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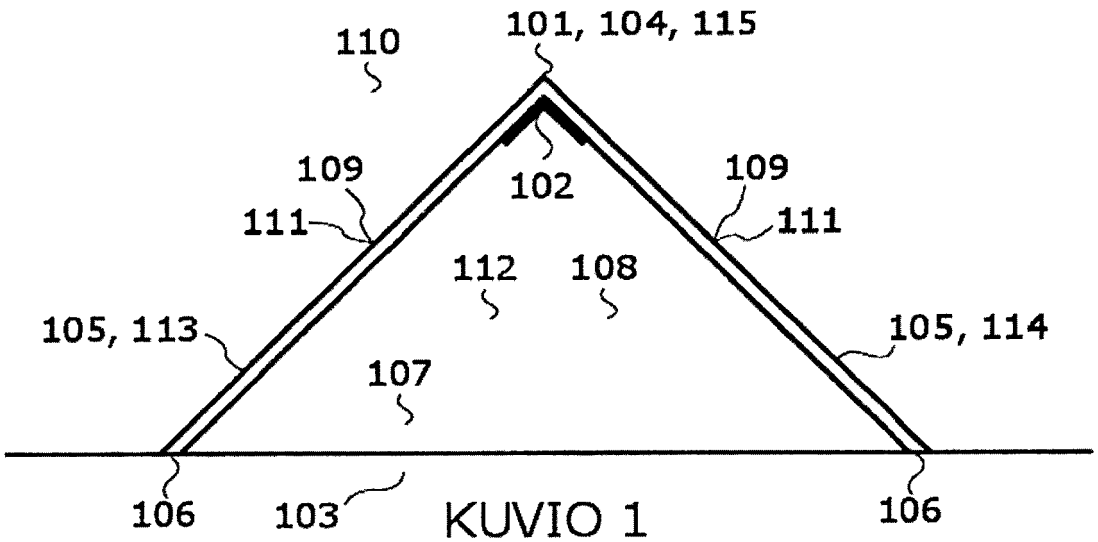
(54) **PLANE DRYER**

(57) The invention relates to removing moisture from the floor of a building or from other planar structures. A plane dryer comprises a heat source for increasing temperature of a plane (103) to be dried, the heat removing moisture from the plane as water vapor. A guidance box (104) of the plane dryer comprises a side structure such that its contiguous edge (106) is intended to be set against the plane to be dried. Drying of the plane happens in a closed air space inside the guidance box. The plane dryer comprises at least one exit route (109) for water vapor from the guidance box to an ambient (110) and sealing material (111) on said at least one exit route. The sealing material has such feature that, due to diffusion, water vapor penetrates it and simultaneously the sealing material prevents a penetration of air.



KUVIO 1

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Description

[0001] Invention relates to removing moisture from the floor of a building or other planar structures, the invention especially relates to drying techniques for water damages.

Background of the technology

[0002] Drying of moist concrete, brick, or other constructions requires a lot of energy and causes thermal stress. The thermal stress means that heat spreads from a room or some other structure to be dried to another part of the room or the building. People may live during repairs in an apartment to be dried and the employees performing the repairs may need to work in the building in the apartment to be dried. Drying of the constructions may make the room temperature harmful high.

[0003] Condensing dryers, absorption dryers, microwave dryers, and infrared dryers are mentioned as examples of the prior art. In addition, the prior art includes dryers which have an air guidance box and a heat blower inside them to create warm air, and a separated blower to remove moist air from the air guidance box. A weakness of this solution is spreading of the heat and also spreading of dust in a building.

[0004] FI20050121 describes an air circulating flat surface dryer that consumes less energy compared to a number of other solutions, and yet it provides a short drying time. The air circulating flat surface dryer exhausts a small amount of air from the guidance box and takes make-up air from the ambient. Due to the exhaust air also the air circulating flat surface dryer causes thermal discharge to the ambient and spreading of dust. The dust entering with the make-up air further deteriorates the operation of the dryer.

Summary of the invention

[0005] An objective of the invention is a plane dryer which is capable to dry fast wet constructions with a small amount of energy and which causes only a minor thermal discharge and remains the air clean. In other words, the plane dryer does not spread dust to its ambient. In addition, ambient dust cannot enter into the plane dryer. This is possible because of a closed air circulation, wherein substantially the same air circulates in a closed air space between a guidance box and a floor, a wall, or some other plane-type-of construction to be dried.

[0006] The invention concerns the plane dryer intended for a plane-type-of construction, shortly a plane. The plane dryer comprises a heat source for increasing a temperature of a plane to be dried so that a heat caused by the heat source removes moisture from the plane as water vapor. The plane dryer comprises a guidance box for insulating the heat. A contiguous edge in a side structure of the guidance box is intended to be set against the plane to be dried. Then the water vapor caused by the heat accumulates into an air space inside the guidance box. The plane dryer comprises at least one exit route for the water vapor from the air space to an ambient.

[0007] The plane dryer further comprises sealing material on said at least one exit route to make the air space a closed air space. The sealing material has such features that the water vapor accumulated inside the guidance box penetrates, due to diffusion, the sealing material and moves from the closed air space to the ambient, and simultaneously the sealing material prevents a penetration of air.

[0008] Thus, the plane dryer in accordance with the invention is based on the diffusion. Moisture can exit the guidance box as water vapor but air cannot. Use of the heat source in the closed air space causes an air circulation, and due to the air circulation the water vapor moves from the surface of the plane to proximity of said at least one exit route.

[0009] Effectivity of the plane dryer can be enhanced with a blower and/or a bulkhead by which the closed air space is divided into a diffusion chamber and a drying chamber.

Brief description of the drawings

[0010] For a more complete understanding of examples and embodiments of the present invention, reference is now made to the following descriptions taken in connection with the accompanying drawings in which:

FIGURE 1 shows an elementary implementation for a plane dryer,

FIGURE 2 shows a plane dryer comprising a heat blower,

FIGURE 3 shows a guidance box comprising a bulkhead and diffusion windows,

FIGURE 4 shows the guidance box and the bulkhead from a bird's perspective,

FIGURE 5 shows a plane dryer comprising the bulkhead.

Detailed description of the invention

[0011] It is appreciated that the following embodiments are exemplary and although the specification may refer to "one" embodiment, the reference is not necessarily made to the same embodiment(s) but the feature in question may apply to multiple embodiments.

[0012] **FIGURE 1** shows an example of a plane dryer 101 in accordance with the invention. Plane dryer 101 comprises a heat source 102 for increasing temperature of a plane 103 to be dried as well as a guidance box 104. Guidance box 104 comprises a side structure 105, whose contiguous edge extends around guidance box 104 and

is intended to be set against plane 103 to be dried. Plane 103 is, for example, a part of a real estate structure such as a floor, a wall, or a ceiling. The heat produced by heat source 102 causes evaporation of moisture, as water vapor 107, from plane 103 to be dried. Guidance box 104 is able to insulate heat because of its manufacturing material, or because of a thermal insulator added to it.

[0013] Plane dryer 101 is configured to function using a closed air circulation so that setting guidance box 104 against plane 103 results in an air space 108 into which the moisture turned into water vapor 107 move from the surface of plane 103. Plane dryer 101 comprises at least one exit route 109 for water vapor 107 from air space 108 to ambient 110, and sealing material 111 on said at least one exit route to make air space 108 a closed air space. Assuming that guidance box 104 as whole is made of sealing material 111, water vapor 107 has more than one exit route.

[0014] Sealing material 111 has such features that, due to diffusion, water vapor 107 penetrates sealing material 111 and simultaneously sealing material 111 prevents a penetration of air. In other words, except unintended air leaks air does not move from air space 108, which is closed, to ambient 110 or vice versa. In one embodiment sealing material 111 comprises at least one of the following materials: wool, flax, wood, wood fiber, felt, or synthetic felt. In one embodiment the heat source to be used with plane dryer 101 is one of the following heaters: a resistor, a convection heater, a blower heater, a radiator heater, an infrared heater.

[0015] In Figure 1 sealing material 111 is wood fiber and heat source 102 is an infrared heater. An end 112 of guidance box 104 and the opposite end (not shown in the figure) as well as sides 113, 114 attached to the ends are made of wood fiber by using a mold. Side structure 105 of guidance box 104 is composed of the ends and sides 113, 114. Sides 113, 114 touch each other and form a ridge 115 of guidance box 104. Heat source 102, i.e. the infrared heater, is attached to the inner surface of ridge 115. A reflection surface for heat source 102 is formed such that the infrared beams meat plane 103 between sides 113, 114.

[0016] **FIGURE 2** shows another example of plane dryer 101. Plane dryer 101 comprises a resistor 201 and a blower 202, and its guidance box 104 comprises, in addition to side structure 105, a deck 203. Deck 203 is a rectangular polyurethane board. Side structure 105 is composed of four wood fiber pieces. These pieces are attached with glue to the sides of the rectangular polyurethane board. Slices 204 of the four wood fiber pieces, which locate between deck 203 and plane 103, provide at least one exit route 109 for water vapor 107.

[0017] Blower 202 forces an air heated by resistor 201 to a circulation in air space 108, which increases evaporation of moisture from plane 103. Blower 202 is located so that it can force with its vanes air and water vapor 107 towards side structure 105 and slices 204 and thus enforce the diffusion of water vapor 107 from air space 108 to ambient 110.

[0018] In this example blower 202 and resistor 201 form one device, i.e. a heat blower 205. Power cord 206 of blower heater 205 is lead to heat blower 205 through a pipe 207. Pipe 207 penetrates a hatch 208 that is made by cutting a hole with a hot cutter to the polyurethane board functioning as deck 203. Heat blower 205 can be placed inside guidance box 104 by lifting from pipe 207 and, when heat blower 205 is put down on plane 103, hatch 208 closes deck 203.

[0019] **FIGURE 3** shows guidance box 104 comprising a bulkhead 301 and diffusion windows 302, 303. Diffusion window 302, 303 is arranged on at least one exit route 109 intended for water vapor. Diffusion window 302, 303 comprises on the wall of guidance box 104 an aperture that is sealed with sealing material 111.

[0020] Guidance box 104 is made, for example, by twisting an aluminum board or some other metal board so that guidance box 104 comprises side structure 105, a deck 304, and a bulkhead 301. A thermal insulation is omitted from this figure. Bulkhead 301 divides air space 108 into a diffusion chamber 305 and a drying chamber 306 so that diffusion chamber 305 is positioned between bulkhead 301 and deck 304. Drying chamber 306 opens towards plane 103 to be dried when contiguous edge 106 of side structure 105 is set against plane 103. Diffusion windows 302, 303 are located in diffusion chamber 305.

[0021] Bulkhead 301 comprises air apertures 307 between diffusion chamber 305 and drying chamber 306. In one embodiment air apertures 307 comprise an air intake 308 for a blower arrangement 310 and further drying chamber apertures 309 is located in proximity of side structure 105. Blower arrangement 310 can be implemented in different manners and thus it is shown with dashed lines. Blower arrangement 310 is configured to force air portions in diffusion chamber 305 towards at least one diffusion window 302, 303 at which time the air portions move through drying chamber apertures 309 to drying chamber 306 and from there via air intake 308 back to diffusion chamber 305. When blower arrangement 310 is in use in diffusion chamber 305 the air pressure is somewhat higher in diffusion chamber 305 than in drying chamber 306. Surface areas of air aperture 307 have such sizes that, during the drying, an over pressure prevails in diffusion chamber 305 also compared to ambient 110.

[0022] Diffusion is a phenomenon in which molecules aim to move from a high concentration to a low concentration decreasing the concentration differences. When water molecules are gathered in proximity of diffusion windows 302, 303, the number of water molecules per a volume unit is substantially higher in diffusion chamber 305 than in the opposite side of diffusion windows 302, 303 (i.e. in ambient 110) due to which the water molecules move from diffusion chamber 305 to ambient 110. Heat source 102 included in plane dryer 101 increases (when on) the temperature of air space 108 and creates temperature differences in air space 108. Because of

these temperature differences there are air flows in air space 108 and the air flows conduct water vapor 107 to an inner surface of guidance box 104. The humidity percent is high due to water vapor 107 and the air temperature is, for example, 60 °C. When the ambient temperature is substantially colder, for example 20 °C, and the humidity percent is typical for a residential building, water vapor 107 conducts in any case to ambient 110.

[0023] Nevertheless, diffusion chamber 305 and blower arrangement 310 enforce the diffusion. Thus, a benefit of diffusion chamber 305 and blower arrangement 310 is that they speed up drying of plane 103 by enforcing the diffusion.

[0024] **FIGURE 4** shows from a bird's perspective bulkhead 301 and guidance box 104 without a deck. In the figure plane 103 to be dried is covered by bulkhead 301. Guidance box 104 to be used with bulkhead 301 is rectangular and it comprises two long sides 401, 402 and two shorter sides 403, 404. Side structure 105 of guidance box 104 comprises diffusion windows 302 and 303 on short sides 403, 404, and diffusion windows 405 and 406 on long sides 401, 402. The both long sides 401, 402 have 13 diffusion windows and the both short sides 403, 404 have 11 diffusion windows and thus, in this example, there are altogether 48 diffusion windows. When the combined area of said 48 diffusion windows is 1 - 3 percent from the surface area of plane 103 to be dried the drying result for plane 103 will be good.

[0025] Drying chamber apertures 309 formed into side structure 105 are located close to said diffusion windows, such as diffusion windows 302, 303, 405, 406. There are as many drying chamber apertures 309 as diffusion windows, i.e. 48. Air intake 308 intended for blower arrangement 310 is located in the middle of bulkhead 301. Arrows illustrate air flows 407 on plane 103 towards the corners of guidance box 104 and the other arrows illustrate air flows 408 on the opposite side of bulkhead 301. Drying chamber apertures 309 are located in bulkhead 301 such that the air circulation via them causes air flows 407, 408. Air flows 408 and heat evaporate the moisture. A benefit of this embodiment is that it enforces drying of plane 103 by increasing the evaporation.

[0026] **FIGURE 5** shows a third example of plane dryer 101. In this embodiment guidance box 104 comprises a deck 501, and a resistor attached to the inner surface of deck 501 operates as heat source 102. A motor 502 of blower 202 is attached to an outer surface of deck 501 and an axel intended for rotating blower vanes 503 extend through deck 501. The implementation includes such benefit that motor 502 is protected from the heat and moisture prevailing under deck 501. Bulkhead 301 in plane dryer 101 is implemented so that its sides 504 are twisted outwards from deck 501 and sides 504 are parallel with sides 505 included in side structure 105 of guidance box 104.

[0027] In one embodiment sealing material 111 is felt made of wool. Felt passes water vapor through itself, but not air, and felt further isolates heat. A strip 506 (made of felt) is attached (with fasteners) to side structure 105 and strip 506 covers apertures made on side structure 105. Thus, diffusion windows 302, 303 are formed at those apertures. Guidance box 104 can be made of aluminum or (perforated) steel, if it is allowed to work or walk on it. Plastic is possible but not as solid production material.

[0028] Strip 506 is partly located between side structure 105 and bulkhead 301 and thus it seals a gap between sides 504, 505. Sides 504, 505 are attached to each other with screws.

[0029] An edge 507 of strip 506 extends longer than contiguous edge 106 of side structure 105 and is foldable such that it gets pressed between contiguous edge 106 of side structure 105 and plane 103 and therefore it operates as a seal between guidance box 104 and plane 103.

[0030] In the example shown in the figure guidance box 104 is made of sea aluminum and, in order to enhance a thermal isolation, a thermal insulator 508 is added to guidance box 104. Thermal insulator 508 is a plate which tolerates moisture and heat and which covers the inner surface of deck 501. Strip 506 thermally isolates side structure 105 of guidance box 104, thus guidance box 104 is fully thermally isolated.

[0031] In the following are given some examples how the before-mentioned embodiments can be completed or altered. Although plane heater 101 requires heat source 102, heat source 102 may locate relative far from guidance box 104, if the heat is conducted with a fluid into guidance box 104. The fluid, which is cooled, is conducted in another pipe back to heat source 102. Correspondingly, it is possible to place blower 202 far from guidance box 104. Blower arrangement 310 can be implemented such that a blower heater comprises heat source 102 and blower 202 and air functions as the fluid that is conducted in a pipe into guidance box 104 and in another pipe back to the blower heater.

[0032] While the present invention has been described in connection with a number of exemplary embodiments, and implementations, the present invention is not so limited, but rather covers various modifications, and equivalent arrangements, which fall within the purview of prospective claims.

Claims

1. A plane dryer (101) comprising
   a heat source (102) for increasing a temperature of a plane (103) to be dried, a heat caused by the heat source removing moisture from the plane as water vapor,
   a guidance box (104) for insulating the heat, the guidance box comprising a side structure (105) whose contiguous edge (106) is intended to be set against the plane to be dried, the water vapor (107) caused by the heat accumulating into an air space (108) in-

side the guidance box, and
at least one exit route (109) for the water vapor from the air space to an ambient (110),
characterized in that the plane dryer further comprises
sealing material (111) on said at least one exit route (109) to make the air space (108) a closed air space, the sealing material having such features that the water vapor penetrates, due to diffusion, the sealing material and moves from the closed air space to the ambient and simultaneously the sealing material prevents a penetration of air.

2. The plane dryer as claimed in claim 1, **characterized in that** the sealing material includes at least one of the following materials: wool, flax, wood, wood fiber, felt, synthetic felt.

3. The plane dryer as claimed in claim 1, **characterized in that** the heat source is one of the following heater: a resistor (201), a convection heater, a blower heater (205), a radiator heater, an infrared heater.

4. The plane dryer as claimed in claim 1, **characterized in that** the plane dryer comprises
a blower (202) for circulating air in the closed air space, a circulation of the air increasing the removing of the moisture from the plane.

5. The plane dryer as claimed in claim 4, **characterized in that** the blower is located inside the guidance box such that the blower is capable to force with its blower vanes (503) air towards said at least one exit route, increasing the removing of the moisture from the plane.

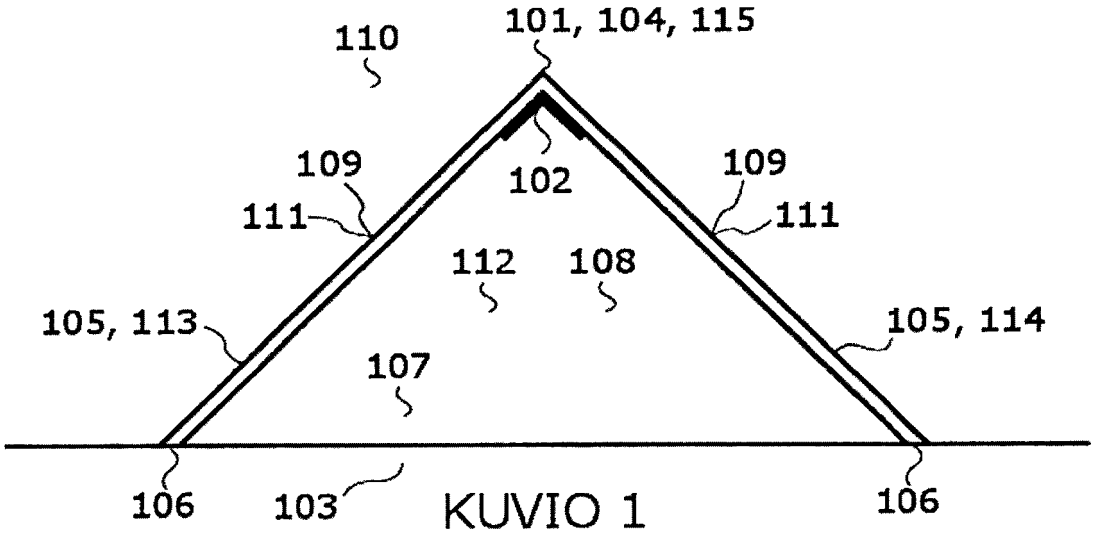
6. The plane dryer as claimed in claim 4, **characterized in that**, in addition to the side structure, the guidance box comprises a deck (501) and the heat source is attached to an inner surface of the deck and a motor of the blower is attached to an outer surface of the deck.

7. The plane dryer as claimed in claim 1, **characterized in that** the plane dryer comprises
a bulkhead (301) for dividing the closed space by the bulkhead into a diffusion chamber (305) and a drying chamber (306) so that the drying chamber opens towards the plane (103) when the contiguous edge (106) of the side structure (105) is placed against the plane (103), and the bulkhead comprises air apertures (307) between the diffusion chamber and the drying chamber, said at least one exit route is located in the diffusion chamber.

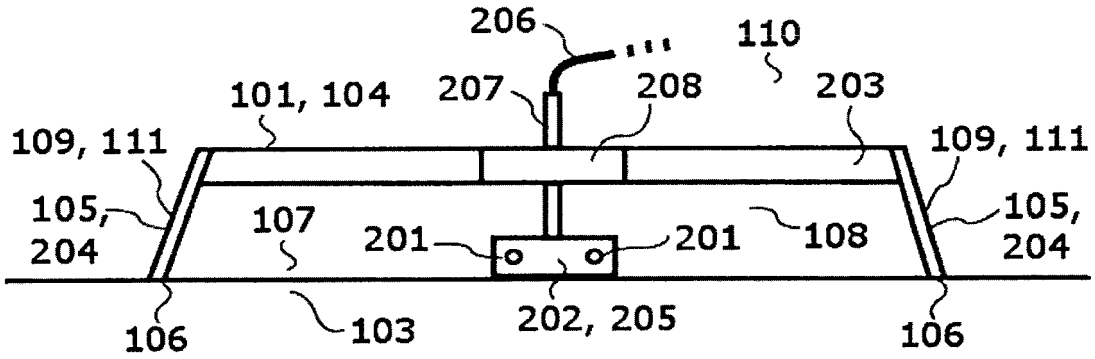
8. The plane dryer as claimed in claims 4 and 7, **characterized in that** the apertures comprises an air intake (308) intended for the blower and drying chamber apertures (309) in the proximity of the side structure, and the blower is configured to push air portions towards, said at least one exit route, the air portions moving via the drying chamber apertures into the drying chamber and from there via the air intake back to the diffusion chamber.

9. The plane dryer as claimed in claim 7, **characterized in that** the sealing material forms a strip (506) that is at least partly located between the side structure and the bulkhead.

10. The plane dryer as claimed in claim 1, **characterized in that** a diffusion window (302, 303) is arranged at said at least one exit route, the diffusion window comprising such aperture formed on a wall of the guidance box that is closed with the sealing material.



KUVIO 1



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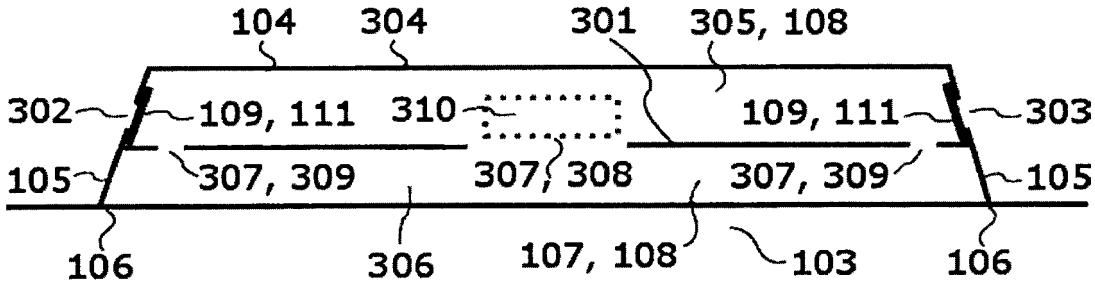

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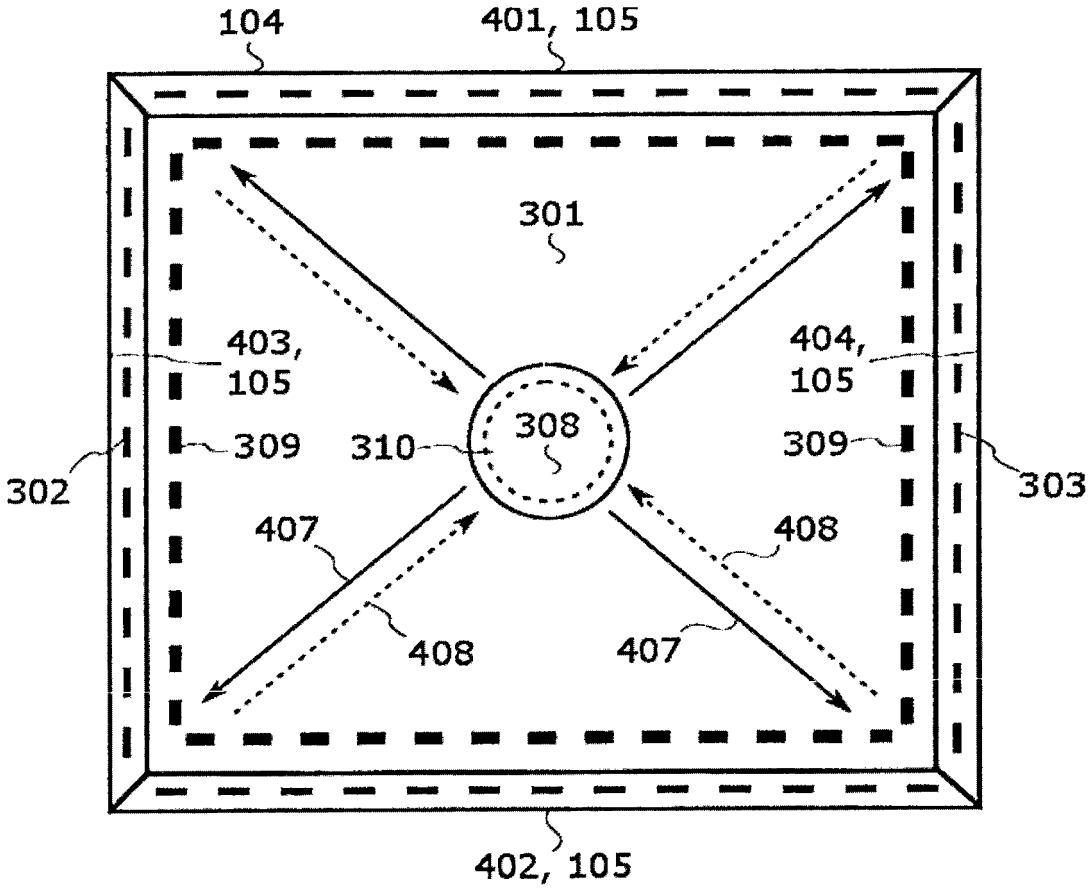
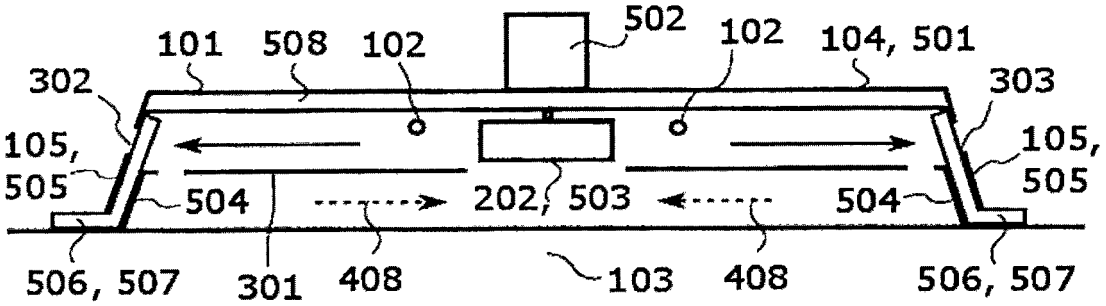


KUVIO 4



KUVIO 5

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EUROPEAN SEARCH REPORT

Application Number
EP 17 00 1511

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 Y A	EP 0 612 883 A1 (TAMPELLA OY VALMET [FI]) 31 August 1994 (1994-08-31) * column 2, line 37 - column 4, line 55; figures 1-3 * -----	1-3,6,8, 10 4,5,7 9	INV. F26B9/02 E04B1/70 F26B21/02 F26B25/06
X A	US 2010/226629 A1 (BASOL BULENT M [US] ET AL) 9 September 2010 (2010-09-09) * figures 1-26 * -----	1 2-10	
Y	US 2006/196074 A1 (VILHUNEN JUHANI [FI]) 7 September 2006 (2006-09-07) * figures 1-5 * -----	4,5,7	

TECHNICAL FIELDS SEARCHED (IPC)

F26B
E04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 March 2018	Makúch, Milan

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

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

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