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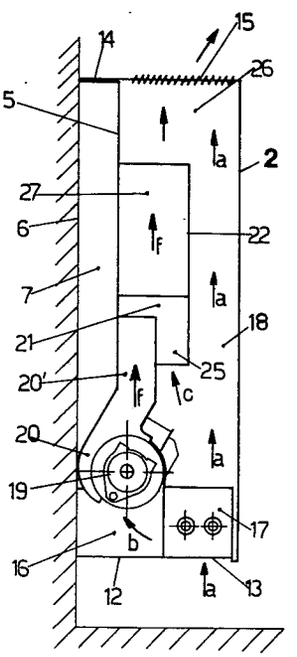
(54) **A thermal convector device capable of operating by natural and/or forced convection.**

(57) The present invention relates to a device capable of exchanging heat by natural and/or forced convection, especially conceived for the heating of rooms, and to this purpose, it is provided with a natural convection circuit in which the air drawn from a lower opening (13) is driven through a heating body (17), to penetrate into a convective chimney (18) and to be expelled from a higher opening (15); a forced convection circuit is provided with a fan (19) which draws the air heated by the heating body and pushes it into a passage (20) separate from the convective chimney in order to expel it from the higher opening.



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A thermal convector device capable of operating by natural and/or forced convection

The present invention relates to a thermal convector device, capable of operating by natural and/or forced convection, especially conceived for the heating of rooms.

According to the actual practice, heating bodies are used for the heating of rooms, usually operating with hot water and characterized by having large surfaces for the thermal exchange between water and air.

Certain types of heaters exchange heat by irradiation and by natural convection and are called radiators. Other types, instead, are conceived to exchange heat essentially by natural convection and are made up of parallel tubes crossed by hot water, provided with a finning for a better thermal exchange, and are disposed at the base of a convective chimney: these heating bodies are generally called thermal convectors.

Both the radiators and the thermal convectors are characterized by a completely static operation and their regulation can be obtained by acting on the temperature and/or

the flow of the hot water.

An evident disadvantage of these heat exchangers is their considerable inertia to follow rapid climatic variations, due for example to heat increase by solar irradiation, or ambient temperature variations, due for example to lighting, or the presence of several home appliances or of persons. Moreover, they appear to be very slow in reaching steady-state heating conditions, after periods more or less continuous of no operation or attenuation of the room heating. This is the case, for example, of houses that are used only at intervals, such as mountain or country houses, and in which the steady-state operation requires a considerable number of hours and, sometime, of days.

On the other hand, dynamic type heating equipment is also known, in which the convective exchange with a set of finned tubes, crossed by hot water or steam, is activated by means of a fan. These thermal convectors are able to supply an acceptable thermal exchange only when the fan is working, but are completely insufficient to supply a good thermal exchange by natural convection, due to the high internal resistance to the air movement and the lack of a convective chimney.

The thermal convector object of this invention presents the advantage of assuring a remarkable thermal exchange, when operating as a natural convector, and also the possibility of increasing considerably this exchange by means of a forced convection, initiated for example by operation

of a suitable fan incorporated in the convector itself.

Furthermore, such thermal convector device presents other noteworthy advantages. First of all, on the basis of a certain, well-predetermined minimum temperature, it can be dimensioned to operate, in steady-state heating conditions, as a thermal convector working by natural convection, and to operate as a thermal convector working by forced convection only to compensate transient thermal needs: the latter case may take place in the initial heating of cold rooms, as it is necessary in houses used only at intervals, or due to sudden lowering of the temperature external to the ambient, below the value considered in the design of the steady-state operation.

Beside the possibility of rapidly reaching steady-state heating conditions in a room by keeping the fan constantly in operation, the thermal convector device gives also the possibility of utilizing hot water at relatively low temperature, as can be obtained by auxiliary or alternative heat sources (heat pumps, heat recuperators, solar panel system, etc.). This availability in the use of water at low temperature (40-60°C), and thanks to the remarkable operation elasticity due to the auxiliary fan, gives also the possibility of operating at low temperatures circuits dimensioned for higher temperatures (80-90° C), whenever the circuits are provided with the thermal convector devices according to this invention.

The device object of this invention is characterized by

having: a heating body; a chamber to contain the heating body; a lower opening at the bottom of this chamber, positioned below the heating body, to draw the cold air from the ambient; a natural convection circuit composed by a convective chimney elevating vertically from the containing chamber, positioned above the heating body; and a higher opening from the superior end of the convective chimney toward the ambient. The entire device is conceived so that the natural convective movement of the air may take place without encountering obstacles of any kind.

The thermal convector device is completed by a forced convection circuit, flanking the natural convection circuit, and including: a fan which draws the hot air coming from the chamber containing the heating body; a vertical passage, separated from the convective chimney of the natural convection circuit, in which the hot air pushed by the fan is forced; and a higher opening through which the forced hot air is introduced into the heated ambient.

Preferably the heating body is made with a set of finned tubes, crossed by hot water or steam. According to the possible variation, the heating body can also be obtained with an electrical resistance, shaped as a coil or as a grill.

Furhter characteristics and advanctages of this invention will become evident from the following description that presents a practical example, not at all limitative of the innovation, which is shown in the enclosed drawings:

figure 1 is a front view of the device, having removed the front wall of the container;
figure 2 is a transversal sectional view taken on line A-A of figure 1.

The device of this invention is delimited by a container 1, substantially a parallelepiped, which includes a front wall 2, two lateral walls 3 and 4 and a rear wall 5 that, for the greater part of its vertical extension, is spaced out from the vertical wall 6 of the ambient, leaving thus an air gap 7 suitable to separate the container itself from the latter wall, thus avoiding the use of the thermal insulating materials.

Two internal lateral walls 8 and 9 separate a large middle space of the container from the lateral spaces 10 and 11, normally used to include auxiliary services such as water tubes or others.

The lower wall 12 of the container presents an opening 13 positioned forward toward the front, which generally extends between the two walls 8 and 9; in the same way, the higher wall 14 presents an opening 15 also extending between the two walls 8 and 9, which is eventually grilled or provided with deflectors to suitably deviate the outcoming air. Generally the higher opening 15 is disposed, at least for a large part, exactly above the lower opening 13.

The lower part of the space delimited by the walls 8 and 9

constitutes a containing chamber 16, partially occupied by a heating body 17, placed immediately above the lower opening 13 and extending for the whole length of this opening. This heating body is preferably made by a thermal convector group formed by a set of tubes crossed, in series or in parallel, by hot water or steam, and having a large number of finnings to improve the thermal exchange; the latter, in this case, are shown of rectangular shape, but which can assume any geometrical contour.

The heating body 17, as a possible alternative solution, can be made up with an electrical resistance extending for the whole length of the lower opening 13, and shaped as a coil or as a grill, in such a way as to present a large surface in contact with the air entering through the lower opening 13.

Above the heating body 17, the container forms a free space 18, extending vertically without any obstacle to the higher opening 15: this space thus constitutes a convective chimney completing a natural convection circuit through which the air, entering from the lower opening 13, is heated by crossing the heating body 17, follows the convective chimney 18 according to the arrows a, and goes out into the ambient through the higher opening 15.

As can be seen particularly from fig. 1, the convective chimney 18 extends between the two walls 8 and 9, substantially above the heating body 17.

Above the containing chamber 16, positioned backward with respect to the heating body 17, a fan 19 is incorporated, which draws the air heated by the contact with the heating body 17 and pushes it into a delivery duct 20, having a transversal extension inferior to the distance between the walls 8 and 9, and which extends toward the top with a last part 20' directed vertically toward the top. The vertical part 20' of the delivery duct enters for a certain part inside a superiorly-placed hood 21 delimited by a front wall 22, by the back wall 5 of the container, and by the two lateral walls 23 and 24. The transversal dimensions of this hood are substantially greater than the transversal dimensions of the vertical part 20' of the delivery duct in such a way that a large gap 25 may be formed between such part 20' and the lower entrance of the hood: this gap surrounds the part 20' from at least three consecutive sides and forms a large communication passage between the convective chimney 18 and the hood 21.

Superiorly the hood 21 is opened and is spaced out from the higher opening 15, forming a chamber 26 common with the convective chimney 18.

The hood 21 presents, above the gap 25, a series of side-by-side, parallel, vertical diaphragms 27 able to uniformly distrubute the air flow coming from the hood itself.

It can be easily seen that the lower chamber 16, the delivery duct 20-20', the hood 21 and the higher chamber 26 constitute a separate forced convection circuit, following

the path along the arrows b and f up to the higher opening 15; this circuit can be operated when the fan 19 is started.

When the forced convection circuit thus defined is not operating, the air heated by the heating body 17 moves upward, by thermal expansion, mainly along the convective chimney 18, following the natural convection circuit: this circuit can be used to maintain the ambient temperature in steady-state conditions and in the cases in which the external temperature is higher than the minimum design-temperature of the heating device.

In the cases of heating transients, such as for example at the start of the heating of a house not used for a certain period, or maintained at a low heating level, or in case of a sudden lowering of the external temperature below the minimum design-temperature, the forced convection circuit can be operated by starting the fan 19.

In this case the air coming in from the lower opening 13, after having been heated by the heating body 17 is drawn by the fan 19 and sent into the delivery duct 20-20', from this along the hood 21 into the higher chamber 26 and to the higher opening 15.

The vertical end 20' of the delivery duct 20 acts, within the hood, as an injector which creates a depression along the gap 25, so that the greater part of the air coming up along the convective chimney 18 is drawn through the gap

25 and is used to increase the hot air flow: the air not drawn from the convective chimney 18 continues toward the higher chamber 26 where it mixes again with the air coming from the hood 21 to finally outgo through the higher opening 15.

The arrangement, therefore, of the gap 25 between the convective chimney 18 and the hood 21 is used to increase the flow of the air heated by forced convection, since the air drawn through the gap 25 creates a depression in the convective chimney which accelerates the air passage also toward the chimney itself.

It is important to notice that the delivery duct 20 is closed, toward the convective chimney base immediately above the heating body 17, by a separation wall which prevents the aspiration by the fan 19 to be extended also to this space.

Naturally the invention may be embodied in forms different from the above-illustrated one and with all the possible variations among the components constituting the natural and forced convection circuits, without for this reason changing substantially the present model.

Claims

1. A thermal convector device, capable of exchanging heat by natural and/or forced convection, characterized by having: a heating body; a chamber containing the heating body; an opening at the base of such chamber, placed below the heating body, to draw the cold air from the ambient; a natural convection circuit consisting in a convective chimney elevating vertically from the containing chamber and positioned above the mentioned heating body; and in a superior exit of the air flow into the ambient to be heated. This circuit is conceived in such a way that the natural convection movement of the air takes place without encountering obstacles of any kind; a forced convection circuit, flanking the natural convection circuit, and including a fan which draws hot air from the chamber containing the heating body; a vertical passage, separated from the convective chimney of the natural convection circuit, in which the hot air is forced by the mentioned fan; and a superior exit through which the forced air is introduced into the ambient.

2. A device as in claim 1, in which the heating body is made up by a set of finned tubes crossed by hot water or steam.

3. A device as in claim 1, in which the heating body is made up by an electrical resistance shaped as a coil or as a grill.

4. A device as in claim 1, in which the convective chimney of the natural convection circuit and the separate forced convection passage of the hot air lead to a common higher chamber, communicating with the ambient to be heated through a single exit.

5. A device as in claim 1, characterized by the fact that the forced convection passage, after the fan, is composed of a first part disposed on the delivery duct of the fan and provided of at least a vertical end, and of successive part shaped as a hood with vertical plane walls, having a plan section with greater dimensions than the section of the first part; in this way the latter can penetrate for a certain length into the hood, leaving between its walls and those of the hood a large gap which connects the convective chimney of the natural convection circuit with the internal part of such hood; thus the end of the first part entering the hood acts as an injector causing an aspiration, toward the hood itself, of part of the hot air coming up from the convection chimney by natural convection, mixing it with the forced convection air and generating in this convective chimney a depression which increases the draw of the air in the chimney through the heating body.

6. A device as in claims 1 and 5, characterized by the fact that it is composed of a parallelepiped container having vertical walls which delimit inferiorly the chamber containing the heating body and superiorly the convective chimney with the eventual superior mixing chamber; inside

this container is disposed the forced convection circuit which is surrounded at least from three sides by the convective chimney and so positioned that the gap connecting the hood of the forced convection circuit with the convective chimney extends at least on three sides, inside such hood, in such a way as to recall hot air along these three sides.

7. A device as in claims 1, 5 and 6, characterized by the fact that the hood is internally divided by parallel vertical diaphragms, suitable to allow a uniform distribution of the air flow coming from the hood itself.

8. A thermal convector device, capable of operating by natural and /or forced convection, substantially similar to the one described and illustrated in the enclosed drawings.

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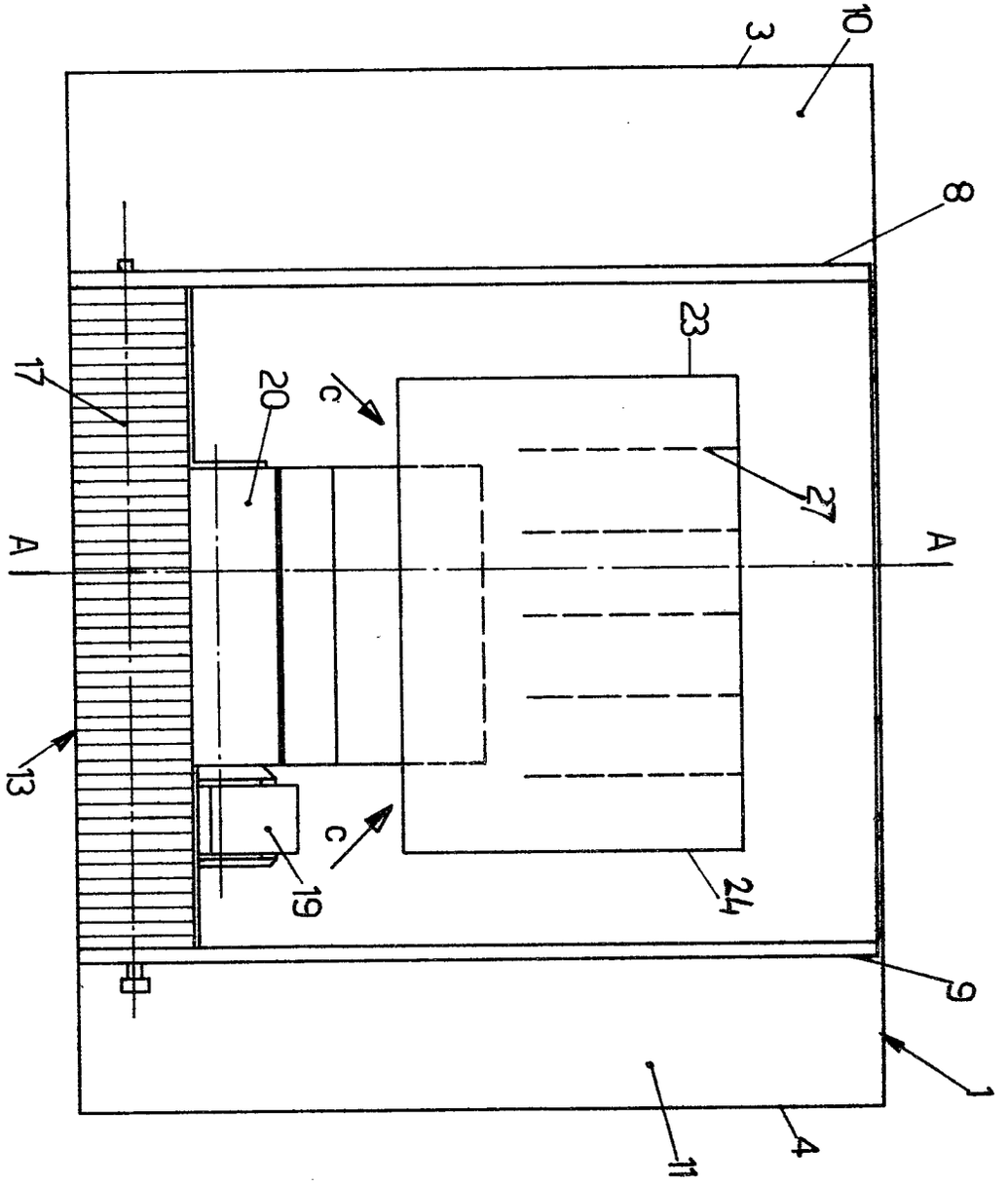

FIG-1

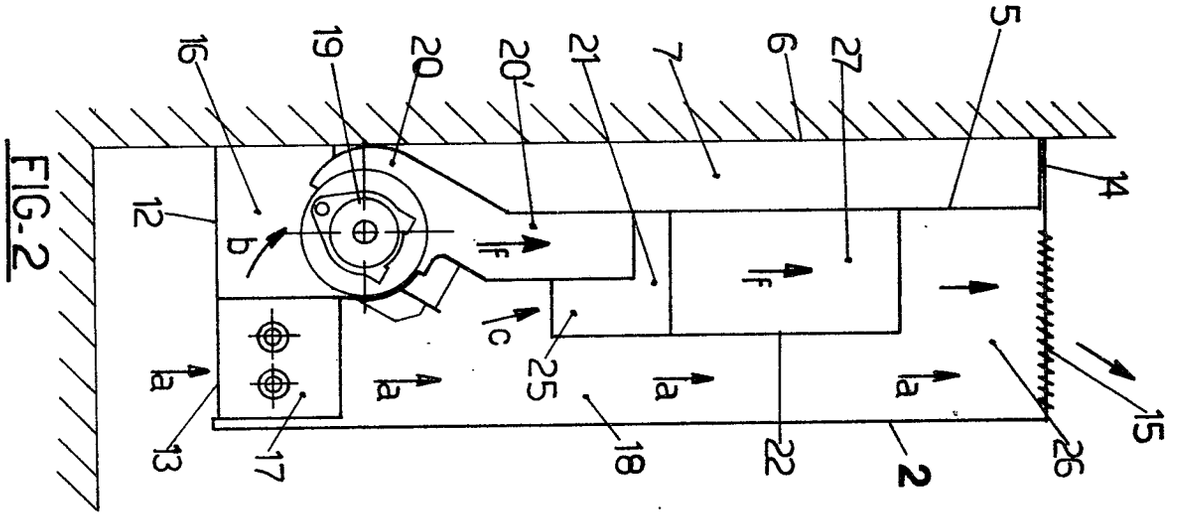

FIG-2

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EUROPEAN SEARCH REPORT

0038308
Application number

EP 81 83 0054

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	US - A - 2 637 532 (BAKER) * Claim 1, figure 1 * --	1,2,4,6,8	F 28 D 1/02 F 24 H 3/04
	CH - A - 431 748 (BRAUN) * Column 3, lines 23-33; figure 1 * --	1,3,8	
	GB - A - 1 148 920 (FIRTH CLEVELAND LTD) * Page 1, line 65 - page 2, line 60; figures 1-4 * --	1,2	TECHNICAL FIELDS SEARCHED (Int. Cl.³) F 28 D F 24 D
	DE - A - 2 403 127 (MASCHINENFABRIK WIESBADEN) * Figure 6 * ----	1	

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14-07-1981	VAN GESTEL

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