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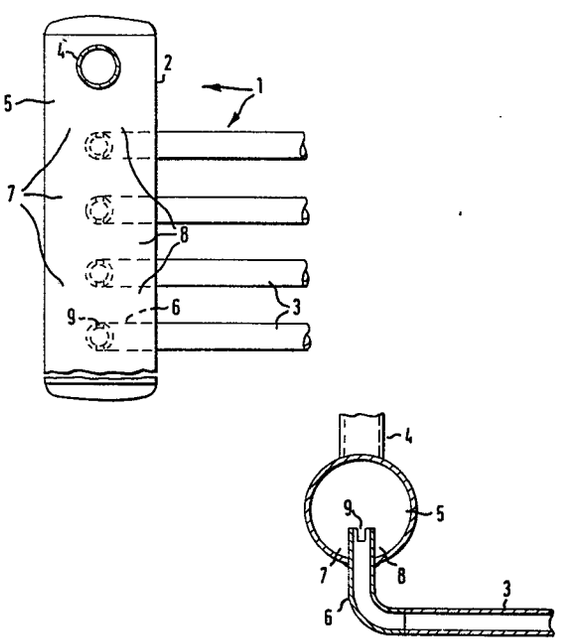
(54) Heat exchanger.

(57) A heat exchanger provided with a series of heat exchange tubes 3, comprises a separator chamber 5, a supply 4 for a gas/liquid mixture to the separator chamber 5 and a series of conduits 6, each conduit 6 forming a fluid communication between the separator chamber 5 and a corresponding heat exchange tube 3. For obtaining a uniform distribution of liquid over the heat exchange tubes 3, the separator chamber is provided with at least one gutter 7, 8 for collecting liquid, extending along the series of conduits 6, and means 9 for causing liquid from the gutter(s) 7, 8 to flow to each gas stream passing through a conduit of the series of conduits 6.



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HEAT EXCHANGER

The invention relates to a heat exchanger provided with a series of heat exchange tubes, wherein the one medium flows around the tubes and the other, heat exchanging, medium is passed through the tubes. Heat exchangers of the above, so-called closed, type are widely used in the industry, for example in the oil processing industry for cooling products from hydrocracking installations.

The present invention relates more in particular to a heat exchanger of the above type which is suitable for the application of gas/liquid mixtures as heat exchanging media.

When a gas/liquid mixture is applied in the known heat exchangers as heat exchanging medium frequently deterioration of the heat exchange tubes and/or other parts of the heat exchanger occurs. It has been found that such a deterioration is caused by a maldistribution of the gas/liquid mixture over the heat exchange tubes. The problems occurring at maldistribution of the gas/liquid mixture over the heat exchange tubes may originate from the differences in heat exchange properties of gas and liquid. Liquid has a much better heat exchange rate than gas. Therefore, if a high temperature gas/liquid mixture is cooled by passing the mixture through heat exchange tubes surrounded by a low temperature fluid a heat exchange tube receiving much liquid and only a small quantity of gas, will cool down more rapidly and to a greater extent than a heat exchange tube receiving only a small quantity of liquid and relatively much gas. The resulting temperature differences between the heat exchange tubes in the known heat exchangers, may cause excessive stresses. Such stresses may in their turn easily result in damage to the heat exchange tubes and other parts of the heat exchanger.

The problems occurring at maldistribution of a gas/liquid mixture over the heat exchange tubes of a heat exchanger may

also originate from the composition of the gas in the mixture. When a high temperature gas contains dissolved corrosive matter, the corrosive matter may come free upon lowering of the temperature of the gas. This for example occurs upon cooling down gaseous reactor effluents containing corrosive ammonium salts. To absorb such corrosive matter, liquid is supplied to the gas prior to cooling down.

It has been found that when such a gas mixed with liquid to absorb the corrosive matter in the gas is cooled down by passing the gas through the heat exchange tubes of a known heat exchanger, some of the heat exchange tubes are damaged by corrosion, due to maldistribution of the liquid over the heat exchange tubes. Insufficient liquid has reached part of the tubes to absorb the corrosive matter and/or to wash the corrosive matter from the walls of these tubes.

From the above it will be clear that gas/liquid mixtures applied as heat exchanging media should be distributed as uniformly as possible over the heat exchange tubes, to avoid deterioration of these tubes.

The object of the present invention is to improve the known heat exchanger provided with a series of heat exchange tubes in such a manner that when a gas/liquid mixture is supplied for passing through the heat exchange tubes the mixture is uniformly distributed over the heat exchange tubes.

The heat exchanger according to the invention provided with a series of heat exchange tubes thereto comprises a separator chamber, inlet means for supplying a mixture of liquid and gas into the separator chamber, a series of conduits, each conduit forming a fluid communication between the separator chamber and a heat exchange tube, at least one gutter extending along the series of conduits for collecting liquid in the separator chamber, and means for causing liquid to flow from the gutter(s) to each gas stream passing through a conduit of the series of conduits.

The invention will now be described by way of example only in more detail with reference to the accompanying drawings, wherein:

Figure 1 shows a cross section of a part of a heat exchanger in accordance with the invention;

Figure 2 shows a top view of the part of the heat exchanger shown in Figure 1;

Figure 3 shows a cross section of a first alternative embodiment in accordance with the invention;

Figure 4 shows cross section IV-IV of Figure 3;

Figure 5 shows a cross section of a second alternative embodiment in accordance with the invention; and

Figure 6 shows cross section VI-VI of Figure 5.

In the embodiment of the invention shown in Figures 1 and 2, a heat exchanger, indicated by reference numeral 1, comprises an elongated, horizontally extending vessel 2, for the supply of fluid to a series of heat exchange tubes 3 arranged along the length of the vessel 2.

Fluid passed through said heat exchange tubes 3 is collected in a not shown collecting vessel of the heat exchanger 1.

The elongated vessel 2 is provided with an inlet 4, for the supply of fluid into a separator chamber 5 formed by the vessel 2. In said separator chamber 5 fluid supplied via the inlet 4 is distributed over the various heat exchange tubes 3 via a series of conduits 6, each conduit 6 forming a fluid communication between the separator chamber 5 and one heat exchange tube 3. The conduits 6 passing through openings of the vessel 2 are secured to the vessel 2 and the heat exchange tubes 3 by means of welding.

The upper ends of the conduits 6 are arranged at a level above the bottom of the separator chamber 5, so that gutters 7 and 8 extending along the conduits 6 are formed for collecting liquid. The walls of the conduits 6 are each provided with a number of slots 9 for discharging liquid from said gutters 7 and

8. The lower ends of the slots 9 in the walls of the conduits 6 are arranged at substantially the same height.

During operation of the heat exchanger 1 a gas/liquid mixture to be cooled is supplied to the vessel 2 via the inlet 4. In the separator chamber 5 the liquid from the gas/liquid mixture will collect in the gutters 7 and 8 and form a layer of liquid over the full length of the gutters 7 and 8.

The gas in the gas/liquid mixture passes through the conduits 6 via their open upper ends and enters into the heat exchange tubes 3. When the liquid level in the gutters 7 and 8 has reached the lower ends of the slots 9 the liquid will flow via said slots 9 into the conduits 6, were it is mixed with the gas passing through said conduits 6, so that mixtures of liquid and gas will flow into the heat exchange tubes 3. By the arrangement of the gutters 7 and 8 in combination with the conduits 6 provided with the slots 9 being arranged at the same height, liquid and gas are equally distributed over the heat exchange tubes 3.

Reference is now made to Figures 3 and 4 showing a first alternative of the embodiment shown in the Figures 1 and 2.

The part of the heat exchanger shown in these Figures comprises an elongated vessel 10 enclosing a separator chamber 11. A plurality of inlets 12 are provided for supplying a gas/liquid mixture into the separator chamber 11. For the sake of simplicity only one inlet 12 is shown in the Figures. A series of heat exchange tubes 13 extends along the length of the vessel 10, said tubes being mounted in openings of a structure 14, for example a forced piece, forming the bottom part of the vessel 10. For inspection and maintenance of the heat exchange tubes 13 removable plugs 15 are arranged in the forced piece 14 opposite of said tubes 13. A series of conduits 16 are arranged along the length of the vessel 10, each conduit 16 forming a fluid communication between the separator chamber 11 and a heat exchange tube 13.

Two substantially parallel gutters 17 and 18, for

collecting liquid supplied via the inlets 12, extend along the conduits 16. Liquid can be supplied from said gutters 17 and 18 to the heat exchange tubes 13 via a plurality of sets of liquid conduits 19 and 20 arranged in the structure 14. Each set of liquid conduits 19 and 20 forms a fluid communication between the gutters 17 and 18 and the interior of an enlarged part 21 in a conduit 16. The enlarged parts 21 of the conduits 16 are interconnected thereby forming a chamber extending along the series of heat exchange tubes 13.

The separator chamber 11 is further provided with baffles 22 arranged in front of the inlets 12 for distributing the incoming fluid over the length of the separator chamber 11.

During operation of the heat exchanger partly shown in Figures 3 and 4 a gas/liquid mixture to be cooled is supplied into the separator chamber 11 via the inlets 12. Due to the presence of the baffles 22 the incoming fluid is distributed over the length of the separator chamber 11 and cannot pass directly into the conduits 16 arranged in front of the inlets 12. The liquid in the supplied mixture will settle down in the gutters 17 and 18 extending along the conduits 16, and is subsequently discharged from the separator chamber 11 via the liquid conduits 19 and 20, respectively. The gas from the supplied mixture leaves the separator chamber 11 via the conduits 16.

In the enlarged part 21 of each conduit 16 the liquid from adjacent liquid conduits 19 and 20 is mixed with the gas stream passing through said conduit 16, so that a mixture of liquid and gas subsequently enters into the heat exchange tube 13 pertaining to said conduit 16. Since the conduits 16 are interconnected via their enlarged parts 21, the gas/liquid mixtures in the conduits 16 can be redistributed over the length of the vessel 10 prior to entering into the heat exchange tubes 13. When the entrance of a heat exchange tube 13 pertaining to a conduit 16 is clogged due to for example contaminations in the

gas/liquid mixture, the mixture from said conduit 16 will flow via the interconnected enlarged parts 21 to heat exchange tubes 13 which are not clogged.

In the embodiment of the invention shown in Figures 3 and 4 the enlarged parts 21 of the conduits 16 should have such a small cross-sectional area that settlement of liquid in the bottom parts of these enlarged parts 21 is prevented.

Reference is now made to Figures 5 and 6 showing a second alternative embodiment according to the invention.

The heat exchanger partly shown in these Figures comprises a series of heat exchange tubes 30, mounted in openings of the bottom part 31 of an elongated vessel 32. The interior of said vessel 32 comprises a separator chamber 33, provided with a plurality of inlets 34 for the supply of fluid into said separator chamber 33. The separator chamber 33 is in fluid communication with the interiors of the heat exchange tubes 30 via a series of conduits 35.

For inspection and maintenance of the heat exchange tubes 30 each conduit 35 is provided with a removable plug 36, arranged opposite to an adjoining heat exchange tube 30.

The bottom of the separator chamber 33 is provided with a lowered part forming a gutter 37 extending over the length of the vessel 32 along the series of heat exchange tubes 30. Liquid collected in the gutter 37 is supplied into the interiors of the conduits 35 via a series of liquid conduits 38. The separator chamber 33 is further provided with baffles 39 for distributing supplied fluid over the length of the separator chamber 33, each baffle 39 being arranged in front of an inlet 34.

During operation of the heat exchanger partly shown in the Figures 5 and 6, the gas from a gas/liquid mixture supplied via the inlets 34 into the separator chamber 33, will directly flow via the conduits 35 into the heat exchange tubes 30. The liquid in the gas/liquid mixture will be first collected in the gutter 37 and subsequently discharged from the separator chamber 33 via

the liquid conduits 38. In each conduit 35 the liquid from a liquid conduit 38 pertaining to said conduit 35 is remixed with the gas flowing through said conduit 35, prior to entering into the adjoining heat exchange tube 30.

The invention is not restricted to the application of gutters for collecting liquid of the types as shown in the drawings, provided that the gutter(s) extend(s) along the conduits 6, 16, 35 forming the main fluid communication between the separator chamber of the heat exchanger and the heat exchange tubes.

Further the invention is not restricted to heat exchangers provided with separator chambers having in cross section shapes as shown in the drawings. The separator chamber can have any other cross-sectional shape, such as a hexagonal shape, without departing from the invention.

Although the drawings show heat exchangers comprising parallel heat exchange tubes cooperating with elongated separator chambers, other arrangements of heat exchange tubes are also possible. The heat exchange tubes may for example be arranged according to the radii of a circle, thereby communicating with a circular or annular separator chamber. In this embodiment the gutter(s) for collecting liquid will have an annular shape.

Instead of the slot(s) 9 arranged in the walls of the conduits 6 shown in Figure 2, for the withdrawal of liquid from the gutters 7 and 8, the walls of the conduits 6 can be provided with any other type of openings provided that these openings are arranged at a level above the lower ends of the gutters.

C L A I M S

1. Heat exchanger provided with a series of heat exchange tubes, comprising a separator chamber, inlet means for supplying a mixture of liquid and gas into the separator chamber, a series of conduits, each conduit forming a fluid communication between the separator chamber and a heat exchange tube, at least one gutter extending along the series of conduits for collecting liquid in the separator chamber, and means for causing liquid to flow from the gutter(s) to each gas stream passing through a conduit of the series of conduits.

2. Heat exchanger as claimed in claim 1, comprising two gutters extending along and at opposite sides of the series of conduits.

3. Heat exchanger as claimed in claim 1 or 2, wherein the means for causing liquid to flow from the gutter(s) to each gas stream comprises a series of liquid conduits.

4. Heat exchanger as claimed in claim 1 or 2, wherein the means for causing liquid to flow from the gutter(s) to each gas stream comprises an opening arranged in each of the walls of the series of conduits at a level above the lower end(s) of the gutter(s).

5. Heat exchanger as claimed in claim 4, wherein the lower ends of the openings in the walls of the series of conduits are arranged on the same level.

6. Heat exchanger as claimed in any one of the claims 1-5, wherein each conduit comprises an enlarged part.

7. Heat exchanger as claimed in claim 6, wherein the enlarged parts are interconnected for redistributing fluid over the series of heat exchange tubes.

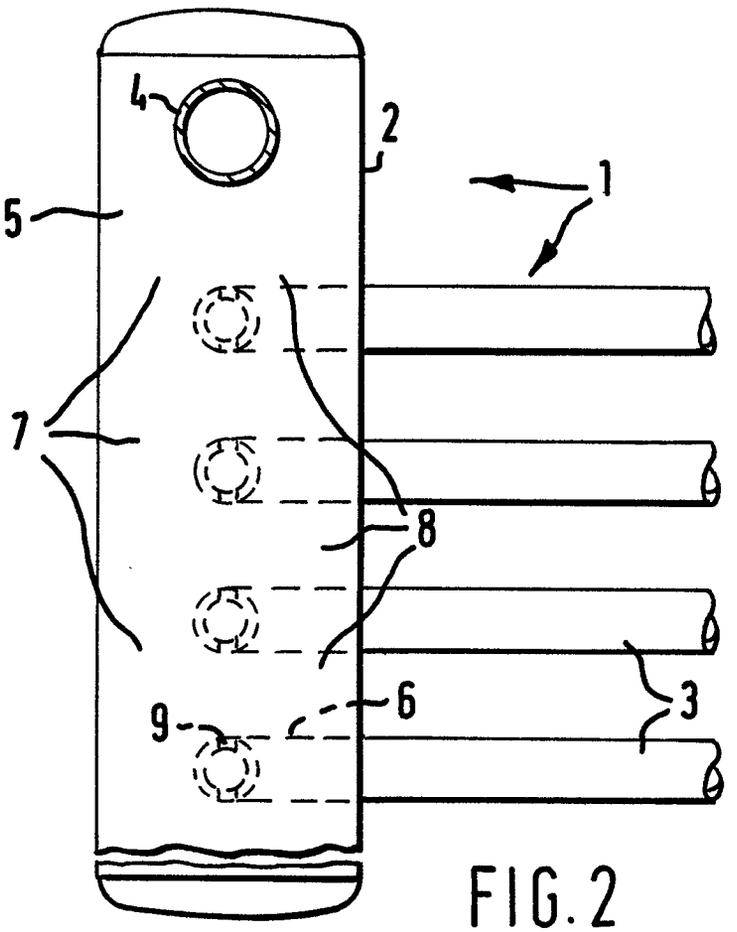


FIG. 2

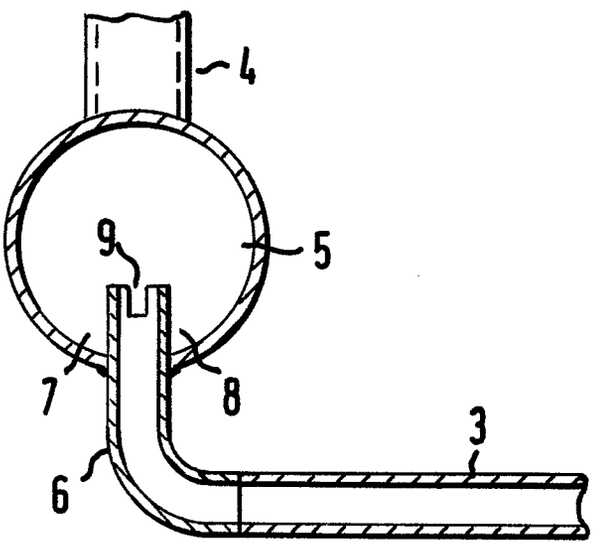


FIG. 1

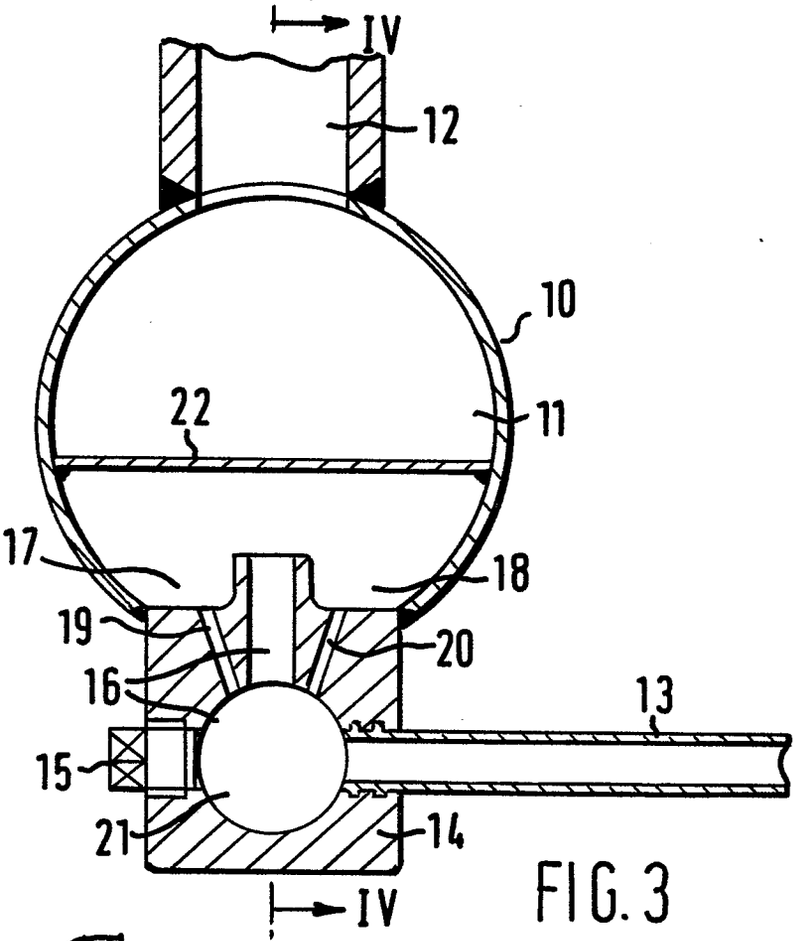


FIG. 3

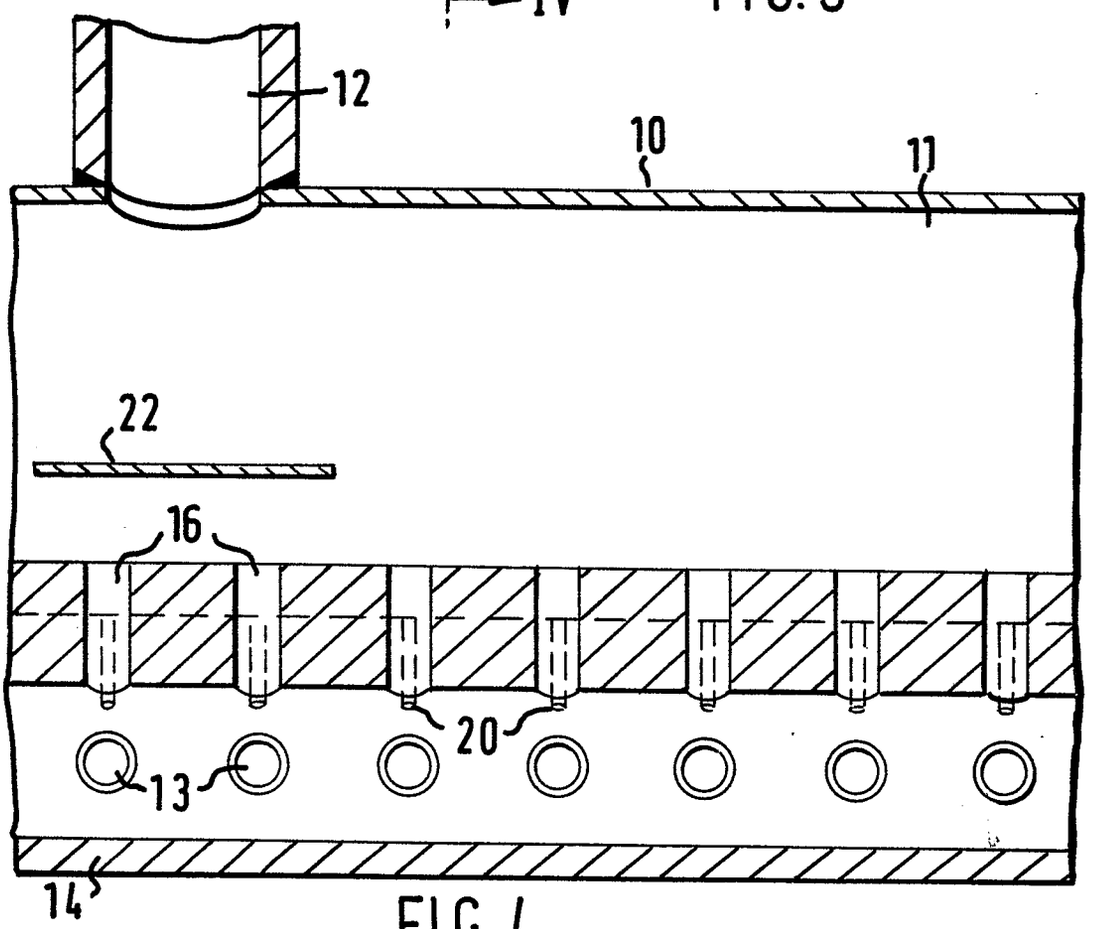


FIG. 4

FIG.5

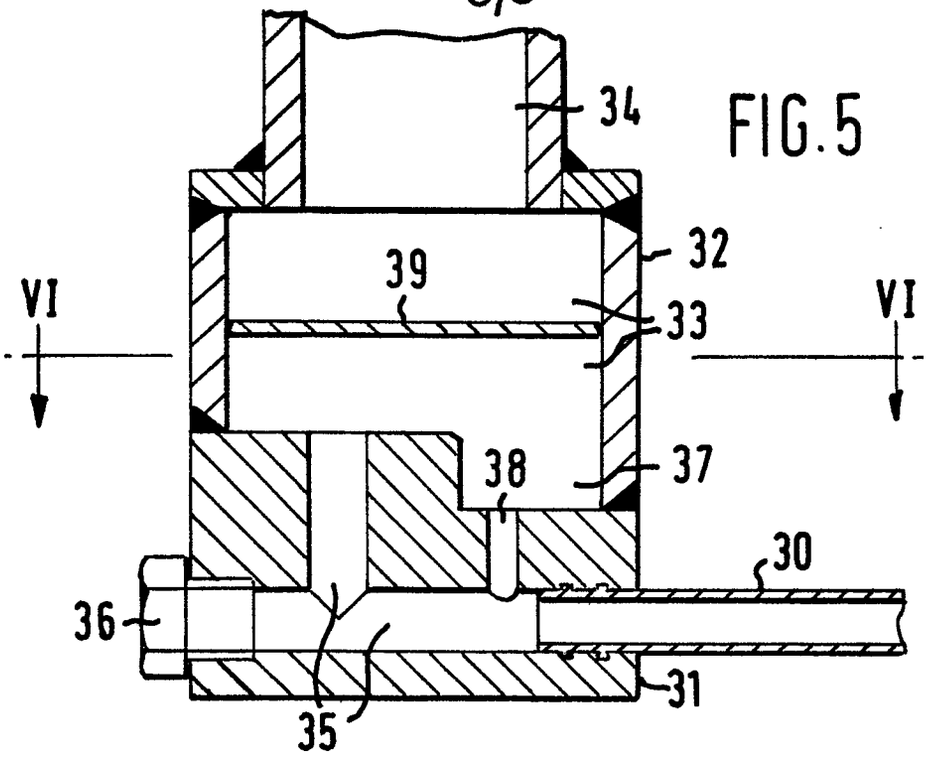
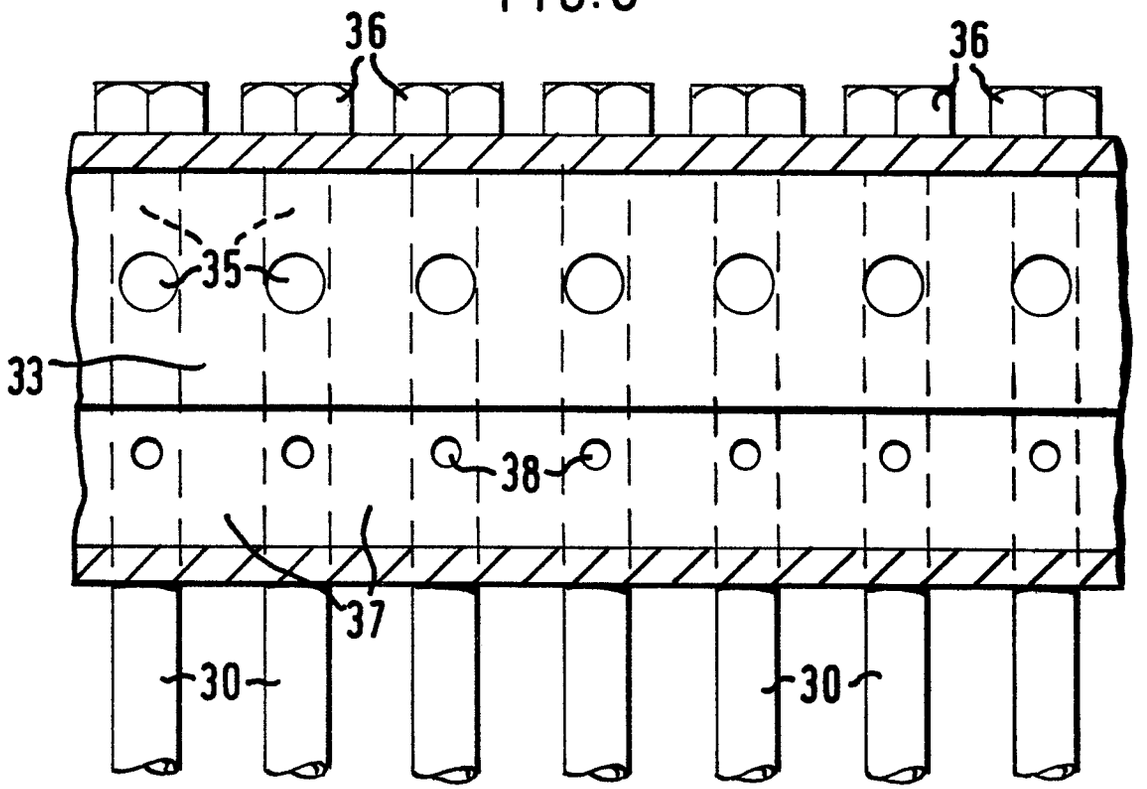


FIG.6



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EUROPEAN SEARCH REPORT

0068529
Application number

EP 82 20 0639

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	FR-A-2 317 534 (ATLANTIC) *Pages 9,10; figures 1,3*	1,2,3, 4,5	F 28 F 27/02
X	GB-A-2 000 688 (KUBA) *Page 3; figures 1,2*	1,2,3, 4,5	
X	US-A-2 193 696 (RAMSAUR) *The whole document*	1,2,4, 5	
A	CH-A- 402 026 (KÜHNI) *The whole document*	1,2,4, 5	
A	US-E- 20 964 (MORTON) *Page 2; figures 3,4*	3,6,7	TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
A	GB-A-1 163 288 (VEB) *Page 2, lines 54-71; figure 1*	7	F 28 F F 28 D F 28 B F 15 D
A	DE-A-2 642 683 (SNAMPROGETTI)		
A	US-A-2 220 595 (ANDERSEN)		
A	US-A-2 196 858 (GLEASON)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22-09-1982	SCHOUFOUR F.L.

CATEGORY OF CITED DOCUMENTS

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