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(54) HEAT EXCHANGER AND USE THEREOF

(57) The present invention provides a heat exchanger (100) for exchanging heat between heat exchanging fluids (107,112) conducted through an inside of the heat exchanger (100), the heat exchanger (100) comprising a connecting piece (108,128) at a bottom side (104) of the heat exchanger (100), the connecting piece (108,128) connecting the inside of the heat exchanger (100) with an outside of the heat exchanger (100), the connecting piece (108,128) comprising a drain line section (124) protruding into the inside of the heat exchanger (100) and having at least one drain opening (125), the drain line section (124) being configured as an overflow for any fluid (116) accumulated inside the heat exchanger up to a retaining height (h) defined by the at least one drain opening (125).

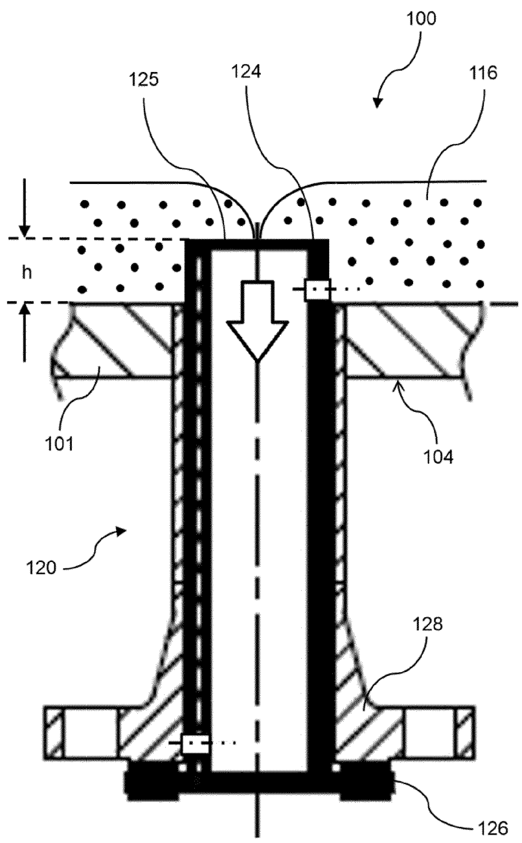

Fig. 1

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Description

[0001] The present invention relates to a heat exchanger and to a use thereof, particularly to heat exchangers, wherein, in operation, a fluid accumulates inside the heat exchanger, e.g. condensate which accumulates at the bottom side of the heat exchanger.

Technical background

[0002] Heat exchangers and their use for a variety of process applications are known in the art. Heat exchangers can be used as condensers, wherein it may be necessary to subcool the condensate produced. This is usually achieved by blocking the condensate discharge pipe causing the condensate to accumulate inside the heat exchanger and cover the heat exchanger tubes. On the one hand, a number of tubes should be covered to this purpose, on the other hand, if too many tubes are covered, this will impede the condensation process. In order to improve the condensate drainage without creating superfluous heating surfaces, horizontal baffle cut-outs are implemented. An exact prediction of the condensate accumulation height, however, is difficult. It may also be necessary to measure and/or to alter the accumulation height. This is not possible with fabricated heat exchangers due a lack of accessibility into the interior of the heat exchanger. The heat exchanger shell is mostly welded to the tube sheet such that no access to the inside of the shell can be realized without massive effort.

Embodiments of the invention

[0003] The present invention provides a heat exchanger and a use of such a heat exchanger according to the independent claims. Embodiments of the heat exchanger are the subject matter of the dependent claims and of the description as follows.

[0004] According to the present invention, a heat exchanger for exchanging heat between heat exchanging fluids conducted through an inside of the heat exchanger comprises a connecting piece at a bottom side of the heat exchanger, the connecting piece connecting the inside of the heat exchanger with an outside of a heat exchanger, the connecting piece comprising a drain line section protruding into the inside of the heat exchanger and having at least one drain opening, the drain line section being configured as an overflow (or spillover) for any fluid accumulated inside of the heat exchanger at its bottom side upon reaching a retaining height defined by the at least one drain opening.

[0005] Typically, in such a heat exchanger heat is transferred between two or more heat exchanging fluids, which are introduced into the heat exchanger at different temperature levels. In operation, the heat exchanger has a top side and a bottom side. The connecting piece, also referred to as a connector or a socket or a nozzle, connects the inside of the heat exchanger with the outside of the heat exchanger, i.e. particularly with the outside of the heat exchanger shell. The connecting piece comprises a drain line section, i.e. a tube section, which protrudes from the connecting piece at the bottom side, in particular essentially perpendicularly, into the inside of the heat exchanger such that its at least one drain opening extends up to a certain height above an inside bottom surface of the heat exchanger. The drain line section is thus configured as an overflow or spillover for any fluid accumulated inside the heat exchanger at its bottom side such that, when the accumulated fluid reaches the at least one drain opening of the drain line section, it overflows and is conducted through the drain line section to the outside of the heat exchanger. The drain line section may have an open upper end and/or one or more openings at its upper end such that accumulated fluid can enter these openings and drain away through the drain line section. In this configuration, the (vertical) height at which such drain openings are arranged, defines a retaining height of the accumulated fluid. Thus, the present invention provides a heat exchanger, wherein the retaining height can be precisely defined and, in some embodiments, also varied as will be explained below.

[0006] In an embodiment, the connecting piece is a connecting piece, i.e. socket or nozzle, of an inlet pipe of the heat exchanger for conducting one of the heat exchanging fluids into the inside of the heat exchanger, or a connection piece, i.e. socket or nozzle, of an outlet pipe of the heat exchanger for conducting one of the heat exchanging fluids to the outside of the heat exchanger. As discussed above, the heat exchanger typically comprises two or more inlet pipes for conducting two or more heat exchanging fluids into the inside of the heat exchanger. On the other hand, the heat exchanger also comprises two or more outlet pipes for conducting the heat exchanging fluids after the heat exchanging process outside of the heat exchanger. If an already existing connecting piece of such an inlet/outlet pipe is used as the connecting piece for use as an overflow according to the present invention, no additional access to the inside of the heat exchanger has to be created, i.e. no additional welding, pressure tests etc. are necessary. A connecting piece of an inlet pipe is also referred to as inlet socket, while a connecting piece of an outlet pipe is also referred to as outlet socket. According to this embodiment, an existing inlet/outlet socket arranged at the bottom side of the heat exchanger can be used as an overflow according to the present invention by mounting a drain line section protruding into the inside of the heat exchanger to this inlet/outlet socket.

[0007] The drain line section may be fixed to the connecting piece e.g. by welding. In such an embodiment, the retaining height defined by the height of the at least one drain opening above the inner bottom side of the heat exchanger would be fixed. It is, however, also possible to realize an overflow according to the present invention having a variable retaining height. To this end, the drain line section, at least partially, has the form of a sleeve, which is inserted into the connecting piece. In this embodiment, the upper end of the sleeve, which is located inside the heat exchanger, comprises the at least one drain opening. Thus, the extent to which the sleeve protrudes into the inside of the heat exchanger defines a retaining height, which may be either predetermined before fixing the sleeve to the connecting piece or varied if the sleeve is configured to be moveable inside the connecting piece. Alternatively, drain line sections of different sleeve lengths can be used to define different retaining heights.

[0008] In an embodiment, the drain line section comprises a sealing flange to provide a sealed connection with the connecting piece (or vice versa). Such a sealing flange makes it possible to sealingly connect to the drain line section (or sleeve) with the connecting piece after having set a desired retaining height. In such an embodiment, it as advantageous if the sealing flange comprises a fastening means for detachably connecting the drain line section/sleeve to the connecting piece. This facilitates subsequent adjustments of the retaining height.

[0009] In an embodiment, the drain line section is an integral part of the connecting piece. In this embodiment the drain line section may either be fixed to the connecting piece or may be mounted to the connecting piece in a way allowing movement of the drain line section/sleeve within the connecting piece to adjust the retaining height.

[0010] Using a drain line section/sleeve equipped with a sealing flange together with an existing inlet/outlet socket of the heat exchanger has the advantage that no welding is required on the heat exchanger shell, no pressure tests are necessary and the modification is reversable.

[0011] In the following, the present invention and its advantages are described in more detail in connection with the following figures.

Brief description of the figures

[0012]

Figure 1 schematically shows a detail of an embodiment of a heat exchanger according to the present invention.

Figure 2 schematically shows a heat exchanger, which can be used to implement the present invention.

Figure 3 schematically shows a connecting piece and a drain line section at the bottom side of a heat exchanger in an exploded view in Figure 3 A, and in the assembled state in Figure 3 B.

Detailed description

[0013] The embodiments according to the figures are discussed comprehensively, same reference signs designate same or structurally identical elements.

[0014] Figure 1 schematically shows a detail of an embodiment of a heat exchanger 100 according to the present invention.

[0015] The heat exchanger 100 comprises a connecting piece 128 at a bottom side 104 of the heat exchanger 100, as will be further explained below in connection with Figure 2. The connecting piece 128 connects the inside of the heat exchanger 100 with an outside of the heat exchanger 100, particularily with the outside of the heat exchanger shell 101. The connecting piece 128 further comprises a drain line section 124, which protrudes into the inside of the heat exchanger 100 and which has at least one drain opening 125. In the embodiment shown, the at least one drain opening 125 is the upper open end of the drain line section 124. By means of this construction, the drain line section 124 is configured as an overflow for any fluid 116 accumulated inside the heat exchanger up to a retaining height h defined by the drain opening 125. As soon as the accumulated fluid reaches the position of the drain opening 125 defining the retaining height, the fluid drains through the drain line section 124 to the outside of the heat exchanger 100. The retaining height h is defined by the vertical distance of the drain opening 125 to the inner surface at the bottom side 104 of the heat exchanger 100 in the configuration of the embodiments shown in the present figures. It goes without saying that depending on the draining capacity of the drain line section 124, the actual retaining height might be larger than the retaining height h defined by the position of the drain opening.

[0016] The connecting piece 128 may be a connecting piece specially provided for its configuration as an overflow according to the present invention, but may also be an existing inlet/outlet socket for an inlet/outlet pipe conducting a heat exchanging fluid into or out of the inside of the heat exchanger 100 as far as this inlet/outlet socket is not connected to tubes in the interior of the heat exchanger. This can be advantageous, for example, for the inlet nozzle/socket of a steam drum. In this case, condensate would be prevented from immediately flowing back into the inlet gas (steam) connection coming from below.

[0017] As shown in Figure 2, a heat exchanger 100, in the present case a tubular heat exchanger, comprises inlet and outlet sockets for conducting heat exchanging fluids through the inside of the heat exchanger 100. As shown in Figure 2, a first heat exchanging fluid 107 is conducted through inlet socket 106 into the inside of the heat exchanger 100 for transferring heat to a second heat exchanging fluid 112 introduced into the heat exchanger 100 at a lower temperature level. After the heat exchanging process, the first fluid 107 leaves the heat exchanger 100 through an outlet socket 108, while the second fluid 112, which was introduced at a bottom side in the head of the heat exchanger 100, leaves the heat exchanger 100 through an outlet socket at the top of the heat exchanger 100 as shown in Figure 2. The top side of the heat exchanger 100, in operation, is designated 102, while the bottom side of the heat exchanger 100, in operation, is designated 104.

[0018] The heat exchanger 100 of Figure 2 may be used as a condenser, wherein condensate accumulates in the interior of the heat exchanger at its bottom side. The accumulated fluid or condesate is designated 116. In order to subcool the condensate it is necessary to accumulate the condensate up to a certain retaining height where the condensate covers a predefined number of heat exchanger tubes. Excess condensate should be drained in order not to impede the condensation process. The present invention provides an overflow 120 for such condensate when the accumulated condensate reaches a predetermined retaining height (h). As can be seen from Figure 2, the existing outlet socket 108 for the first heat exchanging fluid 107 can be used for such an overflow, an embodiment of which is shown as overflow 120 in Figure 1 discussed above.

[0019] Returning to Figure 1, the overflow 120 may comprise the outlet socket 108 of the heat exchanger shown in Firgure 2 as the connecting piece 128. Further, the overflow 120 comprises a drain line section 124, which, at least partially, has the form of a sleeve, which is inserted into the connecting piece 128. Sleeve and connecting piece are coaxial to each other. The drain line section 124 or sleeve further comprises a sealing flange 126 to provide a sealed connection with the connecting piece 128. In a further embodiment, the sealing flange 126 comprises a fastening means for detachably connecting the sleeve 124 and the connecting piece 128. By such a construction, an existing inlet/outlet socket 108 of the heat exchanger 100 may be retrofitted to comprise an overflow 120 according to the present invention. While the outlet socket 108, 128 is still used for conducting the first heat exchanging fluid 107 out of the heat exchanger 100, at the same time, the outlet socket 108, 128 is used to implement a condensate overflow 120. In an alternative embodiment, the sleeve or drain line section 124 is welded to the connecting piece.

[0020] Figure 3 schematically shows an exploded view of an embodiment of a detail of a heat exchanger 100 according the present invention. In the embodiment of Figure 3, the connecting piece 128 comprises different elements, namely a nozzle neck 128a with a flange 128b followed by a piping flange 128c. Again, the connecting piece 128 may be the existing outlet socket 108 of a heat exchanger 100 as shown in Figure 2. In order to implement the overflow function according to present invention, a drain line section 124 is inserted into the connecting piece 128a,128b. The drain line section 124 is formed as a sleeve, the outer diameter of which essentially corresponds to the inner diameter of the connecting piece 128a,128b such that the sleeve part can be inserted coaxially into the connecting piece. The lower end of the drain line section 124 forms a collar, which abuts against the flange 128b in the assembled state. In the embodiment of Figure 3, a sealed connection between the drain line section 124 and the connecting piece 128 is created by means of gaskets 127. In the embodiment of Figure 3, it is possible to realize different retaining heights h by using drain line sections 124 of different sleeve lengths. Figure 3B shows the overflow 120 of Figure 3A in an assembled state.

Claims

1. A heat exchanger (100) for exchanging heat between heat exchanging fluids (107,112) conducted through an inside of the heat exchanger (100), the heat exchanger (100) comprising a connecting piece (108,128) at a bottom side (104) of the heat exchanger (100), the connecting piece (108,128) connecting the inside of the heat exchanger (100) with an outside of the heat exchanger (100), the connecting piece (108,128) comprising a drain line section (124) protruding into the inside of the heat exchanger (100) and having at least one drain opening (125), the drain line section (124) being configured as an overflow for any fluid (116) accumulated inside the heat exchanger up to a retaining height (h) defined by the at least one drain opening (125).

2. The heat exchanger (100) of claim 1, wherein the connecting piece (108,128) is a connecting piece of an inlet pipe of the heat exchanger (100) for conducting one of the heat exchanging fluids (107,112) into the inside of the heat exchanger (100) or a connecting piece (108) of an outlet pipe of the heat exchanger (100) for conducting one of the heat exchanging fluids (107) to the outside of the heat exchanger (100).

3. The heat exchanger (100) of claim 1 or 2, wherein the drain line section (124), at least partially, has the form of a sleeve, which is inserted into the connecting piece (108,128).

4. The heat exchanger (100) of claim 3, wherein the sleeve is configured to be moveable inside the connecting piece (108,128) to adjust the retaining height (h).

5. The heat exchanger (100) of any one of the preceding claims, wherein the drain line section (124) comprises a sealing flange (126) configured to provide a sealed connection with the connecting piece (108,128).

6. The heat exchanger (100) of claim 5, when referring back to claim 4 or 3,
wherein the sealing flange (126) comprises a fastening means for detachably connecting the sleeve and the connecting piece (108,128).

7. The heat exchanger (100) according to any one of the preceding claims,
wherein the drain line section (124) is an integral part of the connecting piece (108,128).

8. Use of the heat exchanger (100) according to any one of the claims 1 to 7 for retaining a condensate as the accumulated fluid (116) inside the heat exchanger (100) up to a retaining height (h) defined by the at least one drain opening (125) of the drain line section (124) protruding into the inside of the heat exchanger (100).

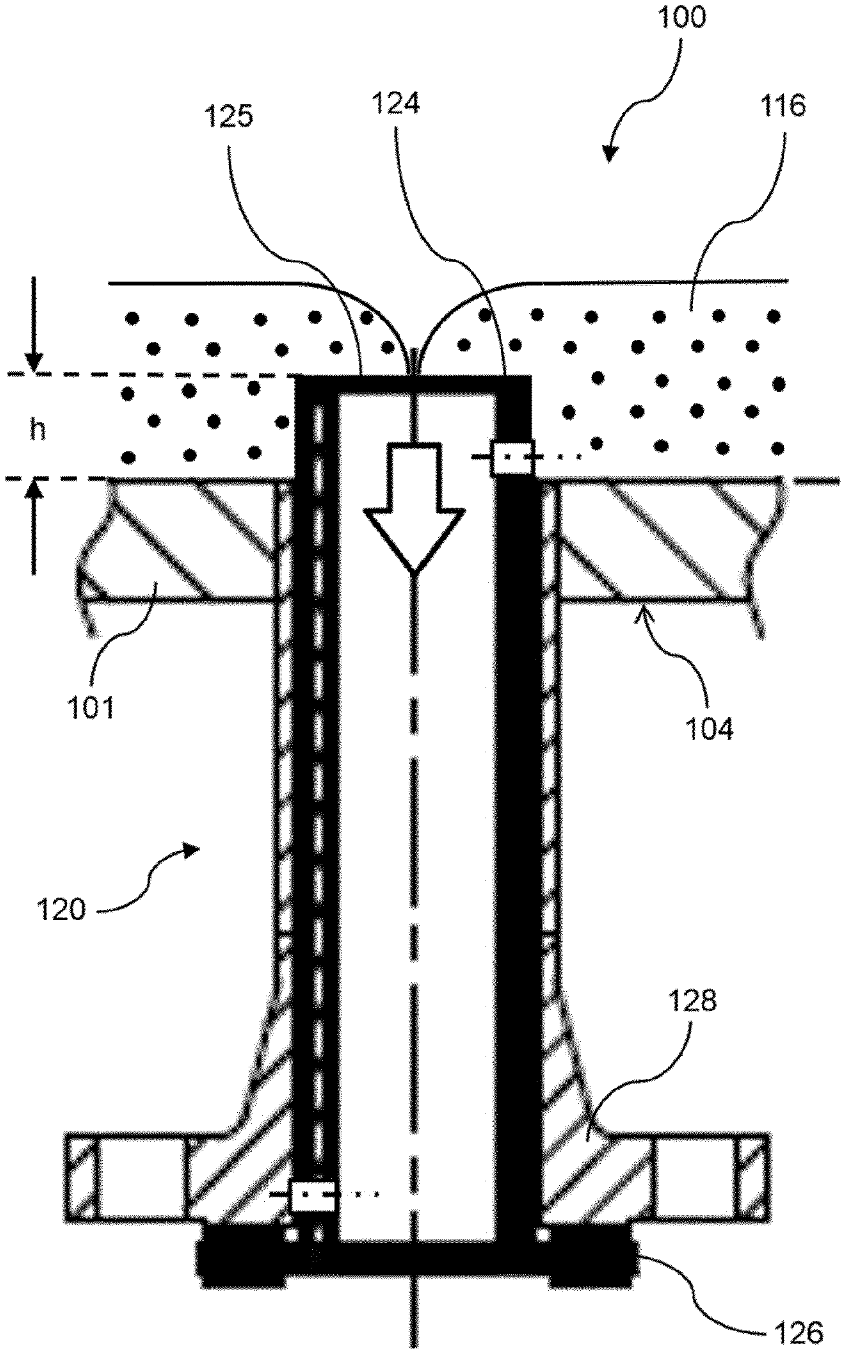

Fig. 1

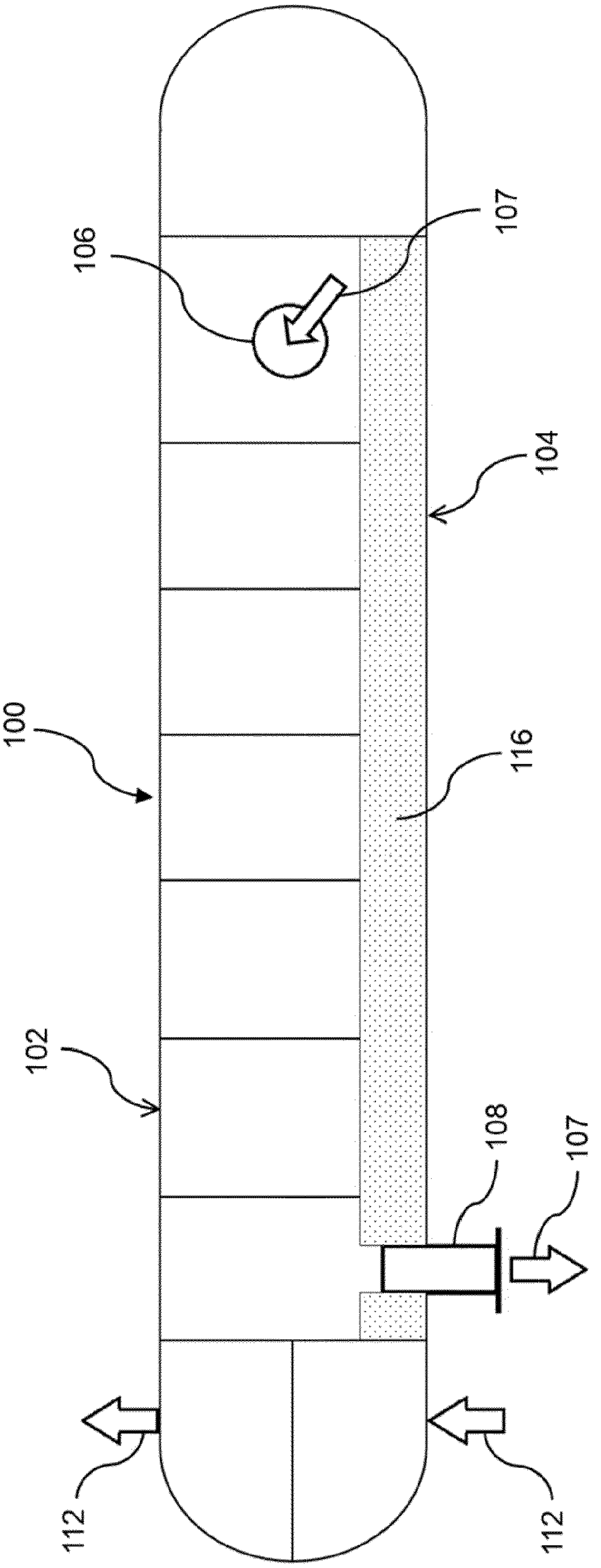

Fig. 2

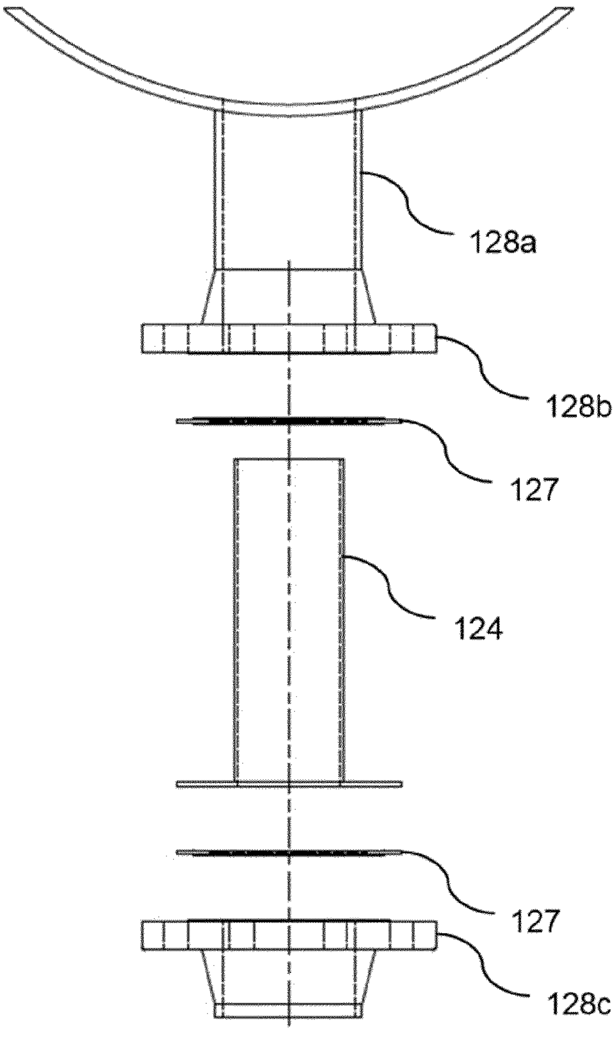

Fig. 3A

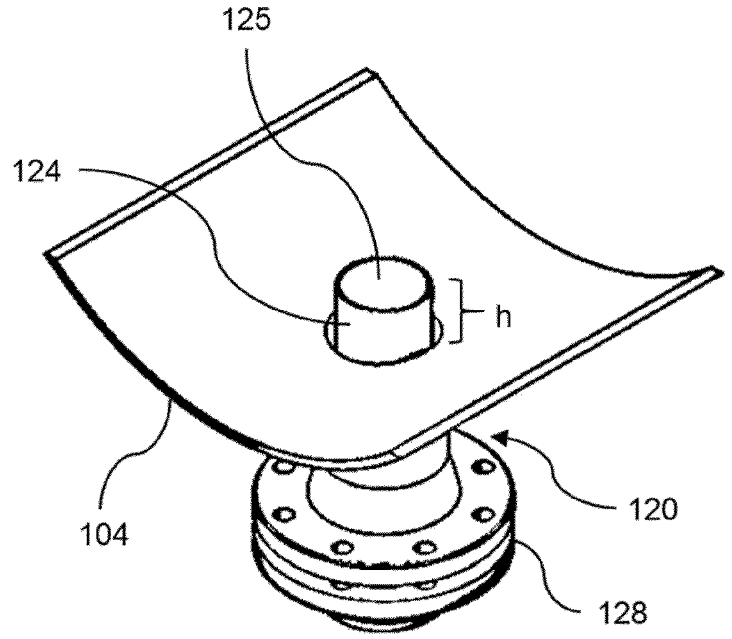

Fig. 3B

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EUROPEAN SEARCH REPORT

Application Number
EP 24 02 0003

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F28F
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	27 May 2024	Bloch, Gregor

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 24 02 0003

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