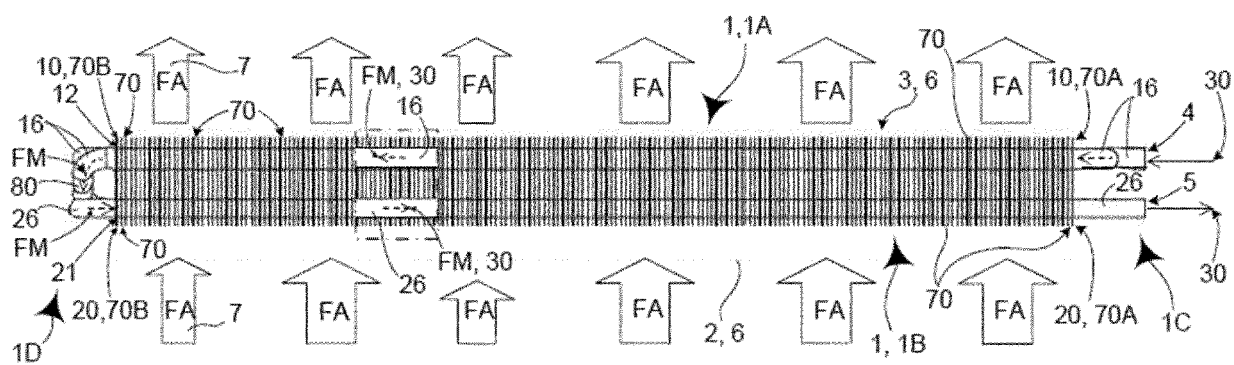


Fig 4A

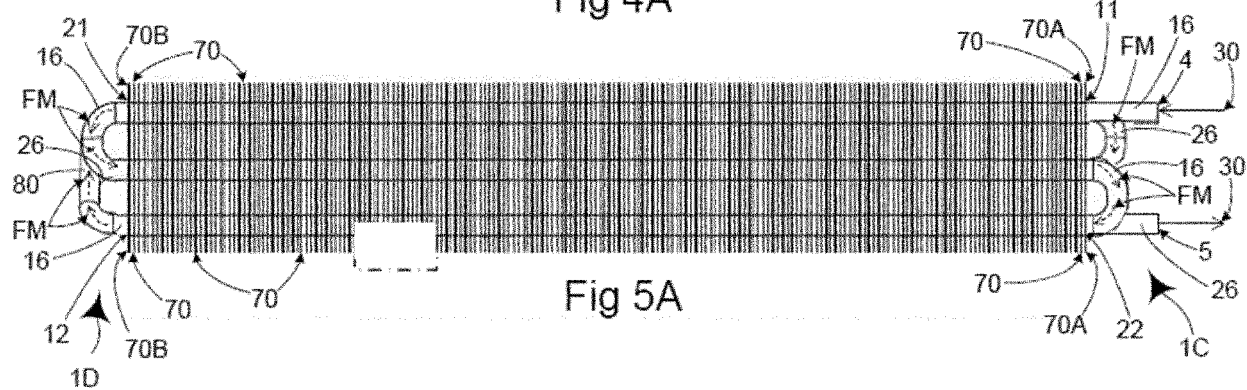
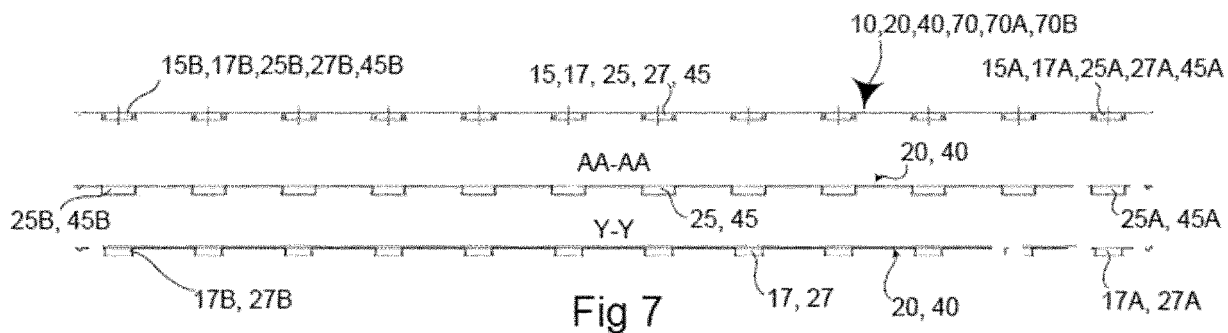
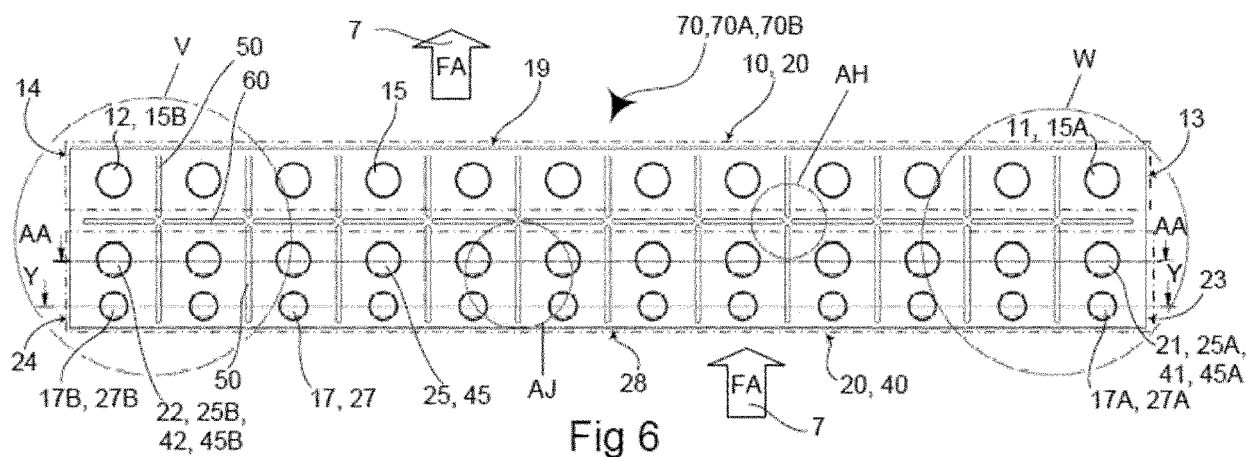


Fig 5A



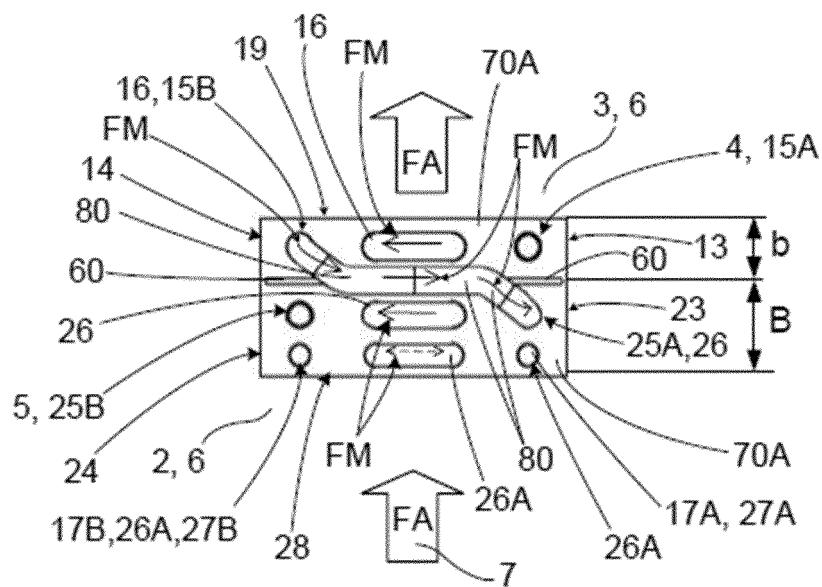


Fig 8

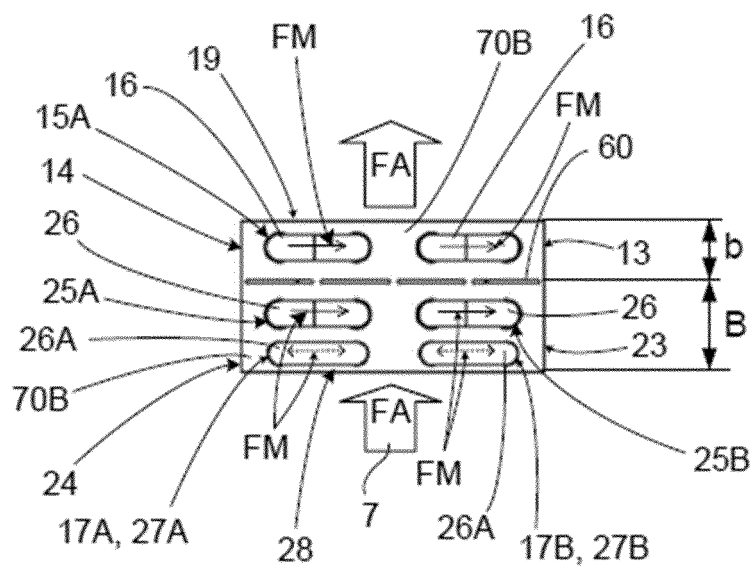
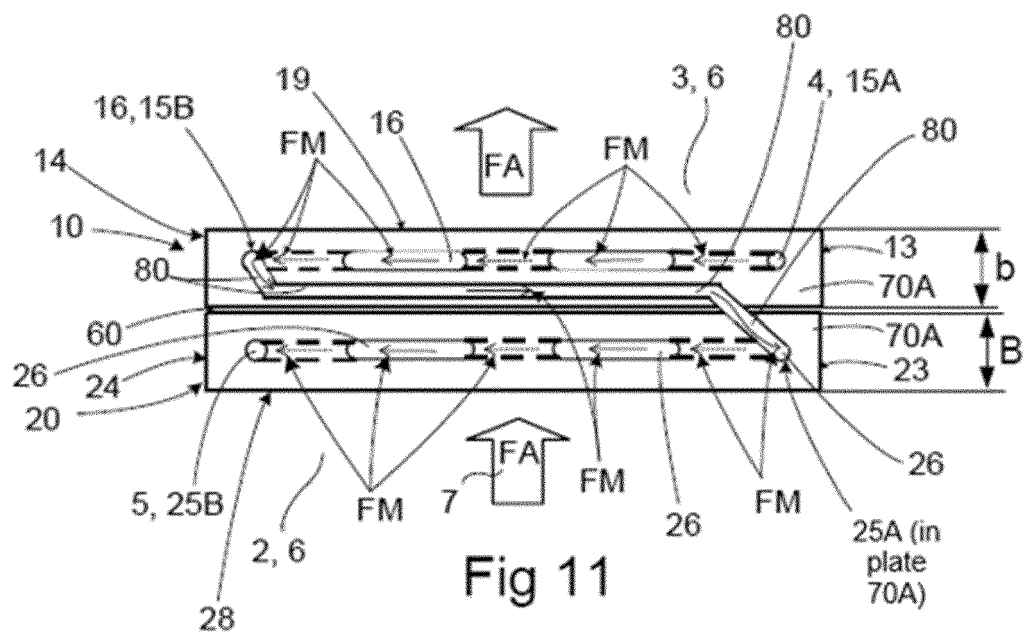
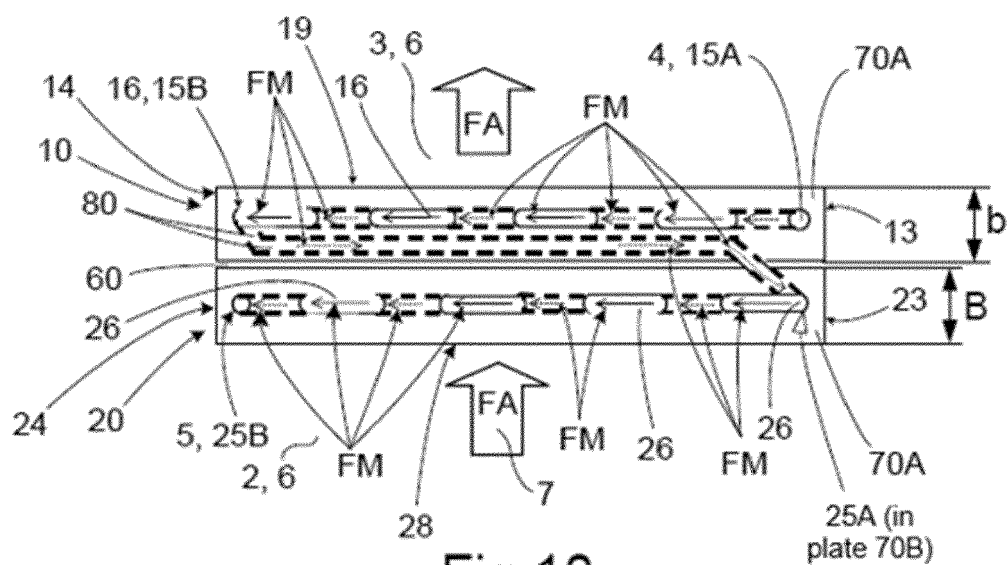


Fig 9



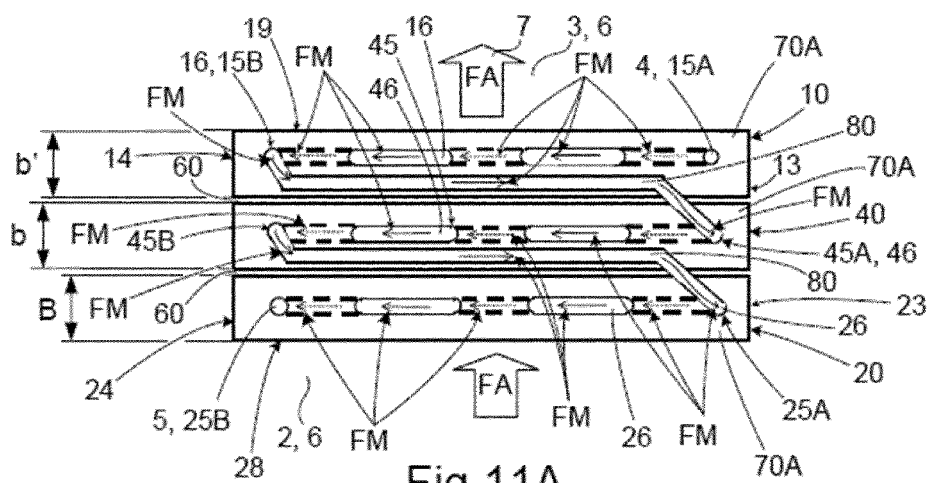


Fig 11A

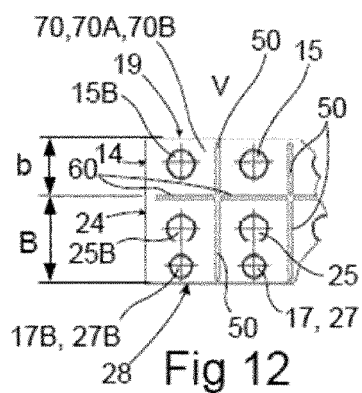


Fig 12

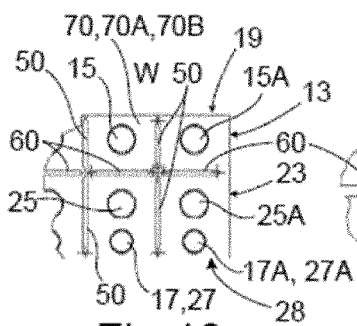


Fig 13

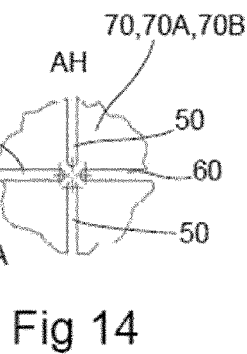


Fig 14

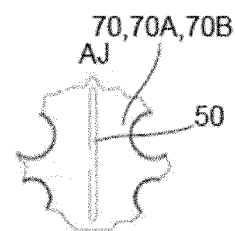


Fig 15



EUROPEAN SEARCH REPORT

Application Number
EP 19 15 1848

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 837 608 A1 (TOSHIBA CARRIER CORP [JP]; ADVANCED AIR CONDITIONING RES [JP]) 26 September 2007 (2007-09-26) * paragraph [0021] - paragraph [0030]; figures 3,5,6 *	1-14, 17-20	INV. F24F1/0067 F28D1/04 F28D1/047 F28F1/32 F28D1/02 F24F1/0063 F24F13/30
A	* paragraph [0021] - paragraph [0030]; figures 3,5,6 *	15,16	
X,D	US 5 181 392 A (ITOH MASAOKI [JP] ET AL) 26 January 1993 (1993-01-26) * column 3, line 14 - column 5, line 30; figures 1-3,7-9 *	1-20	ADD. F28D21/00
X	EP 0 845 649 A2 (KIMURA KOHKI CO [JP]) 3 June 1998 (1998-06-03) * column 4, line 30 - column 7, line 12; figures 3-21 *	1-4,14	
X	JP H02 97897 A (MATSUSHITA REFRIGERATION) 10 April 1990 (1990-04-10) * figures 1-2 *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			F24F F28F F28D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 16 May 2019	Examiner Anconetani, Mirco
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			

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 19 15 1848

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

16-05-2019

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1837608 A1	26-09-2007	CN 101087978 A	12-12-2007
		EP 1837608 A1	26-09-2007
		ES 2456018 T3	21-04-2014
		JP 4818935 B2	16-11-2011
		JP WO2006068210 A1	12-06-2008
		WO 2006068210 A1	29-06-2006

US 5181392 A	26-01-1993	JP 3051420 B2	12-06-2000
		JP H03255857 A	14-11-1991
		KR 960009337 B1	18-07-1996
		US 5181392 A	26-01-1993

EP 0845649 A2	03-06-1998	AU 4441397 A	04-06-1998
		CA 2222402 A1	28-05-1998
		CN 1184245 A	10-06-1998
		EP 0845649 A2	03-06-1998
		ID 18982 A	28-05-1998
		KR 19980042618 A	17-08-1998

JP H0297897 A	10-04-1990	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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

- US 5181392 A [0003]