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(54) **Door for pyrolytic oven**

(57) The present invention relates to a cold door for an oven, the door being characterized by highly efficient thermal insulation and cooling of the outer surface.

In particular, the present invention relates to an oven door, particularly for a pyrolytic oven, comprising a support (16) to which are fixed an inner panel (21), against the oven mouth, and an outer panel (18), between which panels are a first intermediate panel (23) and a second intermediate panel (24), the said intermediate panels being separated by an intermediate gap (27) having air inlets (32) at the bottom of the door and air outlets (32') at the top of the door, in which the said inner panel (21) and the said first intermediate panel (23) are separated by an inner gap (26) and in which the said second intermediate panel (24) and the said outer panel (18) are separated by an outer gap (25), the said door being characterized in that the said intermediate gap (27) is separated from the said inner (26) and outer (25) gaps, in that the said outer gap (25) includes air inlets (20) situated at the top of the door and the said inner gap (26) includes air outlets (31') situated at the top of the door and in that the said outer (25) and inner (26) gaps are in communication at the bottom of the door, so that air enters via the said inlets (20) of the said outer gap (25) and leaves via the said outlets (31') of the said inner gap (26), creating a downward stream of air in the said outer gap (25) in the opposite direction to the separate, upward stream in the said intermediate gap (27), and an upward stream of air in the said inner gap (26).

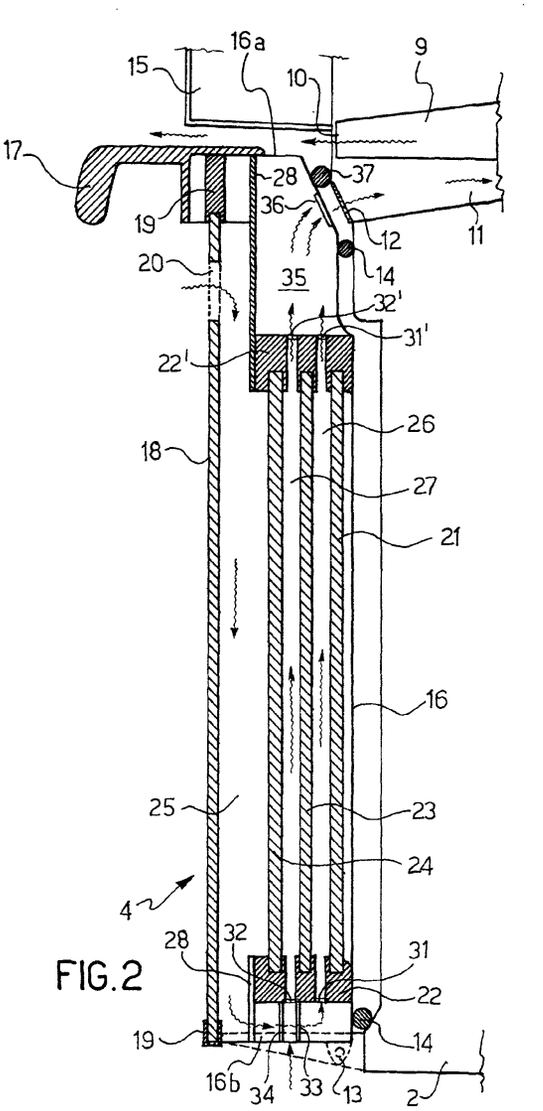

FIG.2

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Description

[0001] The present invention relates to a cold door for an oven, specifically for a pyrolytic oven, the door being characterized by highly efficient thermal insulation and cooling of the outer surface.

[0002] The expression self-cleaning pyrolytic ovens is intended to denote those ovens which include a high-temperature operating cycle (normally of the order of 400-500°C) for eliminating food residues, especially grease, which can be deposited on the walls of the oven during the previous period of baking.

[0003] It is obvious that during the pyrolytic phase the outer surface of the oven is heated to a temperature such as to cause burns to anyone who inadvertently comes into contact with it.

[0004] The surface most subject to this heating is that of the oven door because, whereas the walls of the baking chamber are made of a thermally insulating material, the door is usually made of a transparent material (so as to permit viewing of the oven interior) and is moreover situated in front of the mouth of the oven through which it is in direct contact with the heat emanating from the interior of the baking chamber.

[0005] The problem is aggravated by the fact that the door is situated on the front side of the oven nearest the user. Consequently such ovens, which are in common domestic use, may accidentally be contacted by children, causing them serious burns.

[0006] In order to overcome these drawbacks, many types of oven door have been proposed, all making use of an inner gap through which air from the exterior is circulated, either by natural convection or by forced convection, the latter case involving the use of a fan.

[0007] However, cold doors for ovens of the prior art generally employ an upward stream of air. In this way the air becomes progressively hotter as it moves up through the door and is therefore unable to cool the upper part of the door and the handle adequately.

[0008] The problem addressed by the present invention is therefore that of providing an oven door, particularly for a pyrolytic oven, capable of maintaining, during the high-temperature stage of operation, a temperature that is substantially even over every part of its outer surface.

[0009] This problem is solved by an oven door, in particular for a pyrolytic oven, comprising a support to which are fixed an inner panel, against the oven mouth, and an outer panel, between which panels are a first intermediate panel and a second intermediate panel, the said intermediate panels being separated by an intermediate gap having air inlets at the bottom of the door and air outlets at the top of the door, in which the said inner panel and the said first intermediate panel are separated by an inner gap and in which the said second intermediate panel and the said outer panel are separated by an outer gap, the said door being characterized in that the said intermediate gap is separated from the said inner and outer gaps, in that the said outer gap includes air inlets situated at the top of the door and the said inner gap includes air outlets situated at the top of the door and in that the said outer and inner gaps are in communication at the bottom of the door, so that air enters via the said inlets of the said outer gap and leaves via the said outlets of the said inner gap, creating a downward stream of air in the said outer gap in the opposite direction to the separate, upward stream in the said intermediate gap, and an upward stream of air in the said inner gap.

[0010] Generally speaking, the present invention relates to a method of cooling the outer surface of an oven door, in particular for a pyrolytic oven, characterized in that it employs, in the interior of the door, at least two separate streams of air flowing in opposite directions, one of which streams, which flows in a downward direction, is in contact with the outer panel of the said door.

[0011] Other features and advantages of the cold door for an oven forming the subject matter of the present invention will be made clearer in the description of various preferred embodiments furnished hereinbelow by way of non-restrictive indication, with reference to the following Figures:

Figure 1 is a perspective view with parts in section of an oven according to the present invention;
Figure 2 is a sectional side view of an oven door according to the present invention;
Figure 2a is a sectional view of the detail of the handle of the cold door in a second embodiment of the present invention;
Figure 3a is a top-down view of the lower strip supporting the panels of the door of Figure 2; and
Figure 3b is a side view in direction A1 of the detail shown in Figure 3a.

[0012] Referring now to Figures 1, 2, 3a and 3b, the oven according to the present invention, specifically a pyrolytic oven, which is given the general number 1, comprises a casing 2 containing a baking chamber 3, and a door 4 giving access to the interior of the oven.

[0013] The baking chamber 3 and the casing 2 each have their own side walls and bottom, top and rear walls. The said walls of the baking chamber 3 are made of a thermally insulating material such as e.g. refractory, and define in their interior a baking space 5 which will generally contain heating means, e.g. adjustable electrical resistors (not shown in the Figure) by which the internal temperature of the oven can be raised to the desired temperature. In particular, as already stated, for pyrolytic ovens this temperature can be as much as 400-500°C.

[0014] The baking chamber 3 and the casing 2 have no front wall, allowing the space 5 to communicate with the exterior through a front opening, which can be closed by the said door 4. To this end the door 4 is hinged in a conventional manner to the casing 2 along the lower

edge of the casing's front outline, thus allowing the door to be opened by swinging it down. It may alternatively be hinged along a side edge of the casing 2.

[0015] Between the baking chamber 3 and the casing 2 is a gap 6 which encloses the walls of the baking chamber so as to increase the thermal insulation between the interior of the baking space and the external surface of the oven. For this purpose the baking chamber 3 may be stood on supporting feet (not shown in the Figure) in order to keep it off the base of the casing 2 and so create a space even at its point of support. The casing 2 in turn may possess feet to keep it off the surface on which it stands.

[0016] Accommodated within the said gap 6 is a fan 7, which may be fixed either on the rear of the outer top wall of the baking chamber 3 or again on the rear of the inner top wall of the casing 2. This fan 7 is of conventional type, having fan blades driven by an electric motor, air intake openings, usually situated at the side or rear of the fan, depending on the type of rotor employed, and an air exhaust mouth 8 at the front so that the air is pushed forwards towards the point where it exits from the oven. Because this fan 7 is, as already stated, of conventional type, it will not be described in greater detail.

[0017] Set in front of the exhaust mouth 8 of the fan 7 is an exhaust duct 9. This duct is generally flat and flares out so that its air inlet is substantially the same as the exhaust mouth 8 and preferably connected to it, and one or more air outlets 10 situated all the way along the upper edge of the front face of the oven, above the door 4. If there is only a single outlet 10, this will run approximately the whole length of the upper edge of the oven.

[0018] Underneath the duct 9 is an intake duct 11 which is generally similar in shape to the said duct 9. The intake duct 11 will have one or more air inlets 12 situated underneath the outlets 10 of the exhaust duct 9, and outlets (not shown in the Figure) situated in positions roughly corresponding to the fan 7 air intakes which, as already stated, will generally be situated at the side or rear of the fan blades. These outlets of the intake duct 11 will not generally be connected to the air intakes of the fan 7, so that it can also extract air from the gap 6, setting up within the latter a circulation of cooling air which will further assist in lowering the temperature of the casing 2. Alternatively, the outlets of the intake duct 11 may be connected to the intakes of the fan 7, but the intake duct must possess further openings near the point of connection with the fan in order to extract air from the gap 6. Whichever arrangement is adopted, however, the casing 2 must include suitable inlets for the entrance of air from the exterior. These inlets (not shown) will generally be situated in the bottom or rear of the casing 2.

[0019] The door 4 is, as already stated, hinged to the casing 2 by conventional hinges 13. Leaks between the door 4 and the edge of the oven opening are prevented by seals 14, usually of rubber, placed either on the door or on the oven edge all the way around the frame of the oven opening (only the top and bottom seals 14 are shown in Figure 2). The result is to provide a narrow space between the edge of the oven and the door 4.

[0020] The front face of the oven also has a jutting edge 15 above the door and approximately flush with it. Once again, between this jutting edge 15 and the top of the door 4 a space is created which, as will be described in greater detail below, permits evacuation of the hot air passing out of the exhaust duct 9 towards the exterior.

[0021] The door 4 comprises a support 16 which is essentially the shape of a frame, thus having a central opening containing the transparent panels. The thickness of the support 16 is such as to permit the containment of at least four panels. The support 16 comprises a top closing side 16a and a bottom closing side 16b.

[0022] Along the top edge of the support 16 runs a handle 17 of conventional form.

[0023] Fixed to the said support 16, by means of suitable shaped strips 19, is an outer panel 18. These strips 19 are arranged in the manner of a frame around the four sides of the support 16 or, alternatively, only along the top and bottom edges. The outer panel 18, made of transparent material, possesses one or more air inlets 20 located in the upper part of the panel.

[0024] An inner panel 21 is also fixed to the support 16 by means of a lower supporting strip 22 and an upper supporting strip 22'.

[0025] The said lower 22 and upper 22' strips also support a first intermediate panel 23 and a second intermediate panel 24.

[0026] Both the inner panel 21 and the intermediate panels 23 and 24 are made of transparent material. This material must also be heat-resistant and be able to be treated in such a way as to reflect back the radiant heat from the oven interior. A preferred material is glass, optionally treated to give it reflective properties. These treatments belong to the prior art in the field and will not therefore be described in greater detail.

[0027] The size of the panels 21, 23 and 24 is preferably approximately the same as that of the central opening of the mouth of the oven, while the outer panel 18 may be larger. However, it is possible for the outer panel 18 to be approximately the same size as the other panels, in which case, however, the air inlets 20 will have to be formed directly on the support 16, in a position roughly corresponding to that which they would have had on the panel 18 as described earlier. This is because it is important that these inlets 20 be located in the upper part of the door, immediately beneath the handle 17 or, if the latter is lower than shown in Figure 2, above the handle.

[0028] The strips 22 and 22' are shaped and designed in such a way as to create gaps between the panels. In particular, the outer panel 18 and the second intermediate panel 24 are separated by an outer gap 25, while the inner panel 21 and the first intermediate panel 23 are separated by an inner gap 26. Lastly, the two inter-

mediate panels 23 and 24 are separated by an intermediate gap 27.

[0029] One side of the supporting strips 22 and 22' is fixed directly to the inside surface of the support 16, while the other side is fixed to an internal frame 28 (only the top and bottom sides of each are shown in Figure 2), which in turn is fixed internally to the support 16. Alternatively the frame 28 may be represented only by the top and bottom sides shown in the Figure.

[0030] Figures 3a and 3b show the detail of the lower supporting strip 22. This strip, which is of generally rectangular form, has a long side of approximately the same length as the base of the panels 21, 23 and 24. All the way along the length of the strip 22 run three pairs of walls in relief, which thus form three seats 30, 30a and 30b for receiving the edges of the respective panels, 21, 23 and 24. These seats 30, 30a and 30b are separated in such a way as to create, when the door has been assembled with its panels, the gaps 26 and 27.

[0031] On the base of the strip 22, between seat 30 and seat 30a, is an inlet 31 that runs virtually the entire length of the strip 22. As will be made clearer later, this inlet 31 allows a stream of air to enter the gap 26 from the outer gap 25.

[0032] Also on the base of the strip 22, but between seat 30a and 30b, are one or more inlets 32. These inlets 32 are provided with edges 33 that protrude downwards until they join with the lower closing side 16b of the support 16, on which are formed corresponding inlets 34 for the external air. In this way the intermediate gap 27 communicates only with the exterior, while being isolated from the outer 25 and inner 26 gaps. These last, meanwhile, are in flow communication through the gap created internally at the bottom of the door, between the strip 22 and the lower closing side 16b of the support 16. It is therefore evident that, if only one inlet 32 is provided, it must not extend along the entire length of the strip 22, otherwise its edge 33 would completely or almost completely obstruct the passage for the air between the outer and inner gaps.

[0033] The upper supporting strip 22' is identical to the strip 22, with the sole difference that the inlets 32 between seat 30a and seat 30b are replaced with an opening similar to the inlet 31 between seat 30 and seat 30a, which extends therefore the entire length of the strip. These openings in the strip 22', identified by the respective numbers 31' and 32', are outlets for the streams of air which flow separately through the gaps 26 and 27, respectively.

[0034] The outlets 31' lead into a chamber 35 enclosed between the strip 22', the upper part of the frame 28, the upper closing surface 16a and the inner upper part of the support 16.

[0035] The said chamber 35 includes one or more air outlets 36 positioned substantially opposite the intake inlets 12 of the intake duct 11.

[0036] As stated earlier, between the front edge of the oven and the door 4 a narrow gap is formed by the thickness of the seal 14 which runs around the mouth of the oven. The upper portion of this seal 14 is preferably located beneath the said air inlets 12 and outlets 36 so that the fan does not also draw in air from the oven interior.

[0037] Located above these inlets and outlets 12 and 36 is a seal 37, usually of rubber, which runs all the way along the front face of the oven. The function of this seal 37 is to insulate the inlets and outlets 12 and 36 from the gap through which the hot air is expelled to the outside by the fan 7, thus ensuring that it is not recirculated through the fan.

[0038] Again referring to the Figures, the system for cooling the door of a pyrolytic oven works as follows:

[0039] While the pyrolytic phase is being run, the temperature of the oven is raised to 400-500°C. The fan 7 then comes into operation.

[0040] The cold external air is drawn in through the inlets 20 and 34 and is then directed, after having passed through the interior of the door and having therefore cooled the outer panel 18, into the chamber 35. The air, still subject to the action of the vacuum created by the fan 7, passes out of the chamber 35 through the outlets 36 and enters the intake duct 11 through the various inlets 12.

[0041] The air is then expelled by the fan 7 into the exhaust duct 9, which it leaves via the outlets 10 and emerges into the exterior in a forward direction.

[0042] As already stated, the seals 14 ensure that air is not also extracted from the interior of the oven, as this would produce an undesirable diminution of the temperature of the interior of the baking space and would also lower the intake efficiency of the fan 7.

[0043] The seal 37, on the other hand, ensures that the departing hot air is not recycled. Furthermore, because the gap between the door 4 and the jutting edge 15 of the oven communicates with the exterior, omission of the seal 37 would result in intake of air from the exterior which would compete with the hot air passing out of the exhaust duct 9. This would lower the efficiency of the entire door cooling system.

[0044] The path of the air through the interior of the door is as follows: Air which enters through the inlets 20 under the action of the vacuum produced by the fan 7 flows down through the outer gap 25 and then enters the inner gap 26 through the inlet 31 after passing through the gap between the supporting strip 22 and the lower closing side 16b of the support 16 (a gap which, as mentioned, permits communication between the outer gap 25 and the inner gap 26). The air then flows up the inner gap 26 before passing out through the outlets 31'.

[0045] External air is also drawn in through the inlets 34 and enters the intermediate gap 27 through the corresponding inlets 32 before passing up through the gap and exiting it through the outlets 31'. This stream of air is separated from the stream flowing through the outer gap 25 and inner gap 26 by the presence of the edges

33 which join the inlets 32 to the inlets 34, thus forming what are actually suction ducts.

[0046] Air which travels down the outer gap 25 is therefore moving in the opposite direction to air travelling up the intermediate gap 27. This has the effect of increasing the heat exchange efficiency and results in an even temperature at every point of the outer surface of the panel 18. This contrasts with doors of the prior art in which the stream of air is always in an upward direction, so that the top of the door is always in contact with air which has been heated during its passage up the door. In the cold door of the present invention, on the other hand, the top of the outer panel 18 is directly in contact with the cold air drawn in from the exterior.

[0047] This fact, together with the positioning of the air inlets 20 directly beneath the handle 17, also means that the temperature of the lower surface of the handle 17, which comes into contact with the user's hand, can be kept low.

[0048] In a second embodiment of the present invention, as shown in Figure 2a, the handle 17 may have a deflector 38 on its upper surface. The aim is to prevent hot air coming forwards out of the exhaust duct 9 from blowing directly onto the user.

[0049] The system for cooling the oven door to which this invention relates can be actuated automatically when the temperature of the inside of the baking space exceeds a certain threshold, in which case the system will include an actuating and controlling unit (not shown in the Figures) connected to a thermocouple inside the baking space 5 and to a microswitch connected to the fan 7. When the thermocouple reads a temperature above the set temperature, the actuating and controlling unit throws the microswitch which starts the fan 7.

[0050] Alternatively, the microswitch that acts on the fan 7 may be thrown directly by the user, for example by means of the same external control by which the cooking temperature is selected. These types of control, usually knobs, are of known type and will not therefore be described in more detail.

[0051] It will be obvious that the above description has been only of a particular embodiment of the cold door for an oven forming the subject-matter of the present invention, to which those skilled in the art will be capable of applying all such modifications as may be necessary for adaptation to particular applications, without thereby departing from the scope of protection of the present invention.

[0052] For example, the cold door forming the subject matter of the present invention may be used for an ordinary oven rather than for a pyrolytic oven. In this case, it may be convenient to redesign the door structure, for example reducing the thickness of the transparent panels in line with the lower temperature achieved in the oven interior.

Claims

1. Oven door, in particular for a pyrolytic oven, comprising a support (16) to which are fixed an inner panel (21), against the oven mouth, and an outer panel (18), between which panels are a first intermediate panel (23) and a second intermediate panel (24), the said intermediate panels being separated by an intermediate gap (27) having air inlets (32) at the bottom of the door and air outlets (32') at the top of the door, in which the said inner panel (21) and the said first intermediate panel (23) are separated by an inner gap (26) and in which the said second intermediate panel (24) and the said outer panel (18) are separated by an outer gap (25), the said door being characterized in that the said intermediate gap (27) is separated from the said inner (26) and outer (25) gaps, in that the said outer gap (25) includes air inlets (20) situated at the top of the door and the said inner gap (26) includes air outlets (31') situated at the top of the door and in that the said outer (25) and inner (26) gaps are in flow communication at the bottom of the door, so that air enters via the said inlets (20) of the said outer gap (25) and leaves via the said outlets (31') of the said inner gap (26), creating a downward stream of air in the said outer gap (25) in the opposite direction to the separate, upward stream in the said intermediate gap (27), and an upward stream of air in the said inner gap (26).

2. Oven door according to Claim 1, in which the said door comprises one or more air outlets (36) situated in the rear of the door, in its upper part.

3. Oven door according to Claim 1 or 2, comprising a handle (17) positioned immediately above or immediately beneath the said inlets (20) for the external air.

4. Oven door according to anyone of Claims 1 to 3, in which the said handle comprises, on its upper surface, a deflector (38) for the air coming from the interior of the door.

5. System for cooling the outer surface of an oven door, in particular for a pyrolytic oven, the said system comprising:

   - a door (4) according to anyone of Claims 1 to 4, and
   - a fan (7) to which an intake duct (11) and an exhaust duct (9) are connected,
   - the said intake duct (11) having one or more air inlets (12) situated approximately opposite the outlets (36) of the door (4), and
   - the said exhaust duct (9) having one or more air outlets (10) situated above the door (4), all

the way along the upper edge.

6. System according to Claim 5, in which the said exhaust (9) and intake ducts (11) are flat and flared, and in which the said intake duct (11) comprises air inlets situated close to the point of connection with the fan (7).

7. Oven, in particular pyrolytic oven, comprising a casing (2) closed at the front by a hinged door (4), the said casing (2) containing a baking chamber (3), a gap (6) being provided between the said casing (2) and the said baking chamber (3), and the said baking chamber having walls of thermally insulating material and comprising heating means in its interior, the oven being characterized in that it comprises a system for cooling the outer surface of the said door (4) according to Claims 5 or 6.

8. Oven according to Claim 7, in which the said baking chamber (3) stands on feet and in which the said casing (2) comprises air inlets.

9. Oven according to Claim 7 or 8, in which a seal (14) is located between the said door (4) and the opening giving access to the baking space (5) of the baking chamber (3), below the said air outlets (36) of the door and below the said inlets (12) leading into the intake duct (11).

10. Oven according to anyone of Claims 7 to 9, in which a seal (37) is located above the said air outlets (36) of the door and above the said inlets (12) leading into the intake duct (11).

11. Method of cooling the outer surface of an oven door (4), in particular for a pyrolytic oven, characterized in that it employs, in the interior of the door, at least two separate streams of air flowing in opposite directions, one of which streams, which flows in a downward direction, is in contact with the outer panel (18) of the said door.

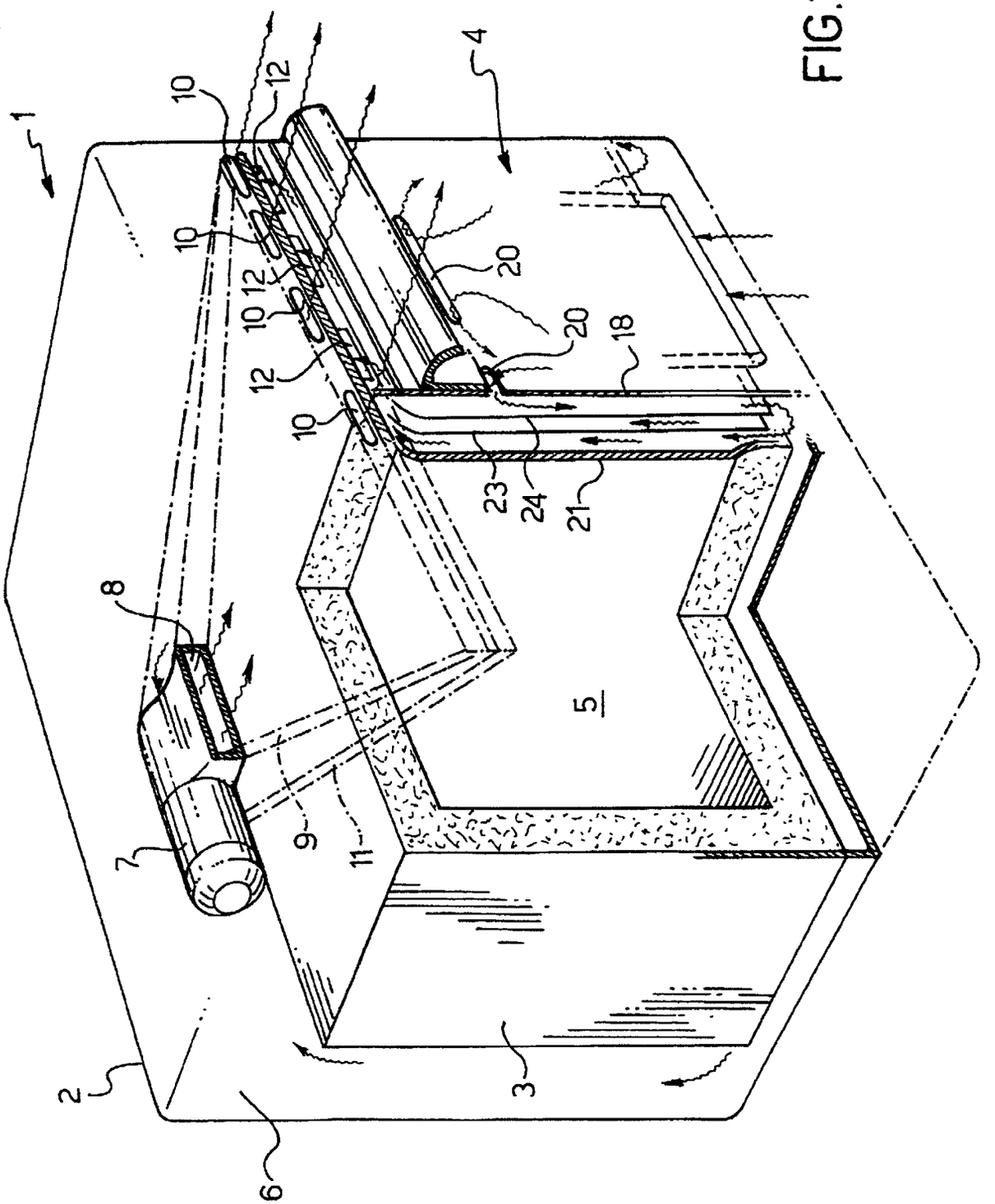

FIG.1

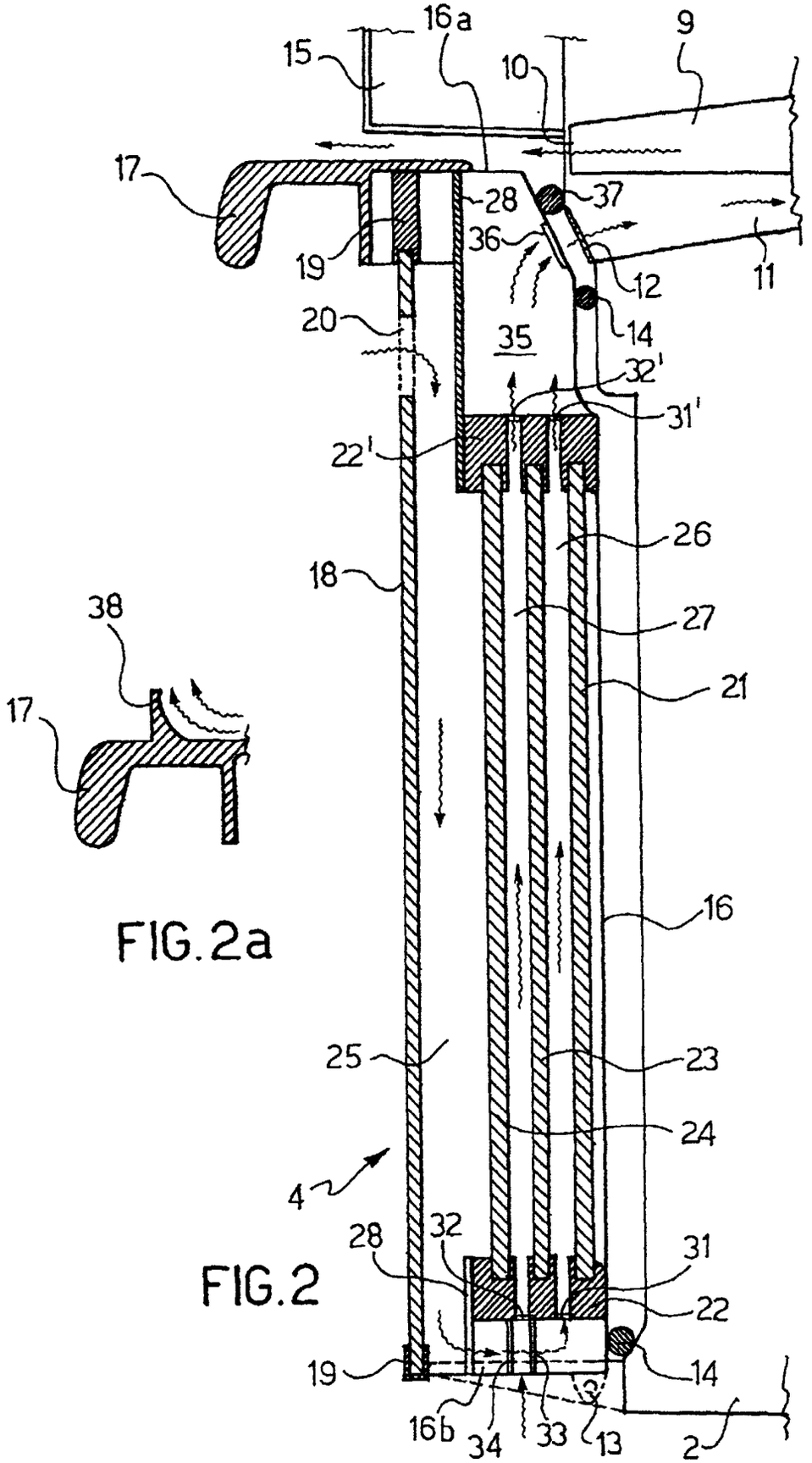
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FIG.2a

FIG.2

FIG.3a

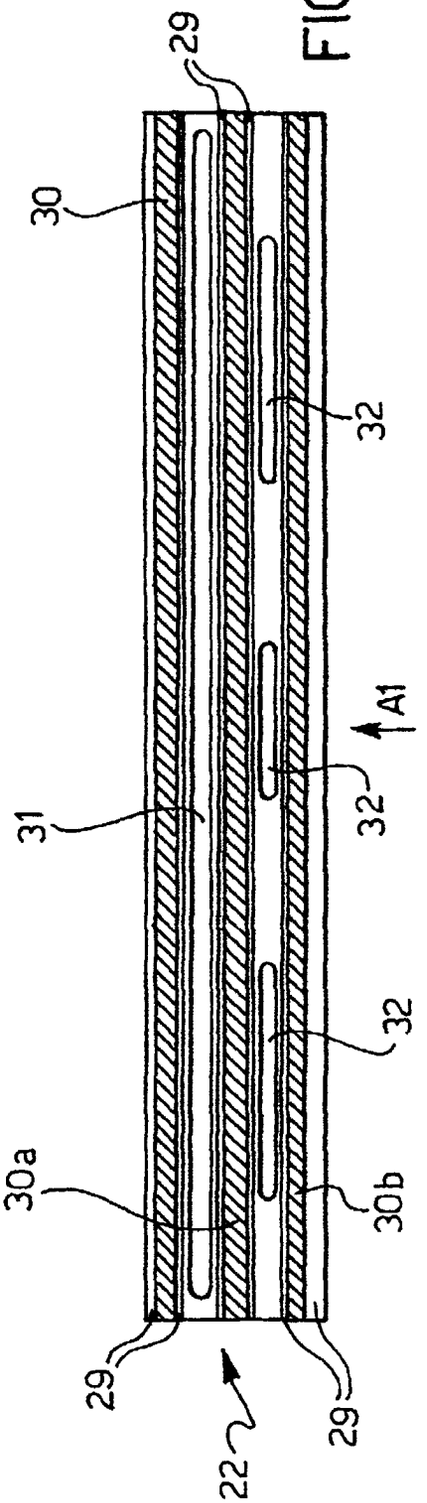
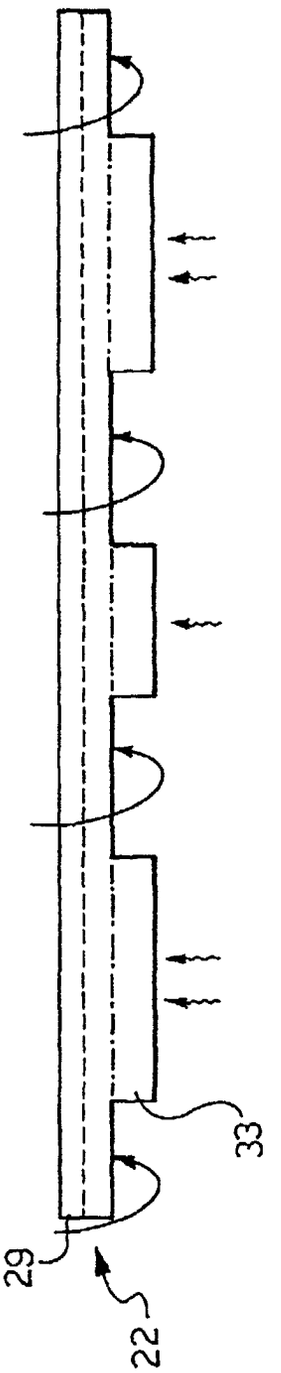


FIG.3b



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EUROPEAN SEARCH REPORT

Application Number
EP 99 83 0024

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	27 May 1999	Filtri, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 83 0024

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
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