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(54) Heat exchanger and a method for demisting

(57) A heat exchanger for and a method of demisting a gas wherein the heat exchanger comprises a case (2) with at least a case inlet for a gas to be demisted (3) and at least a case outlet for the gas to be demisted (4), a separation structure (6) located within the case defining a first section (7) and a second section comprising a hollow curved volume (8), means for heat transfer (10) housed within the first section; and wherein the first section has the case inlet (3) and the second section has the case outlet (4) and a liquid drainage (16) and a channel (17) having a longitudinal axis directed towards a side of the case (2) to pass gas from the first section (7) to the second section (8) such that the gas-flow is tangential to the case curvature and the gas undergoes centrifugal forces.

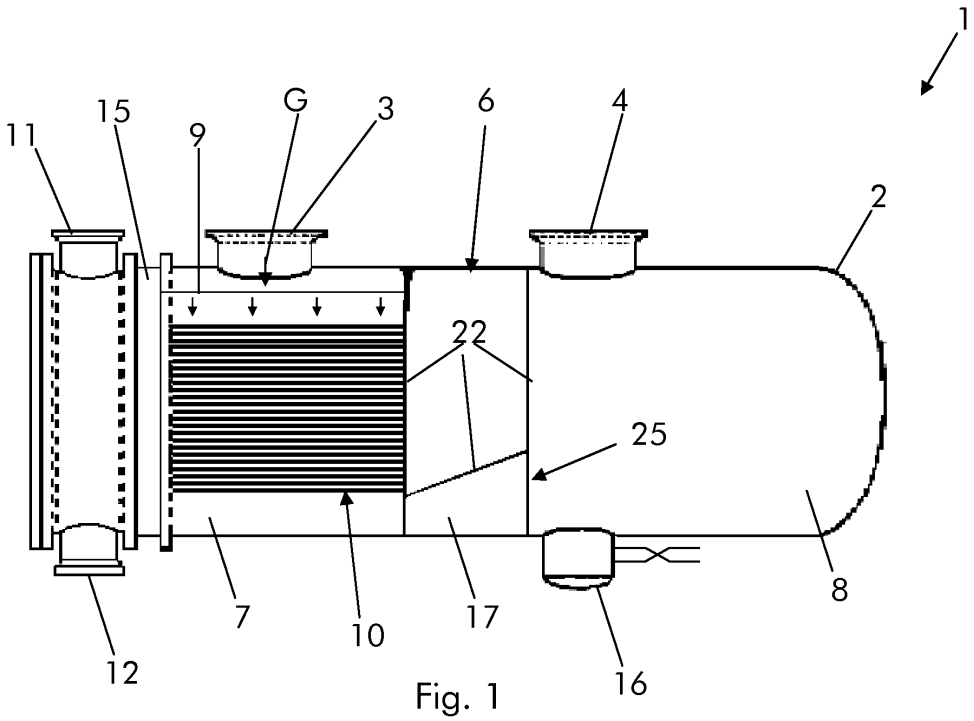

Fig. 1

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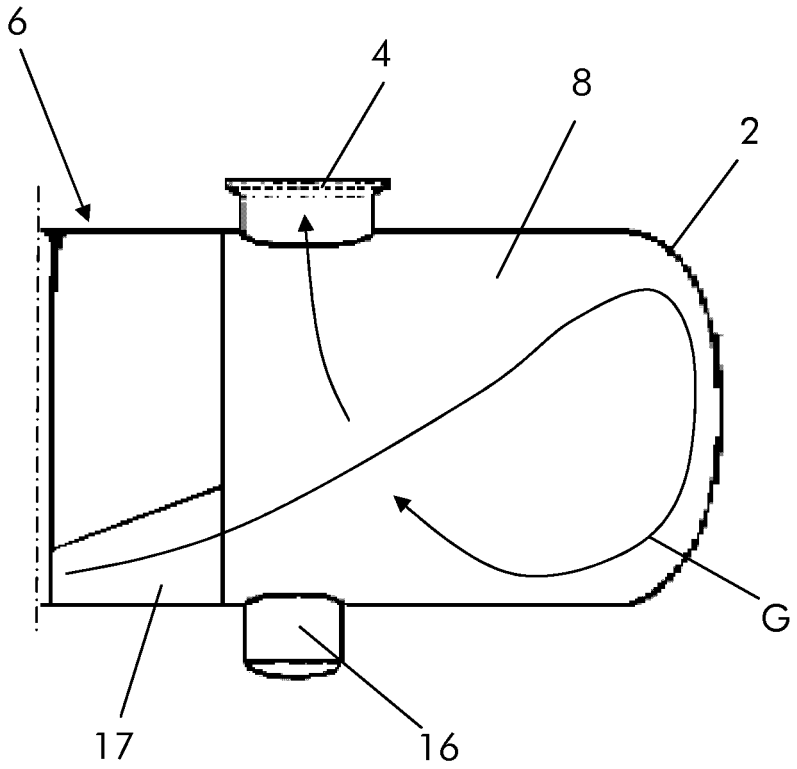

Fig. 10

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a heat exchanger and a method for demisting.

[0002] The heat exchanger is for cooling or heating a gas, preferably a compressed gas such as CO_2.

BACKGROUND

[0003] EP 2 365 269 discloses a heat exchanger with a case having its inner part divided in two sections by a baffle. In a first section there is housed a tube bundle for a cooling fluid, and in the second section there is provided a demister and a liquid drainage. The demister extends horizontally within the second section and can for example be defined by a wire mesh.

[0004] During operation, a gas such as CO_2 enters the first section, it is cooled when passing through the tube bundle, then it passes into the second section by overcoming the baffle and in the second section the gas is demisted. Liquid is collected and removed at the bottom of the second section and gas is removed from the top of the second section.

SUMMARY

[0005] The inventors have found a way to improve demisting of the gas, such that the liquid dragged by the gas moving out of the second section of the heat exchanger of the present description is limited and preferably is reduced when compared with the liquid dragged by the gas moving out of the heat exchangers of the prior art.

[0006] These and further aspects are attained by providing a heat exchanger and a method in accordance with the accompanying claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Further characteristics and advantages will be more apparent from the description of a preferred but non-exclusive embodiment of the heat exchanger and method, illustrated by way of non-limiting example in the accompanying drawings, in which:

Figures 1 and 2 show different examples of heat exchangers;

Figure 3 shows a separation structure between a first and a second section of the heat exchanger;

Figure 4 to 6 show cross sections through respectively lines IV-IV, V-V and VI-VI of figure 3;

Figures 7 and 8 are a front view and a perspective view of a diverter,

Figures 9 and 10 show the gas circulation through the second section of the heat exchanger.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0008] With reference to the figures, these show a heat exchanger 1 comprising a case 2 with at least a case inlet 3 for a gas such as CO_2 (other gas is anyhow possible) and at least a case outlet 4. A separation structure 6 located within the case 2 defines a first and a second section 7, 8.

[0009] The first section 7 houses a bundle of tubes 10; the tubes of the bundle of tubes 10 are preferably U-shaped and have one end connected to an inlet 11 and another end connected to an outlet 12 for a cooling or heating fluid (the bent part of the U-shaped tubes is not shown). In the example shown the inlet 11 and outlet 12 are on the same side of the heat exchanger 1, naturally different embodiments are possible for the tubes of the bundle of tubes 10 (for example the tubes can have a shape different from the U-shape) and for the inlet 11 and/or outlet 12 position. In addition, instead of the bundle of tubes 10 any means for transferring heat can be used; for example plates implementing the Ziepack system from Alfa Laval can be used.

[0010] Advantageously, between the case inlet 3 and bundle of tubes 10 a distributor 9 is provided. In the example the distributor 9 is defined by a perforated plate that distributes the gas entering the case 2 over the whole first section 7. For this reason the perforated plate is preferably non-uniformly perforated. In fact, the nonuniform flow upstream of the distributor 9 requires a non-uniformly perforated plate to render the flow downstream of the distributor 9 uniform.

[0011] The tubes of the bundle of tubes 10 have one end connected to and supported by a wall 15 delimiting the first section 7, and another part connected to a plate or a different support or to the separation structure 6.

[0012] The second section 8 has the case outlet 4 and a liquid drainage 16. Preferably the second section 8 is defined by an empty volume (to promote gas circulation).

[0013] The heat exchanger has one or more channels 17 for directing a gas G passing from the first section 7 into the second section 8 towards the sides of the case 2. The channel or channels 17 have a longitudinal axis 18 directed towards a side of the case 2.

[0014] Advantageously, the heat exchanger 1 has two channels 17 with longitudinal axes 18 directed towards opposite sides of the case 2.

[0015] For example, the axes 18 define an angle A between 5-35 degree with the side of the case 2. This angle A allows the tangential flow of the gas along the case 2.

[0016] The separation structure 6 includes walls 22 extending from the top of the case 2 and a diverter 25 at the bottom of the case 2. The channels 17 are defined by the diverter 25.

[0017] The walls 22 separate the first section 7 from the second section 8 preventing gas G flow at the upper part of the case 2. Below the walls 22, there is positioned

the diverter 25.

[0018] Advantageously the diverter 25 has a wedge shape; this shape allows the gas to be diverted towards the case 2, at opposite sides thereof. Naturally also other shapes are possible for the diverter 25, for example the diverter 25 can be a wall or baffle, a cylindrical element, etc.

[0019] In order to help gas circulation through the heat exchanger 1, the case inlet 3 is positioned at the top of the case 2 and the case outlet 4 is also provided at the top of the case 2.

[0020] In order to help circulation through the second section 8, the case outlet 4 is adjacent the separation structure 6.

[0021] In order to help liquid gathering, the liquid drainage 16 is provided at the bottom of the case 2 and is adjacent the separation structure 6.

[0022] The liquid drainage 16 includes for example a liquid collector and a pipe for liquid removal; the pipe is typically provided with a valve.

[0023] Figure 2 shows an example of a heat exchanger 1 similar to the one of figure 1. In addition, this heat exchanger is provided with a second liquid drainage 26 at the first sector 7, at the bottom of the case 2 and adjacent the separation structure 6.

[0024] The liquid drainage 26 can be similar to the liquid drainage 16, but it can have different dimension and/or shape and/or liquid collector/protector devices from the liquid drainage 16.

[0025] The operation of the heat exchanger 1 is apparent from that described and illustrated and is substantially the following. In the following reference to the embodiment of figure 2 is made, the operation of the embodiment of figure 1 is similar to the one described.

[0026] The gas G to be cooled enters the case 2 through the case inlet 3 and when passing through the distributor 9 it is spread over the whole first section 7.

[0027] Thus the gas G, while flowing through the tube bundle 10, is cooled; cooling causes condensation (gas typically contains water and/or other condensable components). Liquid that is condensed drops at the bottom of the first section and is collected at the second liquid drainage 26. The position of the second liquid drainage 26 close to the separation structure 6 helps liquid collection, because the flowing gas G drags the liquid.

[0028] The gas G thus passes through the channels 17. The channels 17 preferably have a substantially constant cross section (see figures 4 through 6).

[0029] When passing through the channels 17 the gas G is diverted towards the sides of the case 2. Thus the gas G, while circulating through the second section 8, is diverted to follow the case 2 from purely axial direction to a direction tangential the case 2. Thus the gas diverted by the diverter 25 follows the case 2 (i.e. it flows parallel to it). While flowing parallel to the case 2, due to the case 2 curvature, the droplets undergo centrifugal forces that separate them from the gas and push them against the case 2 (figure 9, upper part). This causes liquid droplets L dragged by the gas G to be separated from the gas G and to drip along the case 2 (figure 9, lower part).

[0030] Typically these droplets L form a liquid film that drips towards the bottom of the second section 8. The position of the liquid drainage 16 promotes liquid gathering, because also after separation of the droplets from the gas G the liquid droplets and liquid film are pushed by the gas G towards the liquid drainage 16.

[0031] The present disclosure also refers to a method for demisting a gas G passing through the heat exchanger 1. According to the method, the channels 17 direct the gas G that passes from the first section 7 into the second section 8 towards the sides of the case 2.

[0032] Naturally the features described may be independently provided from one another.

[0033] In practice the materials used and the dimensions can be chosen at will according to requirements and to the state of the art.

REFERENCE NUMBERS

[0034]

1 heat exchanger
2 case
3 case inlet
4 case outlet
6 separation structure
7 first section
8 second section
9 distributor
10 bundle of tubes
11 inlet
12 outlet
15 wall
16 liquid drainage
17 channel
18 axis
22 wall
25 diverter
26 second liquid drainage
G gas
L liquid droplets

Claims

1. A heat exchanger (1) comprising a case (2) with at least a case inlet (3) and at least a case outlet (4), a separation structure (6) located within the case (2) defining a first section (7) and a second section (8), a bundle of tubes (10) or other means for heat transfer housed within the first section (7), wherein the first section (7) has the case inlet (3) and the second section (8) has the case outlet (4) and a liquid drainage (16), **characterised by** comprising at least a channel (17) having a longitudinal axis (18) directed towards a side of the case (2).

2. The heat exchanger (1) of claim 1, **characterized by** comprising two channels (17) having longitudinal axes directed towards opposite sides of the case (2).

3. The heat exchanger (1) of claim 1 or 2, **characterized in that** the separation structure (6) includes at least a wall (22) extending from the top of the case (2) and at least a diverter (25) at the bottom of the case (2), the at least a diverter (25) defining the at least a channel (17).

4. The heat exchanger (1) of claim 3, **characterized in that** the diverter (25) has a wedge shape.

5. The heat exchanger (1) of claim 1, **characterized in that** the case outlet (4) is provided at the top of the case (2) and is adjacent the separation structure (6).

6. The heat exchanger (1) of claim 1, **characterized in that** the liquid drainage (16) is provided at the bottom of the case (2) and is adjacent the separation structure (6).

7. The heat exchanger (1) of claim 1, **characterized by** comprising a second liquid drainage (26) at the first sector (7).

8. The heat exchanger of claim 7, **characterized in that** the second liquid drainage (26) is provided at the bottom of the case (2) and is adjacent the separation structure (6).

9. The heat exchanger of claim 1, **characterized in that** the at least a channel (17) has substantially constant cross section.

10. The heat exchanger of claim 1, **characterized in that** the longitudinal axis (18) of the at least a channel (17) defines an angle (A) between 5-35 degree with the side of the case (2).

11. A method for demisting a gas (G) passing through a heat exchanger (1),
the heat exchanger (1) comprising a case (2) with at least a case inlet (3) and at least a case outlet (4), a separation structure (6) located within the case (2) defining a first section (7) and a second section (8), a bundle of tubes (10) or other means for heat transfer housed within the first section (7), wherein the first section (7) has the case inlet (3) and the second section (8) has the case outlet (4) and a liquid drainage (16), the heat exchanger comprising at least a channel (17) for directing a gas passing from the first section (7) into the second section (8), wherein the heat exchanger (1) comprises at least a channel (17) having a longitudinal axis (18) directed towards a side of the case (2),
the method being **characterized in that** the at least a channel (17) directs the gas (G) passing from the first section (7) into the second section (8) towards the side of the case (2).

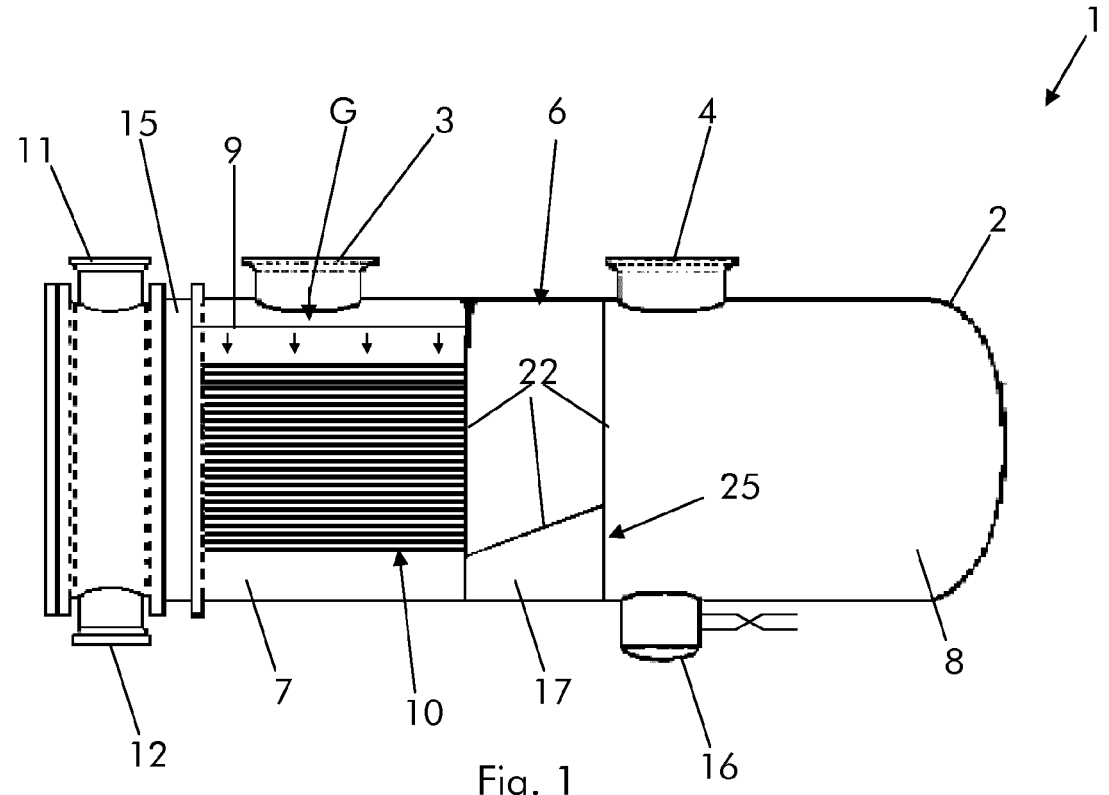
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Fig. 1

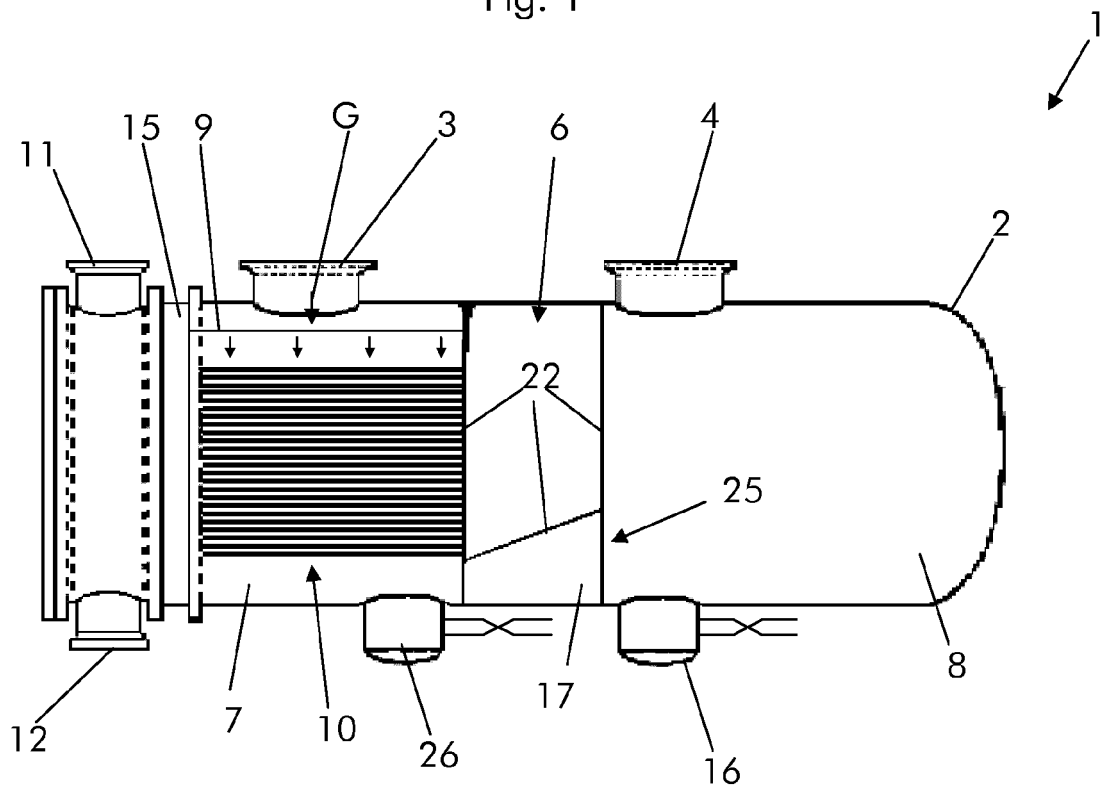
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Fig. 2

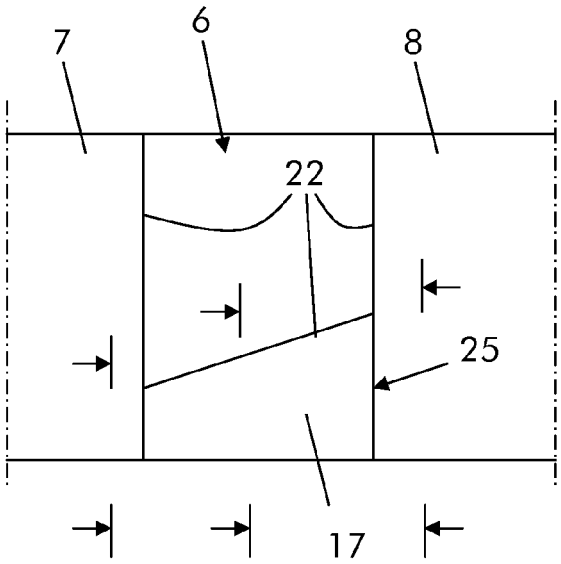

Fig. 3

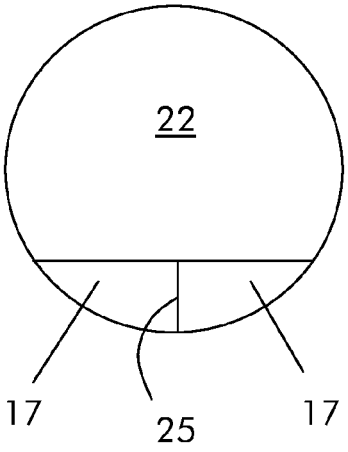

Fig. 4

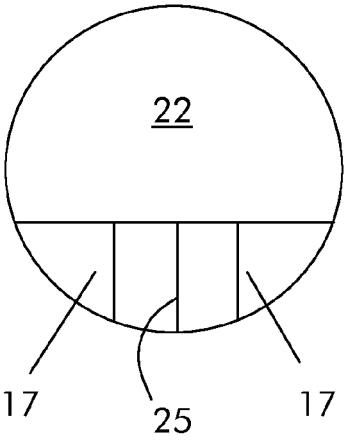

Fig. 5

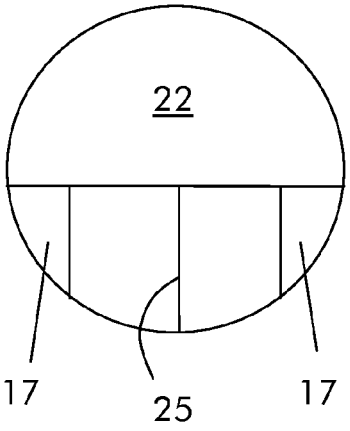

Fig. 6

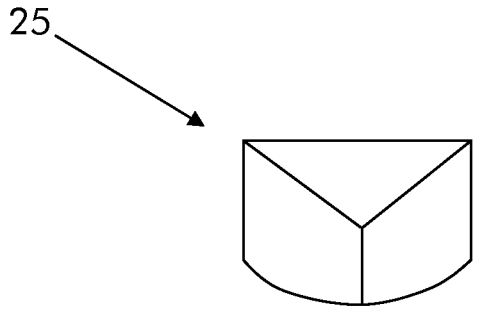

Fig. 7

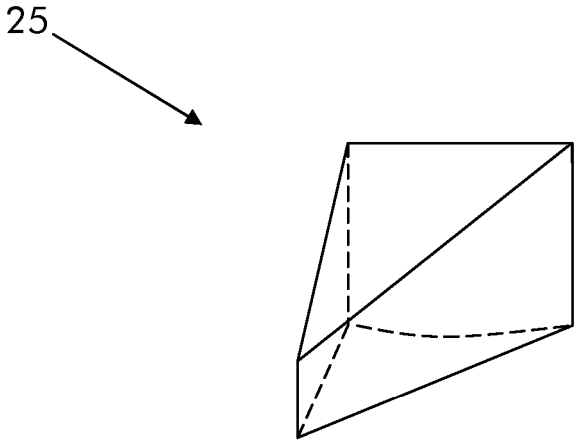

Fig. 8

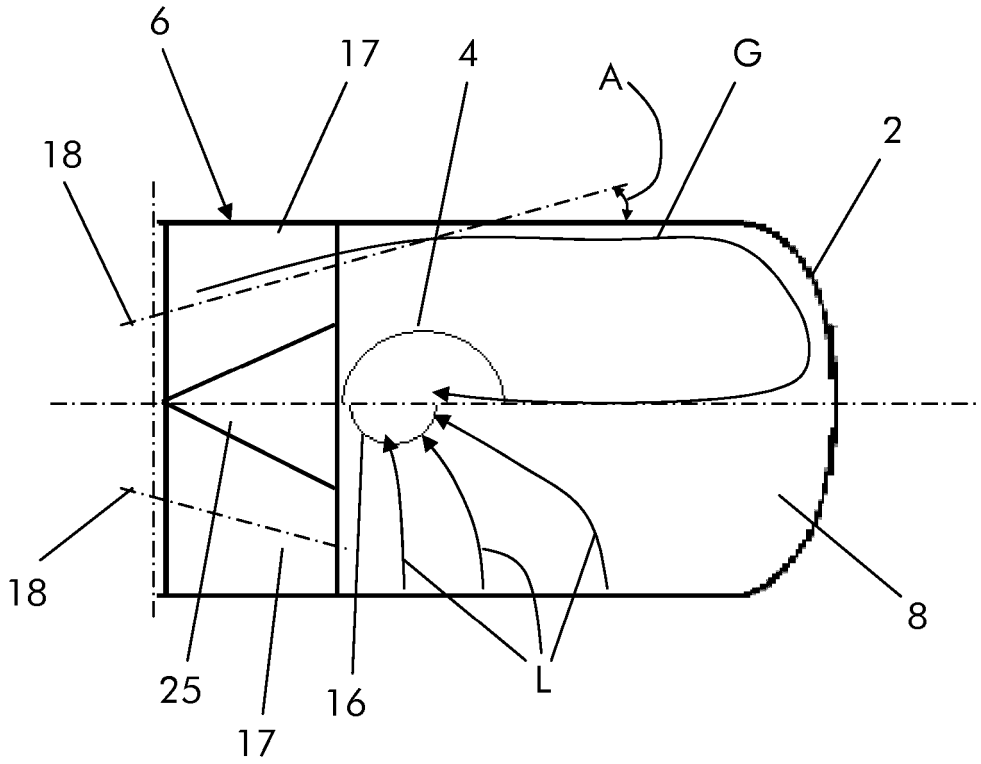

Fig. 9

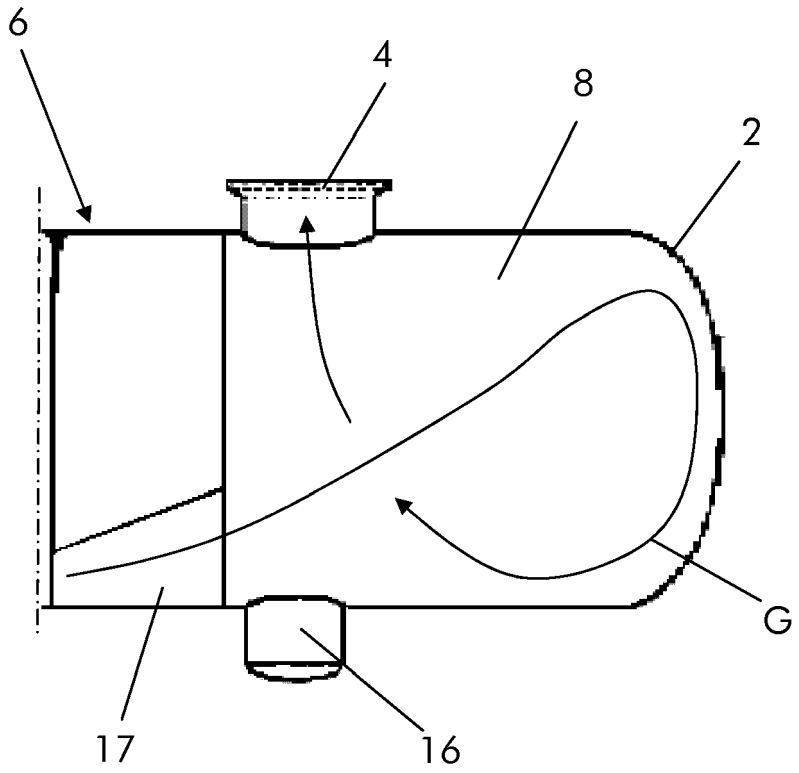

Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 14 15 5144

DOCUMENTS CONSIDERED TO BE RELEVANT

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A	* figures 1,2 *	2-11	F28F17/00 F28D7/06
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A	* figure 1 *	2-11	
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TECHNICAL FIELDS SEARCHED (IPC)
F28F F28D F28B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 June 2014	Berkus, Frank

CATEGORY OF CITED DOCUMENTS

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26-06-2014

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