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(54) Title: APPARATUS FOR HEATING AND VENTILATION OF INDOOR SPACES

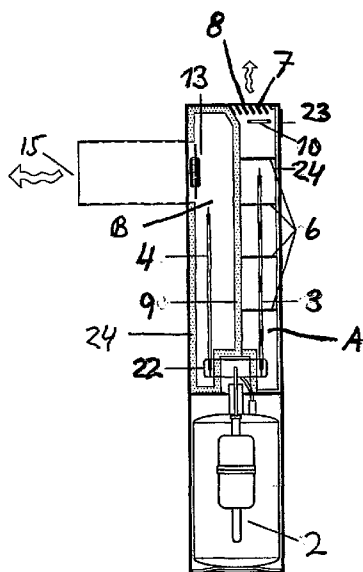


Fig. 2

(57) Abstract: Apparatus for heating and ventilation of an indoor space, comprising a housing (1) divided in at least two defined spaces (A, B) and enclosing a heat pump unit with a compressor (2), a first means (3) for exchanging heat, and a second means (4) for exchanging cold, the housing being divided into at least two defined spaces, the first means (3) being arranged in a first defined space (A) and the second means (4). The apparatus further comprises at least one fan (5) for circulation of air through the first defined space (A), the second defined space (B) being adapted to have fluid communication with outdoor air, and at least one further fan (12,13) is adapted to force the outdoor air through the second defined space (B), and the at least one fan (5) is adapted to supply the indoor space with partly fresh outdoor air via an adjustable outdoor air damper (18). The apparatus comprises at least one electric heating device (10) is provided in the first defined space (A) and adapted to supply heat in the case the heat supplied by the first means (3) is not enough.

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APPARATUS FOR HEATING AND VENTILATION OF INDOOR SPACES**Field of the invention**

The invention relates to an apparatus according to the preamble of claim 1.

5 Background of the invention

An apparatus for heating and cooling of a gaseous or liquid medium is known by WO 93/18351. Said apparatus comprises a heat pump circuit having known structure, and at least one driving device for the flow of the medium. An adjustable control member for the flow of the medium is provided, said control member forms a pivotable separating damper blade.

Moreover it is known since long air heat pumps having a condenser part placed inside a building and an evaporator part placed outside the building. These heat pumps are rather bulky and make a quite loud noise.

Preferably, it would be desirable if a heating devise based upon the heat pump principle could be able to replace electric radiators either when constructing new buildings or when replacing defect electric radiators or other types of heating devices.

Thus, there is a long felt need for a simple relatively slim heating device in the form of a radiator based upon the heat pump principle.

Should the heating device also be able to cool the indoor air and at the same time provide ventilation of the room in which it is placed much would be gained in installation costs, the need for additional equipment such as air conditioners, etc. Also the energy consumption will be reduced and the indoor

climate, thus the comfort for the user, will be improved. Moreover, by the apparatus according to the invention it is possible to replace or improve all ready existing ventilation equipments or even to provide ventilation of indoor spaces not
5 having ventilation at all.

Summary of the invention

Thus, the object of the invention is to provide an apparatus for heating or cooling and ventilation of an indoor space.

10 Said object is achieved according to the invention by an apparatus for heating and ventilation of an indoor space, comprising a housing (1) divided in at least two defined spaces and enclosing a heat pump unit having a structure as known per se, with a compressor, a first means for exchanging
15 heat, and a second means for exchanging cold, the housing being divided into at least two defined spaces, the first means for exchanging heat being arranged in a first defined space and the second means for exchanging cold being arranged in a second defined space, said spaces being arranged mutually
20 opposite to each other, the apparatus further comprises at least one fan for circulation of air of the indoor space through the first defined space, the second defined space being adapted to have fluid communication with outdoor air, and at least one further fan is adapted to force the outdoor
25 air through the second defined space, and the at least one fan is adapted to supply the indoor space with partly fresh outdoor air via an adjustable outdoor air damper is arranged between the first and second defined spaces. According to the invention at least one electric heating device is provided in

the first defined space and adapted to supply heat in the case the heat supplied by the first means is not enough.

Brief description of the drawings

5 Fig. 1 is a schematic front view of an apparatus for heating or cooling and ventilation of an indoor space according to a first embodiment of the invention with the front covering panel removed,

10 Fig. 2 is a schematic side view of the apparatus for heating or cooling and ventilation of an indoor space according to a first embodiment from the left side of Fig. 1 at a section at the location of the compressor,

15 Fig. 3 is a schematic view from behind of the apparatus for heating or cooling and ventilation of an indoor space according to a first embodiment of the invention with the back covering panel removed,

20 Fig. 4 is a is a schematic side view of the apparatus for heating or cooling and ventilation of an indoor space according to a first embodiment taken from the left side of Fig. 3 with the side covering panel removed

Fig. 5 is a schematic front view of an apparatus for heating or cooling and ventilation of an indoor space according to a second embodiment of the invention with the front covering panel removed,

25 Fig. 6 is a schematic side view of the apparatus for heating or cooling and ventilation of an indoor space according to a second embodiment from the left side of Fig. 5 at a section at the location of the compressor,

30 Fig. 7 is a schematic view from behind of the apparatus for heating or cooling and ventilation of an indoor space according to a first embodiment of the invention with the back

covering panel removed,

Fig. 8 is a schematic side view of the apparatus for heating or cooling and ventilation of an indoor space according to a first embodiment taken from the left side of Fig. 7 with the side covering panel removed,

Fig. 9 is a schematic side view of the apparatus for heating or cooling and ventilation of an indoor space shown mounted to an external wall of a building, the inlet and outlet channels for outdoor air having a first design,

Fig. 10 is a schematic side view of the apparatus for heating or cooling and ventilation of an indoor space shown mounted to an external wall of a building, the inlet and outlet channels for outdoor air having a second design,

Fig. 11 is a schematic side view of the apparatus of Fig. 9 shown built-in,

Fig. 12 is a schematic side view of the apparatus of Fig. 10 shown built-in, and

FIG. 13 is a schematic sectional view from above showing the design of the inlet and outlet channels in Fig. 10 and 12, respectively.

Detailed description of preferred embodiments

A first embodiment of an apparatus for heating or cooling and ventilation of an indoor space according to the invention is shown in a front view in Fig. 1 with a front covering panel removed and a side view in Fig. 2 seen from the right side of Fig. 1 with a side covering panel removed. The apparatus comprises a housing 1 having six external side walls/panels and a main partition wall. The housing 1 enclosing a heat pump unit having a structure as known per se, with a compressor 2, a first means 3 for exchanging heat or cold, in the text below

said first means 3 will be called a first heat exchanger 3, and a second means 4 for exchanging heat or cold, in the text below said second means 4 will be called a second heat exchanger 4, the housing being divided into two defined main spaces not having fluid communication with each other except at the bottom via one hand a moisture absorbing means and on the other hand a controllable outdoor air damper. The first heat exchanger 3 is arranged in a first defined space A and the second heat exchanger 4 in a second defined space B. Some parts of the first and second heat exchanger may have some type of insulation for heat and/or cold. The defined spaces A and B are preferably arranged mutually opposite to each other.

The function of the first and second heat exchangers 3,4 are to emit and absorb heat or cold from the fluid, preferably air, which is in the first defined space A and the second defined space B, respectively, as is known per se.

The design and shape of the housing 1 is preferably such that it is similar to an ordinary electrical radiator, but a little bit deeper when looked upon from the front. However, it should be noted that the housing 1 can be mounted close to the wall, as seen in Fig. 9, for instance. This means that it will have more or less the same depth from the wall when mounted as the ordinary electrical radiator or some other type of heating device.

As seen in Fig. 1 the apparatus further comprises a at least fan 5, preferably a drum fan, for circulation of air of the indoor space through the first defined space A and to some extent supply the first defined space A and thus the indoor space with partly fresh outdoor air. By partly fresh air is meant that fresh outdoor air is mixed with indoor air in any ratio of fresh air:indoor air varying from 1:99 to 99:1. The

fan 5 is preferably placed near the bottom of the housing 1 and at one side of the same, in the opposite corner the compressor 2 is preferably placed.

5 The defined space A is divided by air guide plates 6, see Fig 2, so as to form a meandering channel in which the first heat exchanger 3 runs. In the first preferred embodiment the air guide plates 6 extend horizontally, and the uppermost air guide plate 6a is preferably arranged in an angle to the horizontal line, i.e. is sloping in such a way that the
10 velocity of the air leaving an upper portion 7 of the first defined space A will have more or less the same velocity over the whole area of said upper portion 7. The upper portion 7 of the defined space A of the housing 1 is preferably provided with guide lamina 8 for guiding the air flow in the desired
15 direction.

From Fig. 2 it can be seen that a partition wall 9 divides the housing 1 into the two defined main spaces A,B.

Furthermore, an electric heating device 10 such as a resistance wire, for instance, is arranged in the first
20 defined space A, preferably in the upper portion of said space. This electric heating device 10 is only activated when the heat provided by the heat pump 2 is not enough.

The first and second heat exchanger 3,4 are preferably provided with some type of surface increasing means (not
25 shown) so as to increase the efficiency regarding exchange of heat or cold.

The second defined space B of the housing 1 is shown in Fig. 3. Vertically extending air guide plates 11 are arranged in the space B so as to form another meandering channel in which
30 the second heat exchanger 4 runs.

An inlet air fan 12 is preferably provided in an inlet channel 14 for outdoor air, and an outlet air fan 13 is preferably provided in outlet channel 15 for outdoor air possibly mixed with some indoor air. Preferably, the inlet channel 14 and the outlet channel 15 are provided in the upper portion of the defined space B and have a suitable length so that they go through an external wall of a house.

The inlet air fan 12 and the outlet air fan 13 are preferably operated in such way that a positive pressure is formed in the part of the second defined space B in which the inlet air fan 12 is placed. In the same way the outlet air fan 13 is operated in such way that a negative pressure is formed in the part of the second defined space B in which the outlet air fan 13 is placed.

The inlet channel 14 and the outlet channel 15, respectively, are each provided with air filtering means 21, seen Fig 4. The inlet and outlet air fans 12, 13 are preferably reversible for periodically cleaning the air filtering means.

At the bottom of both the first and second defined spaces A, B a condensate absorption means 16 is arranged for absorbing possible condensate which will be formed. Said moisture absorbing means 16 extends between the defined spaces and thus form a fluid communication between them, the purpose of which is to compensate the moisture content in said means and to suck the moisture to that side of said means at which it is easiest evaporated.

Preferably an electrical heating element 27 is arranged near or integrated with the moisture absorbing means 16 so as to improve the evaporation of condensate from said means 16, see Fig. 1.

In one embodiment, in addition to the condensate absorption means 16, a capillary hose 17 may be provided for sucking the condensate by capillary force from the bottom of the defined spaces A,B and to out put the condensate in the outlet channel 15, preferably in or at the air filtering means 21 which then acts as a moisturizing pad, so that the condensate will be force out of said channel by the outlet air fan 13.

In another embodiment a pump, not shown, may be provided adapted to pump condensate to the same place as in the case with the capillary hose 17 or to a drain, not shown.

Preferably, the first and second heat exchangers 3,4 are each provided with a condensate and/or ice pilot switch so as to monitor possible formation of condensate or ice on said heat exchangers dependent upon the mode of operation of the apparatus.

A controllable outdoor air damper 18 is provided in the vicinity of the drum fan 5 to adjust the flow of outdoor air from the second defined space B to the first defined space A and thereby to the indoor space, see Fig. 3. By changing the opening formed by the controllable outdoor air damper 18 the extent of fresh outdoor supplied to the first defined space A, and thereby the indoor space, can be controlled. A controllable exhaust air damper 19 is arranged in the side of the second defined space B, as seen in Fig. 3. The exhaust air damper 19 has the purpose of controlling outflow of air from the indoor space. Also a preferably controllably inlet 20 is provided, preferably at the bottom of the apparatus, for feeding indoor air to the drum fan 5 for circulation via the meandering channel of the first defined space A to the upper portion 7 of the apparatus.

The compressor 2 is provided with a shunting valve 22, as is known per se, and said valve is used to change between cooling and heating mode of operation. In the heating mode of operation the first heat exchanger 3 produces heat and in the cooling mode of operation said heat exchanger produces cold.

The apparatus is provided with a control unit 23, as known per se, and the mode of operation of the apparatus can either be controlled by a remote control or manually.

Another embodiment of an apparatus for heating or cooling and ventilation of an indoor space according to the invention is shown in a front view in Figs. 5-8. Said embodiment differs from the first embodiment only in that the meandering channels in the first and second defined spaces A,B, respectively, are arranged in reverse, i.e. the air guiding plates 6 in the first defined space are arranged vertically and the air guiding plate 11' are arranged horizontally.

Fig. 9 is a schematic side view of the apparatus for heating or cooling and ventilation of an indoor space shown mounted to an external wall 30 of a building, the inlet and outlet channels 14,15 for outdoor air having the design shown in Fig. 2, for instance.

Fig. 10 is a schematic side view of the apparatus for heating or cooling and ventilation of an indoor space shown mounted to an external wall 30 of a building, the inlet and outlet channels 14',15' for outdoor air having another design. The design of said channels is such that they form an elongated opening on the outside of the exterior wall. The elongated openings of the channels 14',15' are preferably placed just under a window 25 so that they will be hidden under a window

ledge 26 and thus will not be visible when one look at the
façade of a building, see Fig. 13.

Fig. 11 is a schematic side view of the apparatus for heating
or cooling and ventilation of an indoor space shown built-in
5 and mounted to an external wall 30 of a building, the inlet
and outlet channels 14,15 for outdoor air having the design
shown in Fig. 2, for instance.

Fig. 12 is a view similar to the one shown in Fig. 11 but
showing the apparatus built-in and with the design of the
10 inlet and outlet channels as shown in Fig. 13.

Fig. 13 is a schematic sectional view from above showing the
design of the inlet and outlet channel 14,15 as shown in Fig.
12, for instance.

The external side walls surrounding the housing 1 are
15 preferably provided on their insides with sound-absorbing
material 24. They may also be provided with insulation for
heat and/or cold and/or sound. More particularly the walls
enclosing the defined space B have a thicker insulation layer
than the walls enclosing the defined space A. The reason for
20 this is elimination of possibly noise from the outdoor
environment.

As can be inferred from the above description it is possible
to save a lot of energy by replacing existing electrical
radiators or by newly mounting the apparatus according to the
25 invention.

Claims

1. Apparatus for heating and ventilation of an indoor space, comprising a housing (1) divided in at least two defined spaces (A,B) and enclosing a heat pump unit having a structure as known per se, with a compressor (2), a first means (3) for exchanging heat, and a second means (4) for exchanging cold, the housing being divided into at least two defined spaces, the first means (3) for exchanging heat being arranged in a first defined space (A) and the second means (4) for exchanging cold being arranged in a second defined space (B), said spaces being arranged mutually opposite to each other, the apparatus further comprises at least one fan (5) for circulation of air of the indoor space through the first defined space (A), the second defined space (B) being adapted to have fluid communication with outdoor air, and at least one further fan (12,13) is adapted to force the outdoor air through the second defined space (B), and the at least one fan (5) is adapted to supply the indoor space with partly fresh outdoor air via an adjustable outdoor air damper (18) is arranged between the first and second defined spaces (A,B), **characterized in** that at least one electric heating device (10) is provided in the first defined space (A) and adapted to supply heat in the case the heat supplied by the first means (3) is not enough.
2. Apparatus according to claim 1, **characterized in** that two fans (12,13) are provided in fluid communication with the second defined space (B), an inlet air fan (12) being adapted to suck in the outdoor air into the second defined space (B) and a outlet air fan (13) being adapted to force out the air contained in said second defined

space (B), and that the inlet air fan (12) is operated so as to achieve a positive pressure in a part of the second defined space (B), and the outlet air fan (12) is operated so as to achieve a negative pressure in another part of the second defined space (B).

5

3. Apparatus according to any of claim 1 or 2, **characterized in** that a condensate absorption means (16) is provided at the bottom of the defined spaces (A,B).
4. Apparatus according to any of claims 1-3, **characterized in** that a means (17) is provided adapted to by capillary force suck the condensate from the bottom of the defined spaces (A,B) and to out put the condensate in the vicinity of the outlet air fan (13) provided in fluid communication with the second defined space (B).
- 10 5. Apparatus according to any of claims 1-3, **characterized in** that a pump is provide for pumping condensate from the bottom of the defined spaces (A,B) and outputting the condensate in the vicinity of the outlet air fan (13) provided in fluid communication with the second defined space (B) or to a drain.
- 15 6. Apparatus according to any of claims 1-5, **characterized in** that horizontally extending air guide plates (6) are arranged in the first defined space (A) in such way that a meandering channel is formed, the first heat exchanger (3) having elongated form is adapted to follow said meandering channel.
- 20 7. Apparatus according to any of claims 1-5, **characterized in** that vertically extending air guide plates (11) are arranged in the second defined space (B) in such way that a meandering channel is formed, the second heat exchanger
- 25
- 30

(4) having elongated form is adapted to follow said meandering channel.

5 8. Apparatus according to any of claims 1-5, **characterized in** that vertically extending air guide plates (6) are arranged in the first defined space (A) in such way that a meandering channel is formed, the first heat exchanger (3) having elongated form is adapted to follow said meandering channel.

10 9. Apparatus according to any of claims 1-5, **characterized in** that horizontally extending air guide plates (11) are arranged in the second defined space (B) in such way that a meandering channel is formed, the second heat exchanger (4) having elongated form is adapted to follow said meandering channel.

15 10. Apparatus according to any of claims 1-9, **characterized in** that at least one adjustable damper (19) for indoor air is arranged in the second defined space (B) for expelling exhaust air to the exterior.

20 11. Apparatus according to claim 6, **characterized in** that the uppermost horizontally extending air guide plate (6a) is sloping in such way that the velocity of the air leaving an upper portion of the first defined space (A) will have more or less the same velocity over the whole area of said upper portion.

25 12. Apparatus according to any of claims 1-11, **characterized in** that the second defined space (B) is provided with an inlet channel (14;14') and an outlet channel (15:15'), and that said inlet and outlet channels (14',15') have an elongated opening adapted to be placed under a window
30 ledge.

13. Apparatus according to any of claims 3-12, **characterized in** that an electrical heating element (27) is arranged near or integrated with the moisture absorbing means (16).
- 5 14. Apparatus according to any of claims 1-13, **characterized in** that fresh outdoor air is mixed with indoor air in any ratio of fresh air:indoor air varying from 1:99 to 99:1.

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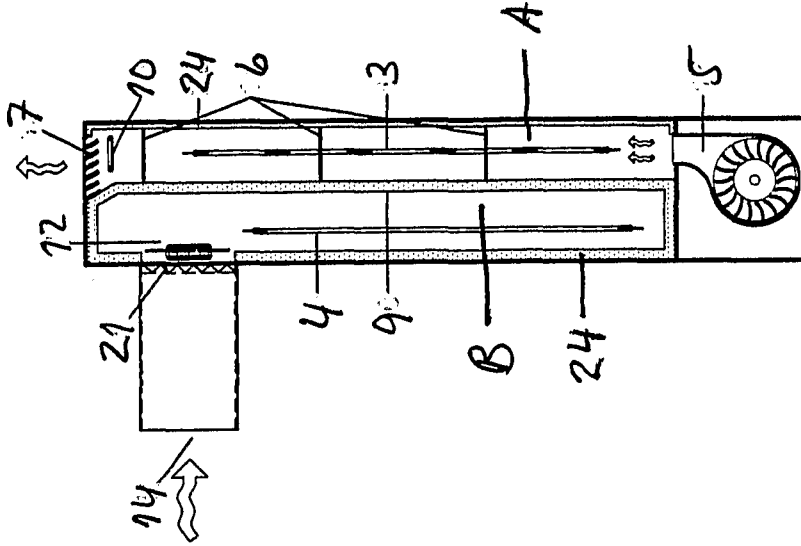


Fig. 4

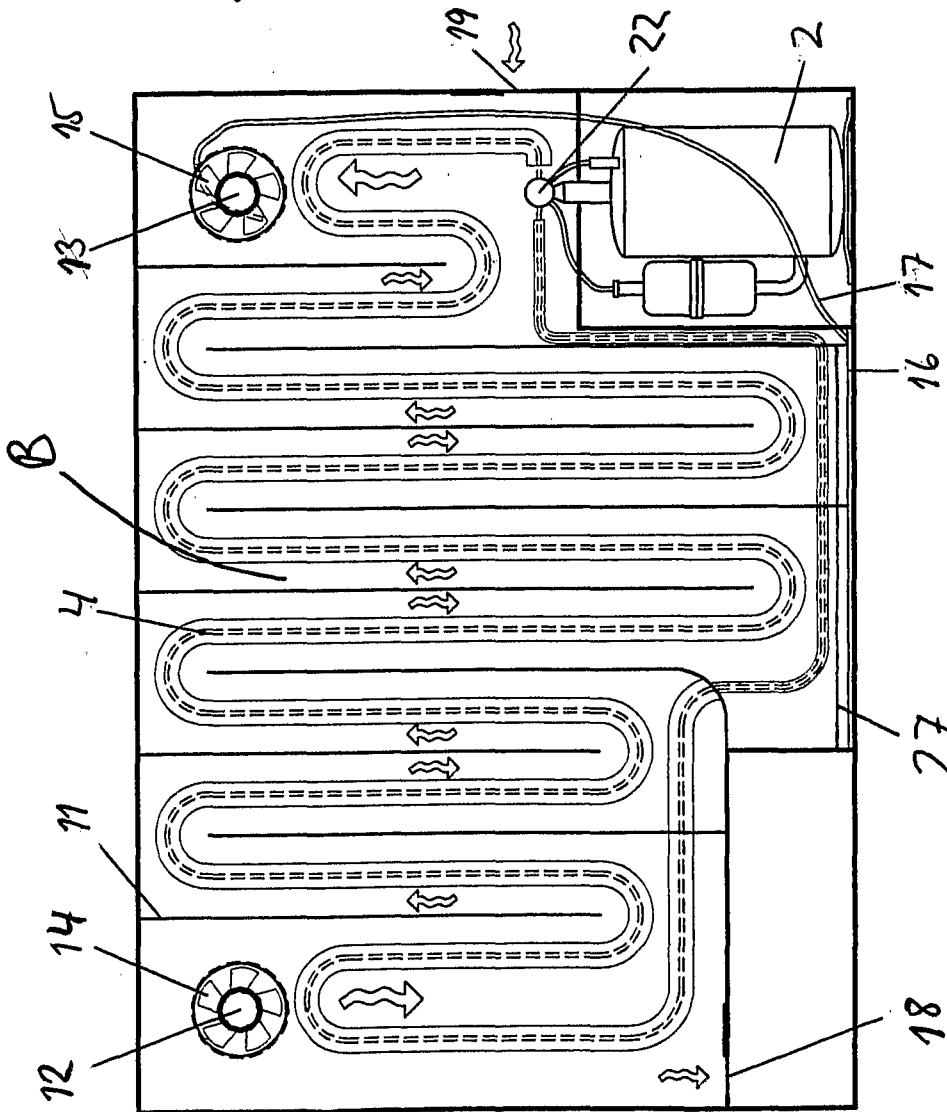


Fig. 3

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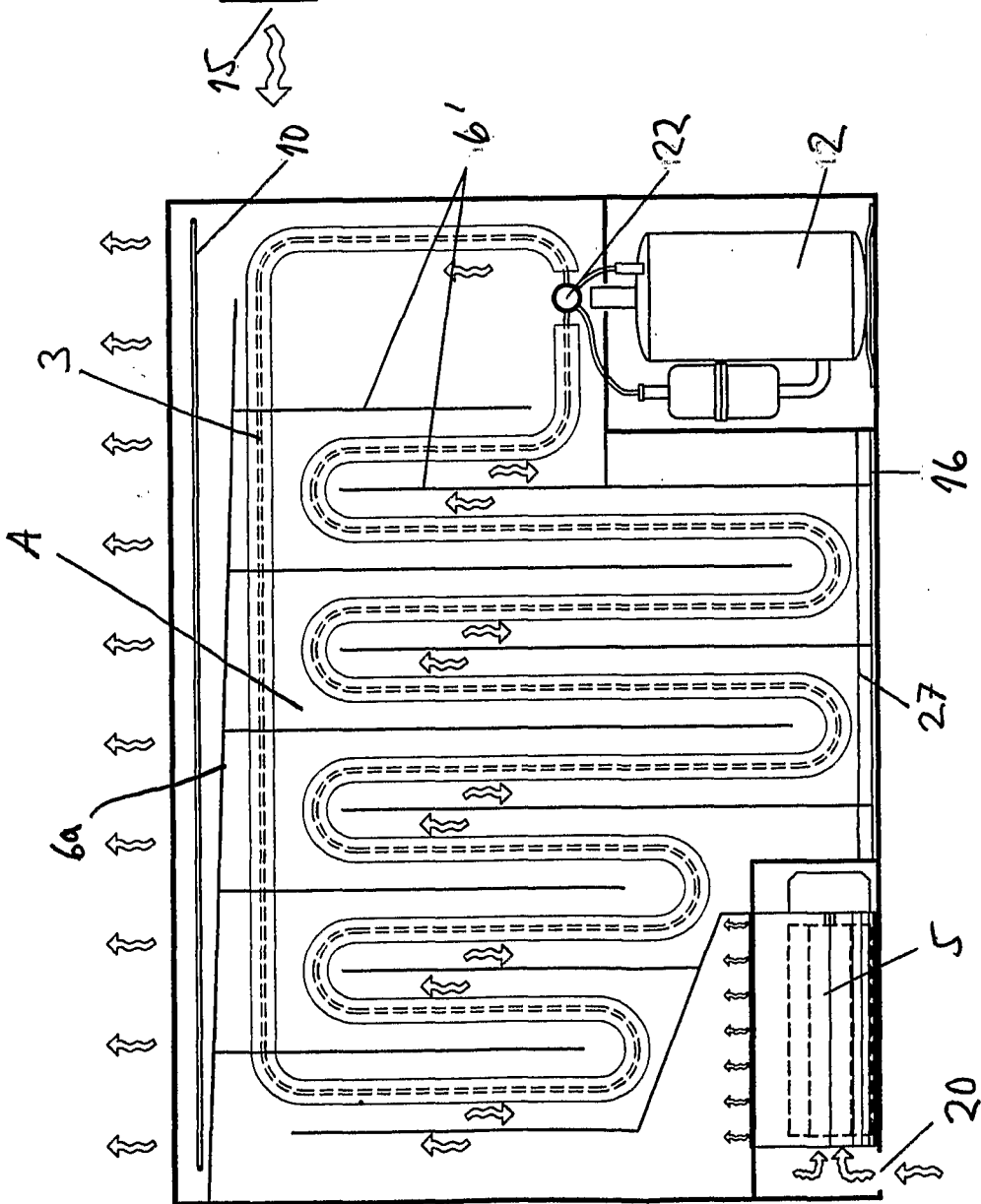


Fig. 5

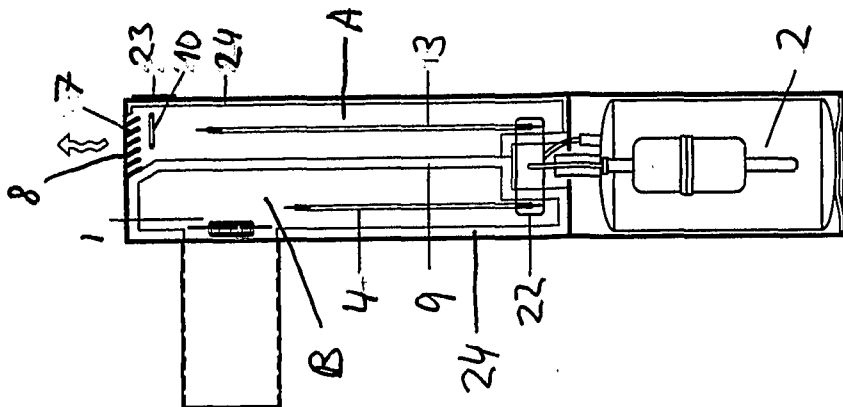


Fig. 6

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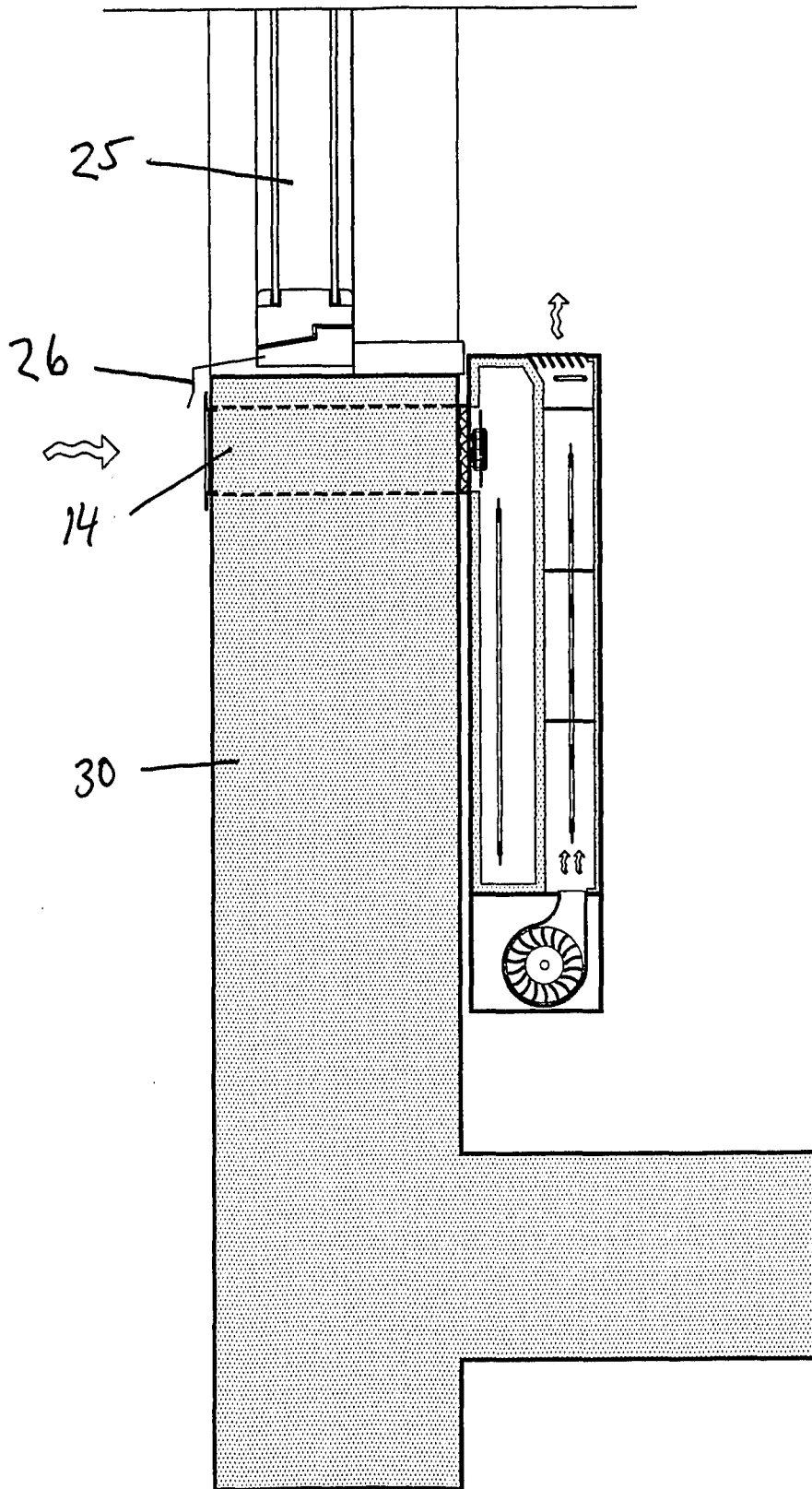


Fig. 9

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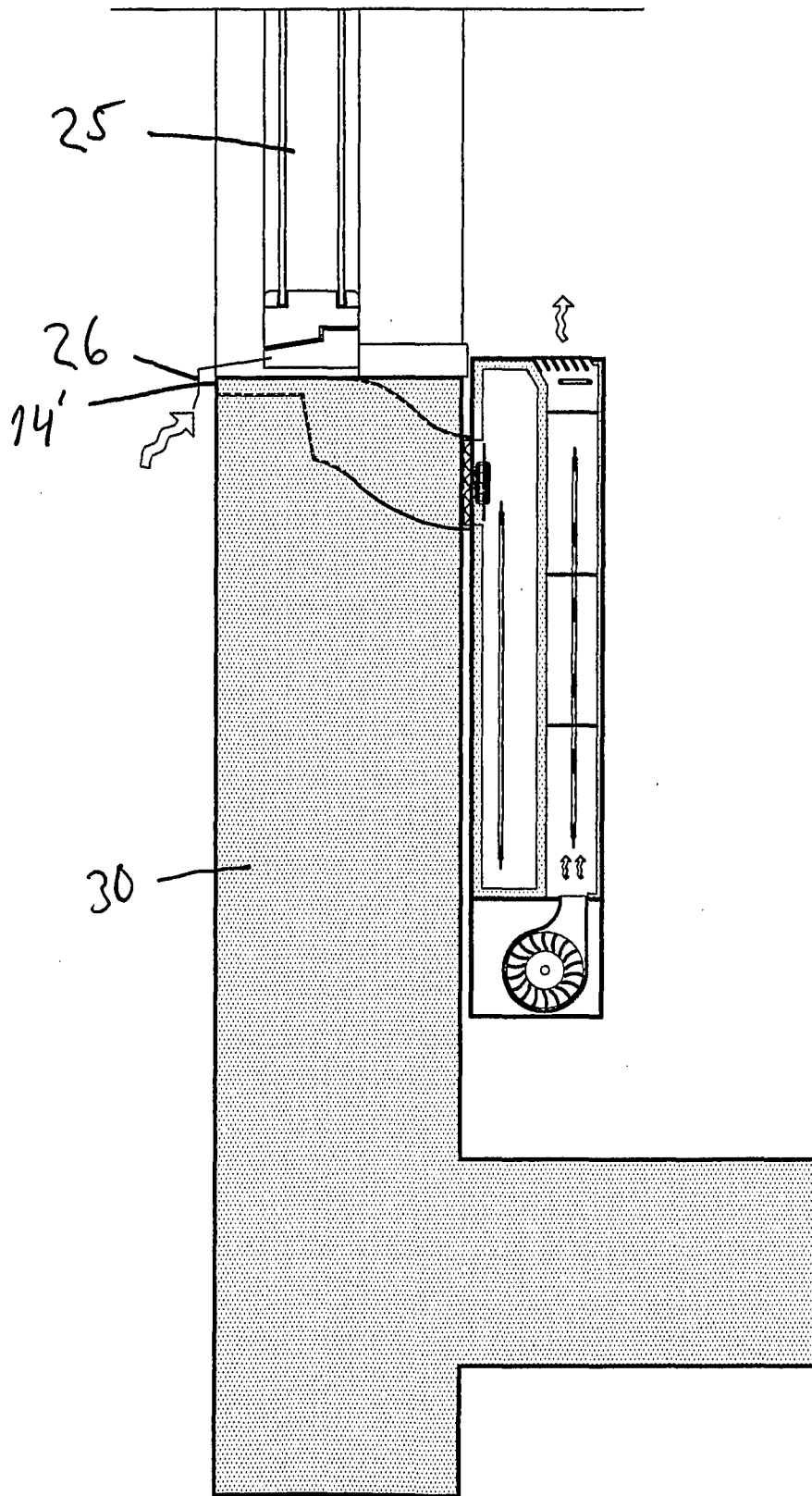


Fig. 10

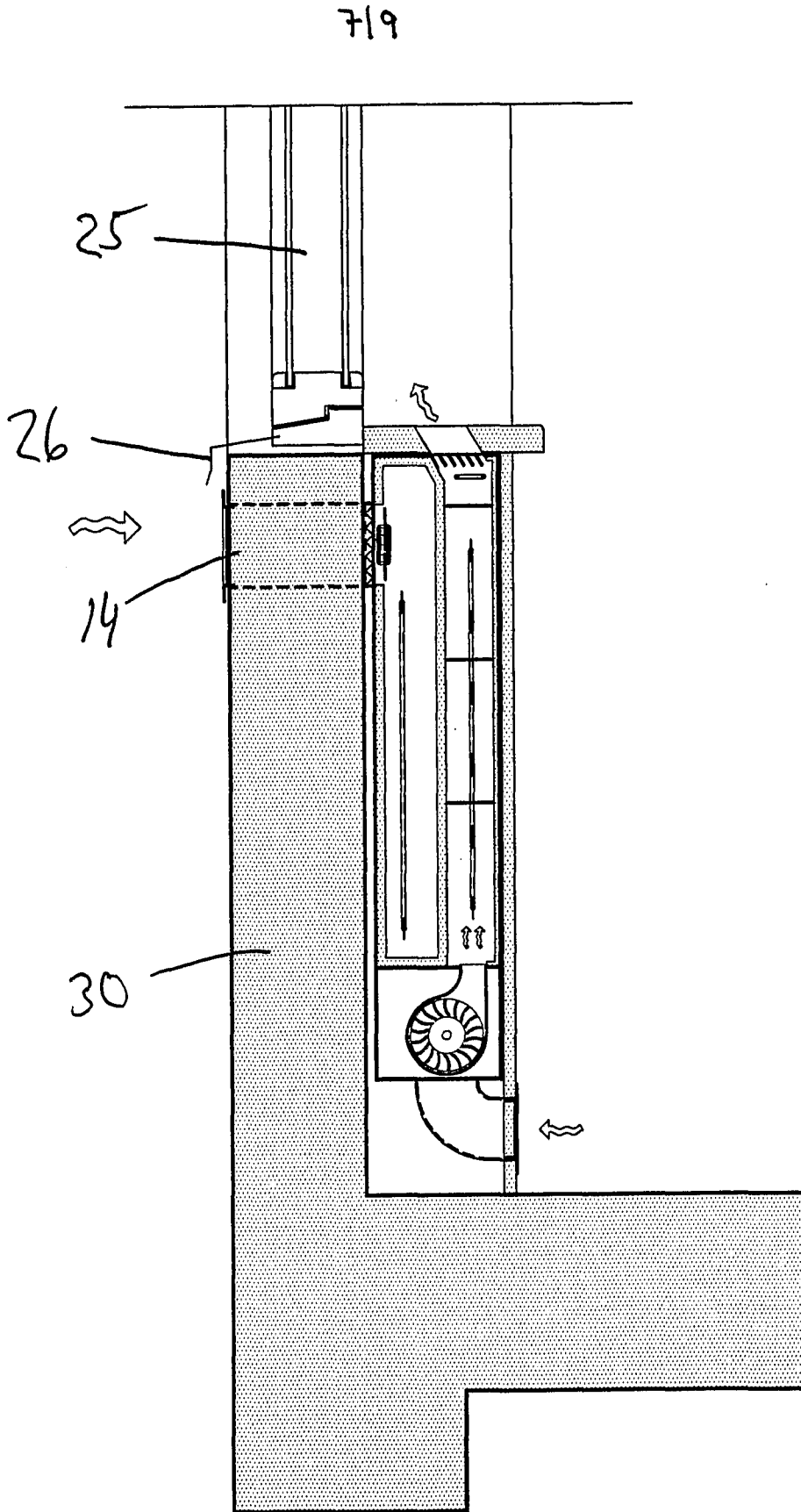


Fig. 11

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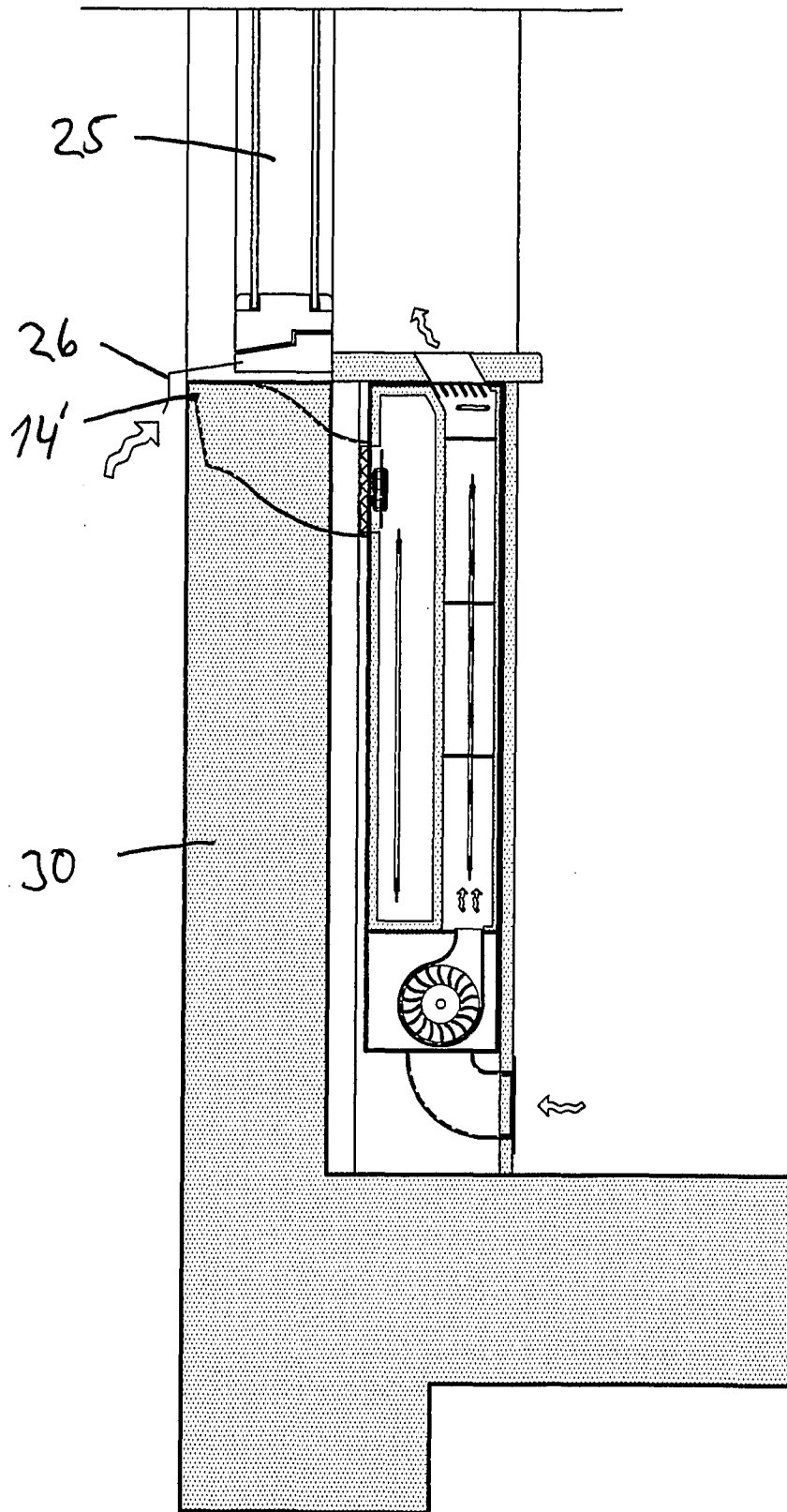


Fig. 12

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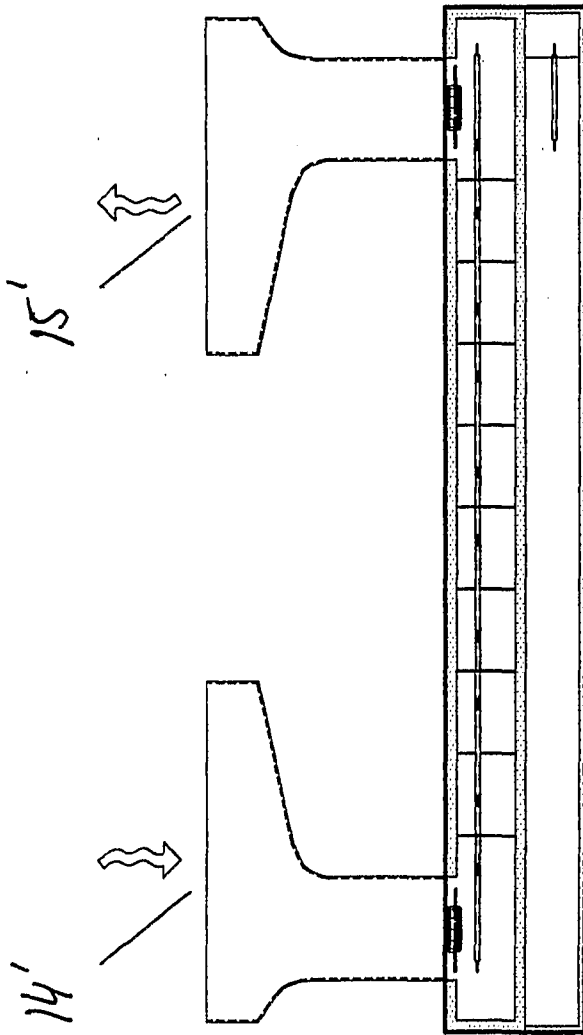


Fig. 13

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2008/000414

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F24F, F24D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 20040168461 A1 (PARK JUNG MEE ET AL), 2 Sept 2004 (02.09.2004), figure 2, paragraphs [0005],[0008],[0009],[0013],[0018],[0143] --	1-15
X	EP 1367331 A1 (UNIFLAIR INTERNATIONAL S.A.), 3 December 2003 (03.12.2003), figure 1, paragraphs [0008],[0013],[0023],[0024] --	1-15
Y	--	2-15
Y	CA 2143881 A1 (MUELLER, HERBERT R.), 4 Sept 1996 (04.09.1996), page 2, figure 9 --	2-15

 Further documents are listed in the continuation of Box C. See patent family annex.

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International application No.

PCT/SE2008/000414

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	JP 2001201098 A, KIMURA KOHKI CO LTD, 2001-07-27: (abstract) Retrieved from: WPI database, WEEK 200256, AN 1001-539323	6-9
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Information on patent family members

30/08/2008

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