(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 467 914 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.11.2024 Bulletin 2024/48

(21) Application number: **24177161.7**

(22) Date of filing: **21.05.2024**

(51) International Patent Classification (IPC):
F28D 1/03 *(2006.01)* ***F28D 21/00*** *(2006.01)*
F28F 3/04 *(2006.01)* ***E03C 1/04*** *(2006.01)*
F28B 1/02 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F28D 21/0012; E03C 1/0408; F28D 1/0308;
E03C 2001/005; F28B 1/02; F28F 3/048

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

(30) Priority: **23.05.2023 US 202363503826 P**
20.05.2024 US 202418668845

(71) Applicant: **Kohler Co.**
Kohler, WI 53044 (US)

(72) Inventors:
- **KALK, William**
  Kohler, 53044 (US)
- **KURU, William**
  Kohler, 53044 (US)

(74) Representative: **Barker Brettell LLP**
100 Hagley Road
Edgbaston
Birmingham B16 8QQ (GB)

(54) SHOWER STEAM CONDENSER

(57) A heat exchanger for a shower environment includes a panel having an inlet, an outlet, and a plurality of flow channels. The panel is disposed within the shower environment. The plurality of flow channels fluidly couples the inlet with the outlet. The panel is configured to condense steam to heat a fluid flowing through the plurality of flow channels.

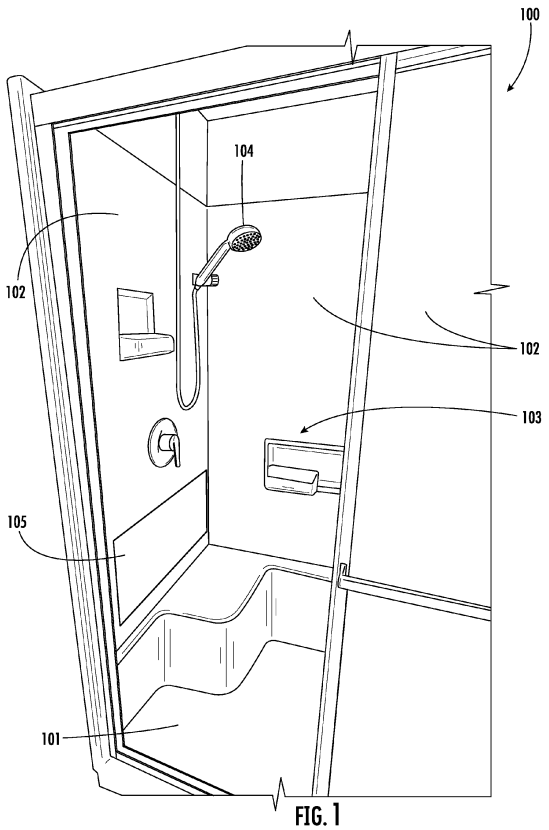

FIG. 1

EP 4 467 914 A1

Description

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

[0001] This application claims the benefit of and priority to U.S. Provisional Patent Application No. 63/503,826, filed May 23, 2023, and U.S. Patent Application No. 18/668,845, filed May 20, 2024, which are incorporated herein by reference in its entirety.

BACKGROUND

[0002] Shower systems in which excess warm liquid from the shower is used to heat incoming cold water are gaining increased prominence as part of an effort to make showers more energy efficient and less wasteful.

SUMMARY

[0003] One embodiment relates to a heat exchanger for a shower environment. The heat exchanger includes a panel having an inlet, an outlet, and a plurality of flow channels. The panel is disposed within the shower environment. The plurality of flow channels fluidly couples the inlet with the outlet. The panel is configured to condense steam to heat a fluid flowing through the plurality of flow channels.

[0004] Another embodiment relates to a method of heating a fluid for a shower environment. The method includes providing a panel disposed within the shower environment, the panel including an inlet, an outlet, and a plurality of flow channels fluidly coupling the inlet with the outlet, condensing, by the panel, steam within an interior volume of the shower environment, receiving, by the inlet, a supply of the fluid from a fluid source, heating, by the panel, the fluid flowing through the plurality of flow channels, and supplying, by the outlet, the fluid heated by the condensed steam to a fixture of the shower environment, the fixture configured to direct the fluid to the interior volume.

[0005] Another embodiment relates a shower environment. The shower environment includes a sidewall, a floor, an interior volume defined by the sidewall and the floor, a fixture configured to direct a fluid to the interior volume, and a heat exchanger including a panel disposed along the sidewall within the interior volume. The panel includes an inlet configured to receive a supply of the fluid at a first temperature, an outlet fluidly coupled with the fixture and configured to supply the fluid at a second temperature, and a plurality of flow channels fluidly coupling the inlet with the outlet. The panel is configured to condense steam to heat the fluid flowing through the plurality of flow channels such that the second temperature is greater than the first temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The accompanying drawings are not intended to be drawn to scale. Like reference numbers and designations in the various drawings indicate like elements. For purposes of clarity, not every component can be labeled in every drawing. Understanding that these drawings depict only several implementations in accordance with the disclosure and therefore, not to be considered limiting of its scope, the disclosure will be described with additional specificity and detail through use of the accompanying drawings.

FIG. 1 shows a perspective view of a shower system including a shower steam condenser panel, according to an exemplary embodiment.

FIG. 2 shows a cross-section view of the shower steam condenser panel of FIG. 1, according to an exemplary embodiment.

FIG. 3 shows a front view of the shower steam condenser panel of FIG. 1 with a front plate removed, according to an exemplary embodiment.

FIG. 4 shows a perspective view of the shower steam condenser panel of FIG. 1 with the front plate removed, according to an exemplary embodiment.

DETAILED DESCRIPTION

[0007] According to an exemplary embodiment, an improved shower system for capturing thermal energy from waste shower water is discussed herein. The shower system may include positioning a shower steam condenser panel inside of a shower to condense steam to heat incoming cooler water.

[0008] The various concepts introduced above and discussed in greater detail below may be implemented in any of numerous ways, as the described concepts are not limited to any particular manner of implementation. Examples of specific implementations and applications are provided primarily for illustrative purposes.

[0009] Shower systems may utilize heat exchangers in a drain to capture thermal energy from waste shower water to heat incoming shower water. However, not all the thermal energy is captured as some thermal energy escapes the shower in the form of steam. Condensing steam from a shower to capture energy to heat incoming shower water would be advantageous. The present application relates generally to the field of condensing steam from a shower to heat incoming shower water.

[0010] Referring to FIG. 1, a shower environment (e.g., shower, steam room, spa, etc.), shown as shower system 100, includes a heat exchanger, shown as shower steam condenser panel 105, according to an exemplary embodiment. The shower system 100 may be located in a bathroom in a residential or commercial building. The

shower system 100 includes a floor 101 and a plurality of sidewalls 102 extending from the floor 101. In some embodiments, the floor 101 is a ground surface. The plurality of sidewalls 102 and the floor 101 collectively define an interior volume 103 (e.g., a showering volume, a steaming volume, etc.) of the shower system 100. In some embodiments, one or more of the sidewalls 102 includes a door movable between an open position and a closed position to provide selective access to the interior volume 103. As shown, the shower system 100 includes one or more fixtures 104 (e.g., shower heads, spray heads, spray faces, etc.) configured to receive a flow of fluid (e.g., water) and supply (e.g., direct, spray, mist, etc.) the flow of fluid within the interior volume 103 (e.g., in a direction towards a user in the interior volume 103). In some embodiments, the fixture 104 is configured to supply steam within the interior volume 103.

[0011] As shown in FIG. 1, the shower steam condenser panel 105 is mounted to one or more of the sidewalls 102 and disposed within the interior volume 103 of the shower system 100 so that it may contact steam or water (e.g., steam produced by the shower system 100, water supplied from the fixture 104, etc.). In some embodiments, the shower steam condenser panel 105 is mounted at another location within the interior volume 103. The shower steam condenser panel 105 may be substantially flat. The shower steam condenser panel 105 is configured to condense steam produced by the shower system 100 to heat incoming fluid (e.g., water supplied to the shower system 100 from a municipal water supply, a private well, rainwater harvesting, a hot water heater, fluid drained down a drain of the shower system 100, etc.). The steam and the steam condensed by the shower steam condenser panel 105 may be warmer than the incoming fluid. The shower steam condenser panel 105 is configured to facilitate transferring thermal energy from the warmer steam and condensed steam to the incoming fluid, thereby heating the incoming fluid. By way of example, the warmer steam and condensed steam may contact an outer surface of one or more flow channels (e.g., flow channels 120, pipes, tubes, conduits, etc.) supplying the fluid to the fixture 104 and transfer heat thereto.

[0012] As shown in FIG. 1, the shower steam condenser panel 105 is positioned proximate the floor 101 on the sidewalls 102 of the shower system 100. In this manner, fluid that is splashing (e.g., after hitting the floor 101, after hitting or being redirected by a user, etc.) can be splashed onto the shower steam condenser panel 105. The shower steam condenser panel 105 may use the thermal energy from the splashing warm fluid that would otherwise be discarded in the drain to heat the incoming fluid.

[0013] The shower steam condenser panel 105 may be decorative so as to enhance the user experience in the shower system 100. Additionally or alternatively, the shower steam condenser panel 105 may make a statement to users that the shower system 100 is energy efficient. This contrasts with a traditional heat exchanger that is located in a drain and cannot be seen by a user. Rather, the shower steam condenser panel 105 may be visible to the user and may notify users that the shower system 100 is energy efficient thereby improving the user experience. Since the shower steam condenser panel 105 may condense steam to heat incoming cooler fluid, the shower steam condenser panel 105 may reduce the amount of steam in a bathroom which may improve the user experience. The reduction in steam may also improve the longevity of fixtures and décor in a bathroom.

[0014] Referring to FIG. 2, a cross-section view of the shower steam condenser panel 105 is shown, according to an exemplary embodiment. The shower steam condenser panel 105 includes a front plate 110 and a back plate 115. The back plate 115 may be selectively coupled to the front plate 110 using one or more fasteners (e.g., bolts, screws, etc.). A front side of the front plate 110 (e.g., a surface facing the interior volume 103 when installed) may be decorative to enhance the user experience. The shower steam condenser panel 105 may be selectively coupled to one of the sidewalls 102 of the shower system 100 using one or more fasteners (e.g., bolts, screws, etc.). In some embodiments, the shower steam condenser panel 105 is made of aluminum. In other embodiments, the shower steam condenser panel 105 is made from another suitable material or combination of materials such as steel or another metal.

[0015] The front plate 110 may be machined on a back side thereof to include flow channels 120. The flow channels 120 may be manufactured using computer numerical control (CNC) machining. The flow channels 120 extend between opposing edges of the front plate 110 (e.g., opposing vertical edges, left and right sides, etc.) along the height of the front plate 110. As shown in FIGS. 3 and 4, the steam condenser panel 105 includes a flow inlet, shown as inlet 125, and a flow outlet, shown as outlet 130. The steam condenser panel 105 (and the shower system 100) is configured to receive a supply of the fluid via the inlet 125. The flow channels 120 provide a flow path to direct the fluid received via the inlet 125 in a direction towards the outlet 130. By way of example, the flow channels 120 may snake along the front plate 110 between the inlet 125 and the outlet 130. The outlet 130 is fluidly coupled with the fixture 104 such that, after flowing through the steam condenser panel 105, the fluid is supplied to the fixture 104 (e.g., directly to the fixture 104 without any intervening components other than a fluid conduit therebetween) and directed to the interior volume 103 of the shower system 100. The back plate 115 may be coupled with the front plate 110 to selectively enclose (e.g., separate, segregate, etc.) the flow channels 120 from the interior volume 103.

[0016] The flow channels 120 are configured to direct the fluid from the inlet 125 to the outlet 130 and fluidly couple the inlet 125 with the outlet 130. As the fluid flows through the flow channels 120, the steam and condensed steam contacts an outer surface of flow channels 120 and transfers heat thereto (e.g., thermal energy transfer, conduction, convection, etc.), thereby heating the fluid

flowing through the flow channels 120. By way of example, the fluid may enter the steam condenser panel 105 via the inlet 125 at a first temperature and exit the steam condenser panel 105 via the outlet 130 at a second temperature greater than the first temperature. The fluid temperature at the inlet 125 may be about 55 degrees Fahrenheit (e.g., within 5% of 55 degrees Fahrenheit, about 50 degrees Fahrenheit, about 60 degrees Fahrenheit, etc.). The fluid temperature at the outlet 130 may be about 80 degrees Fahrenheit (e.g., within 5% of 80 degrees Fahrenheit, about 75 degrees Fahrenheit, about 85 degrees Fahrenheit, etc.). In some embodiments, the flow channels 120 located at the inlet 125 and outlet 130 may include copper tubes at the inlet 125 and outlet 130.

[0017] Referring to FIG. 4, a perspective view of a shower steam condenser panel 105 is shown according to an exemplary embodiment. As discussed in greater detail above, the flow channels 120 are configured to receive cooler fluid at the inlet 125, direct a flow of the fluid through the flow channels 120, and supply the heated fluid at the outlet 130. As shown, the outlet 130 is located vertically above the inlet 125 and laterally offset from the inlet 125. It may be advantageous for the water to flow in a generally upwards direction through the flow channels 120 because thermal gradients are preferred. Additionally, air trapped in the flow channels 120 of the shower steam condenser panel 105 may be pushed out (e.g., removed or expelled from the shower steam condenser panel 105) more readily. The air trapped in the flow channels may inhibit the effectiveness of the thermal energy transfer to heat the fluid flowing through the flow channels 120. Therefore, removing the air trapped in the flow channels 120 increases the effectiveness of the thermal energy transfer to heat the fluid flowing through the flow channels 120.

[0018] As shown in FIGS. 2-4, the flow channels 120 are machined on the back side of the front plate 110. The front plate 110 defines a thickness 135 of about ½" to ¾". The flow channels 120 define a width 140 of about ½" and a depth 145 of about 3/8". The back side of the front plate 110 may include a space 150 (e.g., a shoulder) around an outer perimeter thereof (e.g., an outer perimeter of the flow channels 120) which defines a width 155 of about ½". Additionally or alternatively, the back side of the front plate 110 may include a space 160 (e.g., sidewalls of the flow channels 120) between the flow channels 120 which defines a width 165 of about ¼". The back plate 115 of the shower steam condenser panel 105 may have a thickness 170 of about ¼". The back plate 115 may be coupled to the front plate 110 using about 20 screws. In some embodiments, the steam condenser panel 105 (e.g., the thickness 135, the width 140, the depth 145, the width 155, the width 165, the thickness 170, etc.) is otherwise suitably dimensioned.

[0019] It should be noted that the term "example" as used herein to describe various embodiments is intended to indicate that such embodiments are possible examples, representations, and/or illustrations of possible embodiments.

[0020] Various numerical values herein are provided for reference purposes only. Unless otherwise indicated, all numbers expressing quantities of properties, parameters, conditions, and so forth, used in the specification and claims are to be understood as being modified in all instances by the term "about" or "approximately." Accordingly, unless indicated to the contrary, the numerical parameters set forth in the following specification are approximations. Any numerical parameter should at least be construed in light of the number reported significant digits and by applying ordinary rounding techniques. The term "about" or "approximately" when used before a numerical designation, e.g., a quantity and/or an amount including range, indicates approximations which may vary by (+) or (-) 10%, 5%, or 1%.

[0021] As will be understood by one of skill in the art, for any and all purposes, particularly in terms of providing a written description, all ranges disclosed herein also encompass any and all possible subranges and combinations of subranges thereof. Any listed range can be easily recognized as sufficiently describing and enabling the same range being broken down into at least equal halves, thirds, quarters, fifths, tenths, etc. As a non-limiting example, each range discussed herein can be readily broken down into a lower third, middle third and upper third, etc. As will also be understood by one skilled in the art all language such as "up to," "at least," "greater than," "less than," and the like include the number recited and refer to ranges which can be subsequently broken down into subranges as discussed above. Finally, as will be understood by one skilled in the art, a range includes each individual member.

[0022] As utilized herein, the term "substantially" and similar terms are intended to have a broad meaning in harmony with the common and accepted usage by those of ordinary skill in the art to which the subject matter of this disclosure pertains. It should be understood by those of skill in the art who review this disclosure that these terms are intended to allow a description of certain features described and claimed without restricting the scope of these features. Accordingly, these terms should be interpreted as indicating that insubstantial or inconsequential modifications or alterations of the subject matter described and claimed are considered to be within the scope of the invention as recited in the appended claims.

[0023] The terms "coupled," "connected," and the like as used herein mean the joining of two members directly or indirectly to one another. Such joining may be stationary (e.g., permanent) or moveable (e.g., removable or releasable). Such joining may be achieved with the two members or the two members and any additional intermediate members being integrally formed as a single unitary body with one another or with the two members or the two members and any additional intermediate members being attached to one another.

[0024] It is important to note that the construction and arrangement of the various exemplary embodiments are

illustrative only. Those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter described herein. Other substitutions, modifications, changes and omissions may also be made in the design, assembly and arrangement of the various exemplary embodiments without departing from the scope of the embodiments described herein.

[0025] While this specification contains implementation details, these should not be construed as limitations on the scope of any embodiment or of what may be claimed, but rather as descriptions of features specific to particular implementations of particular embodiments. Certain features described in this specification in the context of separate implementations can also be implemented in combination in a single implementation. Conversely, various features described in the context of a single implementation can also be implemented in multiple implementations separately or in any suitable subcombination. Moreover, although features may be described above as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a subcombination or variation of a subcombination.

Claims

1. A heat exchanger for a shower environment, comprising:

a panel disposed within the shower environment, and including:

an inlet;
an outlet; and
a plurality of flow channels fluidly coupling the inlet with the outlet;

wherein the panel is configured to condense steam to heat a fluid flowing through the plurality of flow channels.

2. The heat exchanger of claim 1, wherein the shower environment includes a sidewall and a floor defining an interior volume of the shower environment, and wherein the panel is disposed along the sidewall within the interior volume, optionally wherein the panel is configured for vertical placement along the sidewall and proximate the floor of the shower environment.

3. The heat exchanger of claim 2, wherein the shower environment includes a fixture configured to direct the fluid to the interior volume, and wherein the outlet is fluidly coupled with the fixture.

4. The heat exchanger of any one of claims 1 to 3, wherein the plurality of flow channels extends between opposing edges of the panel along a height of the panel.

5. The heat exchanger of any one of the preceding claims, wherein the outlet is positioned vertically above the inlet.

6. The heat exchanger of any one of the preceding claims, wherein each flow channel of the plurality of flow channels defines a width of about 0.5 inches and/or a depth of about 0.375 inches.

7. The heat exchanger of any one of the preceding claims, wherein the inlet is configured to receive a supply of fluid at a first temperature, and wherein the outlet is configured to supply the fluid at a second temperature greater than the first temperature, optionally wherein the first temperature is about 55 degrees Fahrenheit, and wherein the second temperature is about 80 degrees Fahrenheit.

8. The heat exchanger of any one of the preceding claims, further comprising a back plate configured to selectively couple with the panel, optionally wherein the back plate is configured to enclose the plurality of flow channels.

9. A method of heating a fluid for a shower environment, the method comprising:

providing a panel disposed within the shower environment, the panel including:

an inlet;
an outlet; and
a plurality of flow channels fluidly coupling the inlet with the outlet;

condensing, by the panel, steam within an interior volume of the shower environment;
receiving, by the inlet, a supply of the fluid from a fluid source;
heating, by the panel, the fluid flowing through the plurality of flow channels; and
supplying, by the outlet, the fluid heated by the condensed steam to a fixture of the shower environment, the fixture configured to direct the fluid to the interior volume.

10. The method of claim 9, wherein heating the fluid flowing through the plurality of flow channels includes the condensed steam contacting on outer surface of

the plurality of flow channels.

11. The method of claim 9 or claim 10, wherein the plurality of flow channels extends between opposing edges of the panel along a height of the panel.

12. The method of claim 9, claim 10 or claim 11, wherein the fluid received by the inlet is received at a first temperature, and wherein the fluid supplied by the outlet is supplied at a second temperature greater than the first temperature.

13. A shower environment comprising:

a sidewall;
a floor;
an interior volume defined by the sidewall and the floor;
a fixture configured to direct a fluid to the interior volume; and
a heat exchanger including a panel disposed along the sidewall within the interior volume, the panel including:

an inlet configured to receive a supply of the fluid at a first temperature;
an outlet fluidly coupled with the fixture and configured to supply the fluid at a second temperature; and
a plurality of flow channels fluidly coupling the inlet with the outlet;

wherein the panel is configured to condense steam to heat the fluid flowing through the plurality of flow channels such that the second temperature is greater than the first temperature.

14. The heat exchanger of any one of claims 1 to 8 or claim 13, wherein the steam contacts an outer surface of the plurality of flow channels, and wherein the panel is configured to transfer thermal energy from the steam contacting the outer surface of the plurality of flow channels to the fluid flowing through the plurality of flow channels, thereby heating the fluid.

15. The heat exchanger of claim 13 or claim 14 when dependent on claim 13, wherein the heat exchanger includes a back plate configured to selectively couple with the panel to enclose the plurality of flow channels or the method of any one of claims 9 to 12, further comprising providing a back plate configured to selectively couple with the panel to enclose the plurality of flow channels.

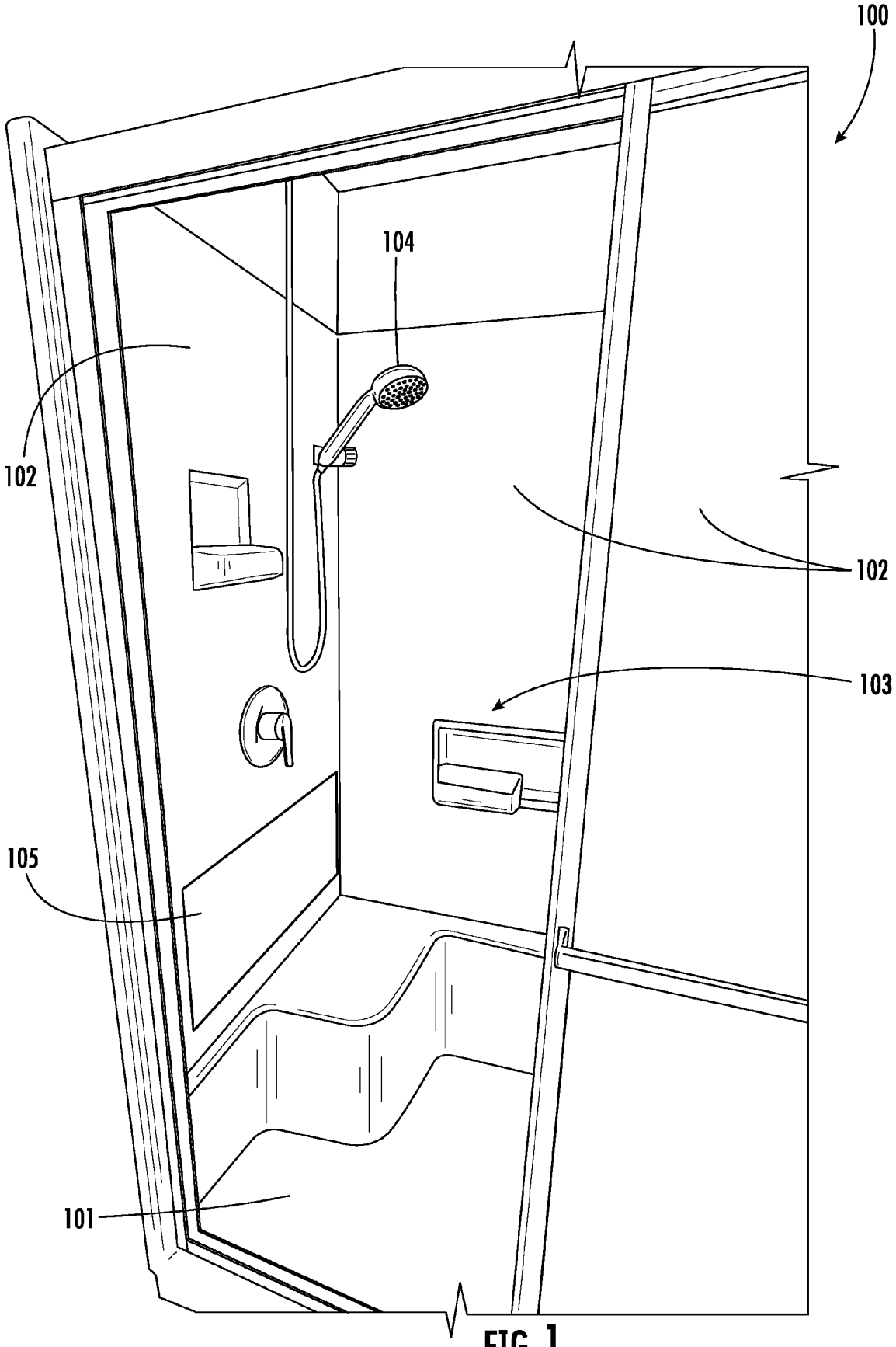

FIG. 1

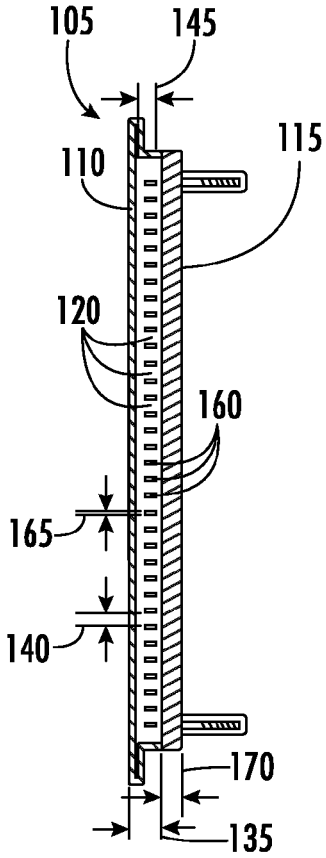

FIG. 2

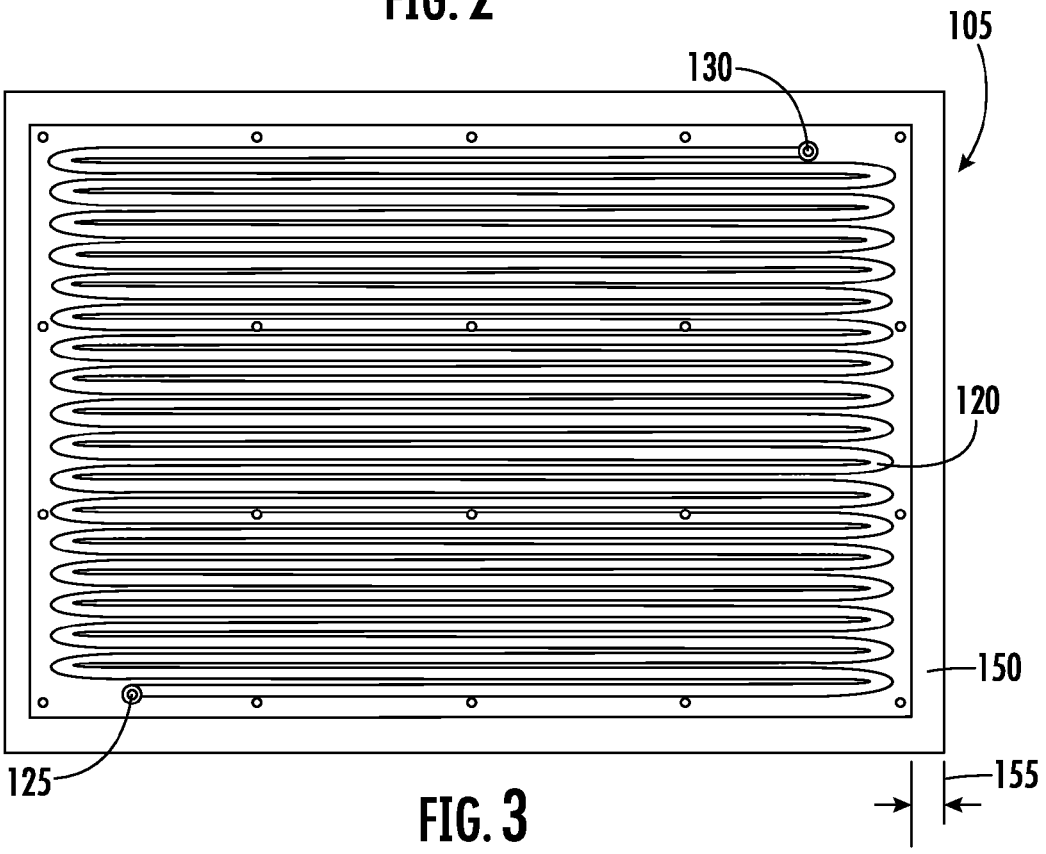

FIG. 3

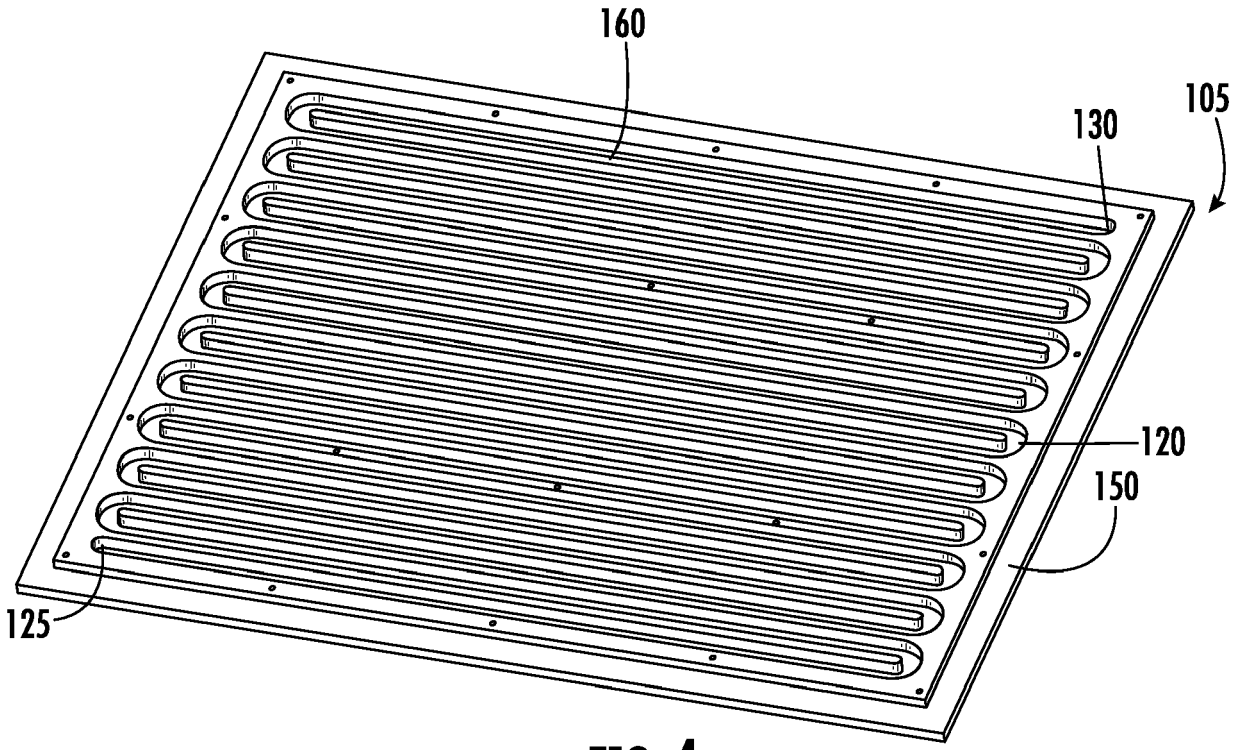

FIG. 4

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 24 17 7161

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	US 2016/076230 A1 (CAI YING LIN [CN] ET AL) 17 March 2016 (2016-03-17) * paragraphs [0005] - [0006], [0050] - [0051]; figures 9, 10, 19, 20 *	1-15	INV. F28D1/03 F28D21/00 F28F3/04 E03C1/04
X	US 8 904 638 B2 (CAI YING LIN [CN]) 9 December 2014 (2014-12-09) * column 4, line 4 - column 4, line 64 *	1-15	F28B1/02
X	US 2013/031716 A1 (HALL DAVID R [US] ET AL) 7 February 2013 (2013-02-07) * paragraphs [0076] - [0082]; figures 15a-15d, 16 *	1-15	
A	US 8 104 532 B2 (CARDONE JEREMIAH [US]) 31 January 2012 (2012-01-31) * the whole document *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

F28D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	7 October 2024	Axters, Michael

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 24 17 7161

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

07-10-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2016076230 A1	17-03-2016	US 2016076230 A1	17-03-2016
		WO 2016040546 A1	17-03-2016
US 8904638 B2	09-12-2014	EP 2224197 A2	01-09-2010
		JP 2010210228 A	24-09-2010
		KR 20100097078 A	02-09-2010
		US 2010212878 A1	26-08-2010
US 2013031716 A1	07-02-2013	US 2013031715 A1	07-02-2013
		US 2013031716 A1	07-02-2013
US 8104532 B2	31-01-2012	NONE	

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 63503826 **[0001]**
- US 66884524 **[0001]**