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(54) CLAMP ASSEMBLY AND HEAT EXCHANGER WITH CLAMP ASSEMBLY

(57) A clamp assembly (100) for connecting a first part (1101) of a heat exchanger (1100) to a second part (1102) of the heat exchanger (1100). The clamp assembly comprises a clamp device (120) that acts on the second part (1102), an elongated bar (130) that is connected to the clamp device (120) and extends through the first part (1101), and a tightening nut (140) that is attached to the elongated bar (130) and acts on the first part (1101) for pressing the first and second parts (1101, 1102) towards each other. A heat exchanger comprising a shell (1102), a first cover (1101), a second cover (1109) and a number of clamp assemblies (100) arranged such that each elongated bar (130) extends through one of a plurality of holes (1106) or recesses through a protruding portion (1105) of at least one of the first and second covers (1101, 1109).

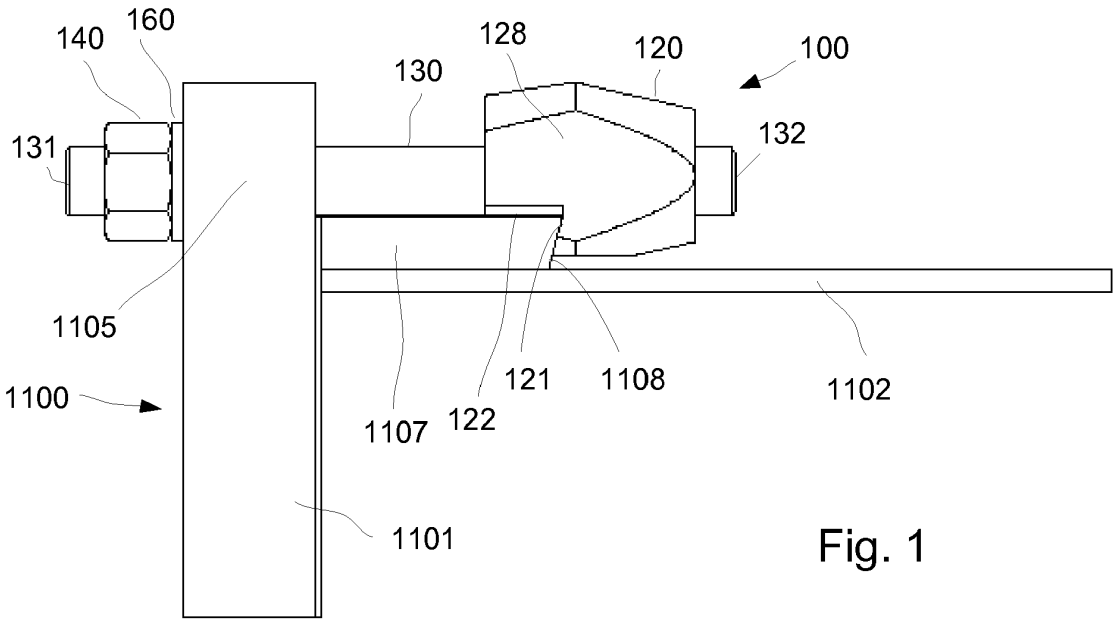

Fig. 1

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Description

Technical Field

[0001] The invention relates to a clamp assembly for connecting a first part of a heat exchanger to a second part of the heat exchanger. The invention also relates to a heat exchanger comprising a clamp assembly.

Background Art

[0002] Today many different types of plate heat exchangers exist and are employed in various applications depending on their type. Generally, a heat exchanger has a number of heat transfer elements that form alternating first and second flow paths in between the elements. A first fluid flows in the first flow path and a second fluid flows in the second flow path. As such flow goes on and when there is a temperature difference between the fluids, heat is transferred from the warmer fluid to the colder fluid.

[0003] The design of the heat exchanger is important for providing efficient transfer of heat between the fluids. The heat transferring elements must also be durable and should withstand various stresses that may occur, for example due to pressure variations and temperature differences. The heat transferring elements are often located inside a shell that protects the elements and assures that the pressurized fluid is contained within the heat exchanger. It is then important that the shell is properly sealed. In some cases it is also important that the shell can be opened for allowing the heat transferring elements to be cleaned or replaced. After such cleaning or replacement the shell must be sealed again. A number of techniques exist for sealing a shell of a heat exchanger.

[0004] When a possibility to open the heat exchanger is required then a number of techniques are used for connecting the parts of the shell to each other. For example may conventional bolts be used, or so called hook bolts. Some examples of such techniques are shown in patent document US1969135, where a hook bolt is tightened by a conventional nut that is located on an opposite side of the hook. This document also shows how two parts of a heat exchanger shell are connected to each other by a large number of bolts that pull a ring towards a flange of one of the parts that shall be connected.

[0005] In particular so called spiral heat exchangers relies on techniques that allows the shell of the heat exchanger to be repeatedly opened and closed. The spiral heat exchanger has a coiled tube, or spiral, that is located inside the shell and the shell is sealed by bolts. The alternating first and second flow paths are formed in the spiral and the distance between a steel sheet that makes up the spiral is maintained by using spacer studs that were welded to the sheet prior to rolling it into a spiral. When the spiral has been rolled, alternate side edges are welded and the spiral is placed in a shell that is closed by flat or conical covers that is bolted to the shell. The covers are removed from the shell whenever cleaning is required, or if the spiral needs to be replaced.

[0006] Today various shells for different kinds of heat exchangers are successfully sealed by using bolts and/or hook bolts, including shells for spiral heat exchangers. However, it is estimated that such bolts may be improved, in particular in respect of their manufacturing costs, and in respect of being effectively used for a spiral heat exchanger that needs to be repeatedly opened and closed.

Summary

[0007] It is an object of the invention to at least partly overcome one or more of the above-identified limitations of the prior art. In particular, it is an object to provide a hook assembly for connecting two pieces of a heat exchanger to each other. Another object is to provide a heat exchanger with a shell and covers that are effectively connected to the shell.

[0008] To solve these objects a clamp assembly for connecting a first part of a heat exchanger to a second part of the heat exchanger is provided. The clamp assembly comprises a clamp device that acts on the second part. An elongated bar is connected to the clamp device and extends through the first part. A tightening nut is attached to the elongated bar and acts on the first part for pressing the first and second parts towards each other.

[0009] The clamp assembly is advantageous in that the clamp device not is an integral part of the bar to which the tightening nut is attached. This allows for using more standardized components for the clamp assembly, which decreases costs. The clamp assembly only has a few components, which also reduces costs. Further, the clamp assembly provides a steady and reliable connection.

[0010] The elongated bar may be a threaded elongated bar.

[0011] The tightening nut may be is a threaded nut that is screwed onto the elongated bar.

[0012] The elongated bar may be directly attached to the clamp device.

[0013] The clamp device comprises a hole into which the elongated bar is inserted.

[0014] The hole of the clamp device comprises an inner thread to which the elongated bar is screwed.

[0015] The clamp assembly comprises a washer mounted on the elongated bar, acted upon by the tightening nut and abutting the first part of the heat exchanger.

[0016] The clamp device comprises a clamping surface engaging the second part of the heat exchanger.

[0017] The clamping surface is inclined.

[0018] The clamp device comprises an abutment surface that extends in a direction that is parallel to a longitudinal axis of the elongated bar, said abutment surface engaging the second part of the heat exchanger.

[0019] The clamp device comprises two parallel surfaces extending parallel to a longitudinal axis of the elongated bar.

[0020] According to another aspect a heat exchanger is provided, which comprises a shell, a first cover, and a second cover that form an enclosure for two fluid flow channels. At least one of the first and second covers has a protruding portion protruding beyond the shell. The protruding portion comprises a plurality of holes or recesses through the cover. Said at least one of the first and second covers is connected to the shell by a number of clamp assemblies of the type previously described arranged such that each elongated bar extends through one of the holes or recesses of said at least one of the first and second the covers. The heat exchanger is advantageous in that it may easily be opened and closed by virtue of clamp assemblies, while at the same time giving the total heat exchanger a lower production cost.

[0021] Said at least one of the first and second covers has a dimension that is larger than the corresponding dimension of the shell such that said at least one of the first and second covers protrudes beyond the shell.

[0022] Still other objectives, features, aspects and advantages of the invention will appear from the following detailed description as well as from the drawings.

Brief Description of the Drawings

[0023] Embodiments of the invention will now be described, by way of example, with reference to the accompanying schematic drawings, in which

Fig. 1 is a side view of a clamp assembly connecting two parts of a heat exchanger to each other,
Fig. 2 is a cross-sectional side view of the clamp assembly of Fig. 1 connecting two parts of a heat exchanger to each other,
Fig. 3 is a perspective view of the clamp assembly of Fig. 1,
Fig. 4 is a cross-sectional side view of the clamp assembly of Fig. 1,
Fig. 5 is an exploded side view of the clamp assembly of Fig. 1,
Fig. 6 is perspective view of a clamp device of the clamp assembly of Fig. 1,
Fig. 7 is a perspective view of a heat exchanger that is closed by a number of clamp assemblies of the same type as shown in Fig. 1.

Detailed description

[0024] With reference to Figs 1-6 a clamp assembly 100 is illustrated. The clamp assembly 100 connects a first part 1101 of a heat exchanger 1100 to a second part 1102 of the heat exchanger 1100 as shown in Fig. 7. The clamp assembly 100 comprises an elongated bar 130, a clamp device 120 and a tightening nut 140.

[0025] With reference to Fig. 7 a heat exchanger 1100 in the form of a spiral heat exchanger 1100 is illustrated. The heat exchanger 1100 comprises a first part 1101, which in Fig. 7 is illustrated as a first cover 1101 and a second cover 1109. The heat exchanger 1100 also comprises a second part 1102, which in Fig. 7 is illustrated as a shell 1102. The shell 1102, the first cover 1101 and the second cover 1109 form an enclosure for two fluid flow channels. The first part 1101 has a protruding portion 1105 protruding beyond the second part 1102. The protruding portion 1105 comprises a plurality of holes 1106 through the first part 1101. The first part 1101 is connected to the second part 1102 by a number of clamp assemblies 100.

[0026] The clamp device 120 acts on the second part 1102. The elongated bar 130 is connected to the clamp device 120 and extends through the first part 1101. The tightening nut 140 is attached to the elongated bar 130 and acts on the first part 1101. When the tightening nut 140 acts on the first part 1101 and the clamp device 120 acts on the second part 1102, the first and second parts 1101, 1102 are pressed towards each other.

[0027] The elongated bar 130 is a threaded elongated bar. The threaded elongated bar 130 is an externally threaded elongated bar, i.e. an elongated bar having external threads. The elongated bar 130 is a round bar, and thus the elongated bar is a cylindrical bar. The elongated bar 130 is preferably a conventional externally threaded elongated bar.

[0028] The tightening nut 140 is a threaded nut. The tightening nut 140 is screwed onto the elongated bar 130. The tightening nut 140 is an internally threaded nut, i.e. a nut having internal threads. The tightening nut 140 is preferably a conventional, internally threaded nut. The tightening nut 140 of conventional type has six outer, flat sides that allows a nut tightening device to grip the nut for tightening it. The tightening nut 140 may of course have another number of sides, or another external shape, as long as it can be gripped and tightened by a tool. The inner threads of the tightening nut 140 matches the threads of the elongated bar 130.

[0029] The elongated bar 130 is attached to the clamp device 120. The elongated bar 130 is directly attached to the clamp device 120. Thereby, the elongated bar 130 is connected to the clamp device 120 without intermediate means. Thereby, the number of parts and thus the costs are reduced and the handling of the clamp assembly is facilitated. The clamp device 120 comprises a hole 126 into which the elongated bar 130 is inserted. The hole 126 may be a through hole 126 or a blind hole. The hole 126 of the clamp device 120 comprises an inner thread and the elongated bar 130 is screwed to the threaded inner hole. The inner threads of the hole 126 of the clamp device 120 matches the threads of the elongated bar 130. Alternatively or as a supplement, the elongated bar 130 may be welded to the clamp device 120.

[0030] The clamp device 120 comprises a clamping surface 121 engaging the second part 1102 of the heat exchanger 1100. The clamping surface 121 is inclined. The inclination of the clamping surface 121 pushes the clamp device and the clamp assembly towards the heat exchanger and improves the clamping effect of the clamp

assembly. The inclined clamping surface 121 forms an acute angle ε between the inclined clamping surface 121 and the elongated bar 130. Thus, the inclined clamping surface 121 forms an acute angle ε between the inclined clamping surface 121 and a longitudinal axis A1 of the elongated bar 130. The angle ε may for example be 45-85°, such as 60-80°, such as 70-80°, such as about 75°.

[0031] The clamping surface 121 engages, i.e. applies pressure on, the second part 1102 of the heat exchanger 1100. The applied pressure is applied in a direction substantially along the longitudinal axis A1, when the clamp device 120 abuts the second part 1102 of the heat exchanger 1100, when the tightening nut 140 acts on the first part 1101 (directly by abutting the first part 1101 or by abutting a washer 160 that in turn abuts the first part 1101) and when the tightening nut 140 is tightened towards the clamp device 120.

[0032] The clamp device 120 comprises an abutment surface 122 that extends in a direction that is parallel to the longitudinal axis A1 of the elongated bar 130. The abutment surface 122 engages the second part 1102 of the heat exchanger 1100. The abutment surface 122 engages the second part 1102 of the heat exchanger 1100 in a direction that is perpendicular to the longitudinal axis A1, such that the clamp device 120 becomes fixed in a radial direction of the elongated bar 130.

[0033] The clamp device 120 comprises two parallel surfaces 128 (the other not shown) extending parallel to the longitudinal axis A1 of the elongated bar 130. The two parallel surfaces enable engagement of the clamp device 120 with a spanner to facilitate tightening of the clamp assembly.

[0034] The clamp device 120 is a one piece device, i.e. a single piece device, meaning that the clamp device only consist of one single piece. The clamp device 120 is preferably manufactured from a single solid metal piece, e.g. by machining.

[0035] The clamp assembly 100 also comprises a washer 160. The washer 160 is mounted on the elongated bar 130. The tightening nut 140 acts on the washer 160. The washer 160 abuts the first part 1101 of the heat exchanger 1100. The washer 160 is arranged between the tightening nut 140 and the first part 1101 of the heat exchanger 1100. Thus, the washer 160 is mounted on the elongated bar 130 between the tightening nut 140 and the first part 1101.

[0036] The clamp device 120 engages the second part 1102. In particular, the clamp device 120 engages a projection 1107 of the second part 1102. As illustrated in Figs. 1, 2 and 7, the clamp device 120 engages a sealing ring 1107 of the second part 1102. The sealing ring 1107 is fixed to the second part 1102, e.g. by welding or by bolts. The projection 1107 of the second part 1102, e.g. in the form of a sealing ring 1107, comprises a clamping surface 1108. The clamping surface 1108 of the second part 1102 is inclined. The inclined clamping surface 1108 of the second part 1102 mates with the inclined clamping surface 121 of the clamp device 120. The inclined clamping surface 1108 of the second part 1102 forms an acute angle between the inclined clamping surface 1108 of the second part 1102 and a wall 1102 of the second part. The acute angle between the inclined clamping surface 1108 of the second part and the wall 1102 of the second part is preferably the same as the angle ε of the inclined clamping surface 121 of the clamp device 120. The acute angle between the inclined clamping surface 1108 of the second part and the wall 1102 of the second part may for example be 45-85°, such as 60-80°, such as 70-80°, such as about 75°.

[0037] The first part 1101 comprises a plurality of holes 1106 through the first part 1101. As an alternative to the holes 1106 of the first part 1101, the first part 1101 may comprise a plurality of recesses extending through the first part 1101. The recesses are open towards the edge of the first part 1101. The protruding portion 1105 of the first part 1101 may comprise the plurality of recesses extending through the first part 1101.

[0038] The holes 1106 are through holes 1106. The holes 1106 or recesses extend through the first part 1101. The holes 1106 or recesses extend from one side of the first part 1101 to another side of the first part 1101.

[0039] An inner diameter of the holes 1106 is slightly larger than the outer diameter of the threads of the elongated bar 130, such that the elongated bar 130 can move freely in the hole 1106 along the longitudinal axis A1. A width of the recesses is slightly larger than the outer diameter of the threads of the elongated bar 130, such that the elongated bar 130 can move freely in the recess along the longitudinal axis A1.

[0040] The clamp assembly 100 is arranged in the hole 1106 or recess such that the elongated bar 130 extends through the hole 1106 or recess from one side of the first part 1101 to another side of the first part 1101.

[0041] The elongated bar 130 extends through the hole 1106 or recess in the first part 1101. A first end 131 of the elongated bar 130 is located on one side of the first part 1101 and a second end 132 of the elongated bar 130 is located on an opposite side of the first part 1101. The clamp device 120 is attached to the second end 132 of the elongated bar 130 and the tightening nut 140 is attached to the first end 131 of the elongated bar 130. Thus, the clamp device 120 is located on one side of the first part 1101 and the tightening nut 140 is located on another side of the first part 1101.

[0042] When the tightening nut 140 acts on the first part 1101, the tightening nut 140 is fixed relative the first part 1101 and when the clamp device 120 acts on the second part 1102, the clamp device 120 is fixed relative the second part 1102. Thereby, the first part 1101 and the second part 1102 are pressed towards each other. By tightening the tightening nut 140, the first and second parts 1101, 1102 are pressed towards each other. When the tightening nut 140 is tightened the nut 140 is moved closer to the clamp device 120 and then the first and second parts 1101, 1102 are pressed towards each oth-

er, since the tightening nut 140 abuts the first part 1101 and the clamp device 120 abuts the second part 1102. When the tightening nut 140 is attached to the elongated bar 130 and acts on first part 1101, and the clamp device 120 is connected to the elongated bar 130 and acts on the second part 1102, then the first and second parts 1101, 1102 of the heat exchanger 1100 become connected to each other.

[0043] The protruding portion 1105 protrudes outside the shell 1102. The first part 1101 has a dimension that is larger than the corresponding dimension of the second part 1102. Thus, the first part 1101 protrudes beyond the second part 1102. The first part 1101 is preferably circular. The second part 1102 is preferably cylindrical. The first part 1101 has a diameter that is larger than the diameter of the second part 1102. The first part 1101 has a diameter protruding beyond the second part 1102.

[0044] The clamp assembly 100 is advantageous in that it is releasable from the first and second parts 101, 102 of the heat exchanger 100 by only disengaging the tightening nut 140. Here disengaging the tightening nut means screwing it such that it moves along the elongated bar 130, in a direction away from the clamp device 120.

[0045] Another advantage is that conventional, threaded bars may be obtained and used as the elongated bar 130. Also conventional nuts may be obtained and used as the tightening nut 140. Further, conventional washers may be obtained and used as the washer 160.

[0046] The clamp assembly 100 comprises in a preferred embodiment only four components, i.e. not more than four components, the four components being the clamp device 120, the elongated bar 130, the tightening nut 140 and the washer 160. In another embodiment, where the washer 160 is omitted, the clamp assembly 100 comprises only three components, i.e. not more than three components, the three components being the clamp device 120, the elongated bar 130 and the tightening nut 140. In other embodiments additional components may be used.

[0047] The heat exchanger 1100 as illustrated in Fig. 7 comprises a shell 1102, a first cover 1101 and a second cover 1109 that together form an enclosure for two fluid flow channels. The first and second covers 1101, 1109 have a protruding portion 1105 protruding beyond the shell 1102. The protruding portion 1105 comprises a plurality of holes 1106 through the cover. The first and second covers 1101, 1109 are connected to the shell 1102 by a number of clamp assemblies 100 of the type described above. The clamp assemblies 100 are arranged such that each elongated bar 130 extends through one of the holes 1106 of the first and second covers 1101, 1109.

[0048] As mentioned above, an alternative to the holes 1106 of the protruding portion 1105 is that the protruding portion 1105 may comprise a plurality of recesses extending through the first and second covers 1101, 1109.

[0049] The heat exchanger in Fig. 7 is a spiral heat exchanger. In case of a spiral heat exchanger, an enclosure for two spiral fluid flow channels is formed. The spiral fluid flow channels are formed by a coil.

[0050] Each of the first and second covers 1101, 1109 is connected to the shell 1102 by a number of clamp assemblies 100 of the type described above. The heat exchanger 1100 has an inlet and an outlet for a first fluid and an inlet and an outlet for a second fluid, and is, apart from the clamp assemblies, a conventional heat exchanger, such as a spiral heat exchanger, that is manufactured according to known techniques and principles.

[0051] The first and second covers 1101, 1109 have a dimension that is larger than the corresponding dimension of the shell 1102. Thus, the first and second covers 1101, 1109 protrude beyond the shell 1102. The first and second covers 1101, 1109 are preferably circular. The shell 1102 is preferably cylindrical. The first and second covers 1101, 1109 have a diameter that is larger than the diameter of the shell 1102.

[0052] As used herein, the first cover 1101 and the second cover 1109 correspond to the first part 1101, while the shell 1102 corresponds to the second part 1102.

[0053] From the description above follows that, although various embodiments of the invention have been described and shown, the invention is not restricted thereto, but may also be embodied in other ways within the scope of the subject-matter defined in the following claims.

Claims

1. A clamp assembly for connecting a first part (1101) of a heat exchanger (1100) to a second part (1102) of the heat exchanger (1100), comprising
   a clamp device (120) that acts on the second part (1102),
   an elongated bar (130) that is connected to the clamp device (120) and extends through the first part (1101), and
   a tightening nut (140) that is attached to the elongated bar (130) and acts on the first part (1101) for pressing the first and second parts (1101, 1102) towards each other.

2. A clamp assembly according to claim 1, wherein the elongated bar (130) is a threaded elongated bar.

3. A clamp assembly according to claim 1 or 2, wherein the tightening nut (140) is a threaded nut that is screwed onto the elongated bar (130).

4. A clamp assembly according to any of the preceding claims, wherein the elongated bar (130) is directly attached to the clamp device (120).

5. A clamp assembly according to any of the preceding claims, wherein the clamp device (120) comprises a hole (126) into which the elongated bar (130) is in-

serted.

6. A clamp assembly according to claims 2 and 5, wherein the hole (126) of the clamp device (120) comprises an inner thread to which the elongated bar (130) is screwed.

7. A clamp assembly according to any of the preceding claims, wherein the clamp assembly comprises a washer (160) mounted on the elongated bar (130), acted upon by the tightening nut (140) and abutting the first part (1101) of the heat exchanger (1100).

8. A clamp assembly according to any of the preceding claims, wherein the clamp device (120) comprises a clamping surface (121) engaging the second part (1102) of the heat exchanger (1100).

9. A clamp assembly according to claim 8, wherein the clamping surface (121) is inclined.

10. A clamp assembly according to any of the preceding claims, wherein the clamp device (120) comprises an abutment surface (122) that extends in a direction that is parallel to a longitudinal axis (A1) of the elongated bar (130), said abutment surface (122) engaging the second part (1102) of the heat exchanger (1100).

11. A clamp assembly according to any of the preceding claims, wherein the clamp device (120) comprises two parallel surfaces (128) extending parallel to a longitudinal axis (A1) of the elongated bar (130).

12. A heat exchanger comprising a shell (1102), a first cover (1101), and a second cover (1109) that form an enclosure for two fluid flow channels, wherein at least one of the first and second covers (1101, 1109) has a protruding portion (1105) protruding beyond the shell (1102), the protruding portion (1105) comprising a plurality of holes (1106) or recesses through the cover, wherein said at least one of the first and second covers (1101, 1109) is connected to the shell (1102) by a number of clamp assemblies (100) according to any of the claims 1 - 11 arranged such that each elongated bar (130) extends through one of the holes (1106) or recesses of said at least one of the first and second covers (1101, 1109).

13. A heat exchanger according to claim 12, wherein said at least one of the first and second covers (1101, 1109) has a dimension that is larger than the corresponding dimension of the shell (1102) such that said at least one of the first and second covers (1101, 1109) protrudes beyond the shell (1102).

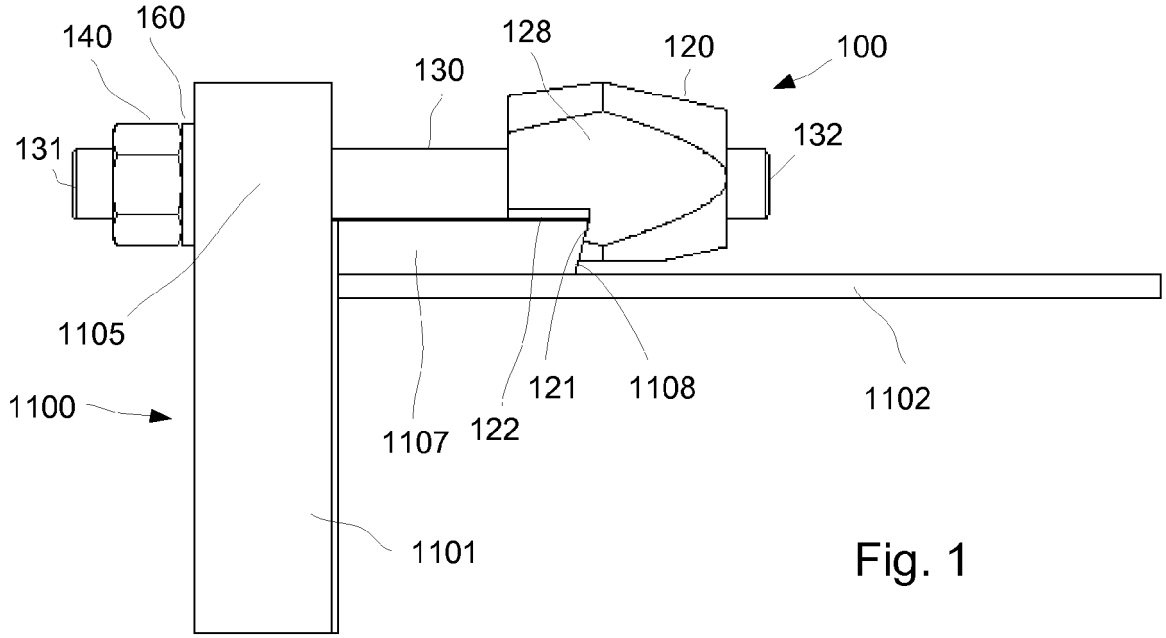

Fig. 1

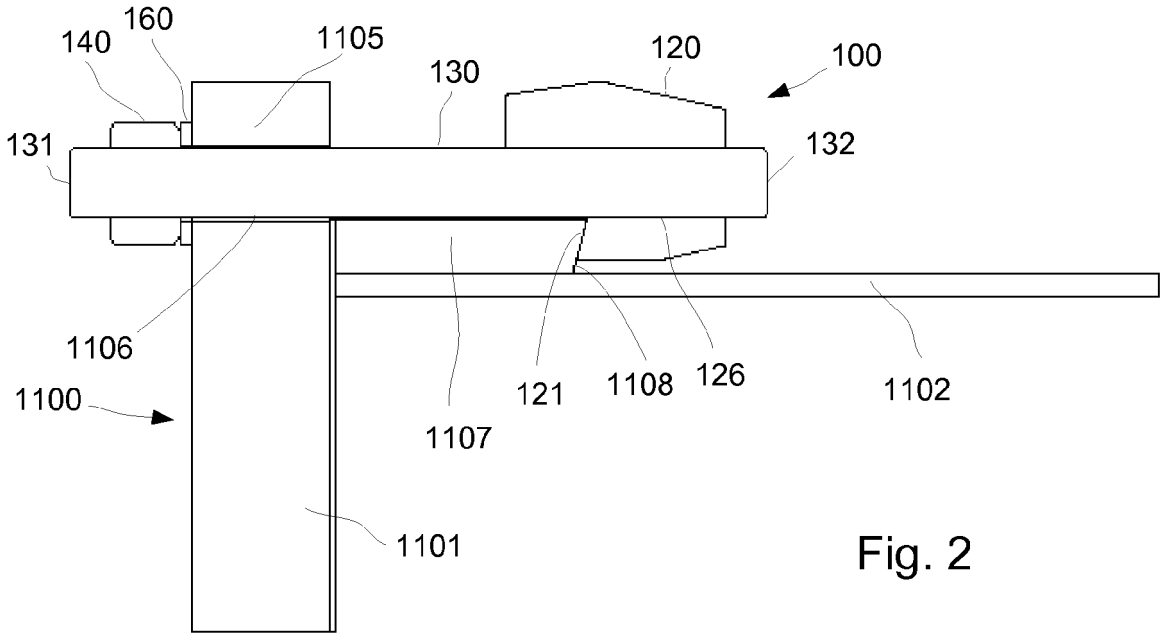

Fig. 2

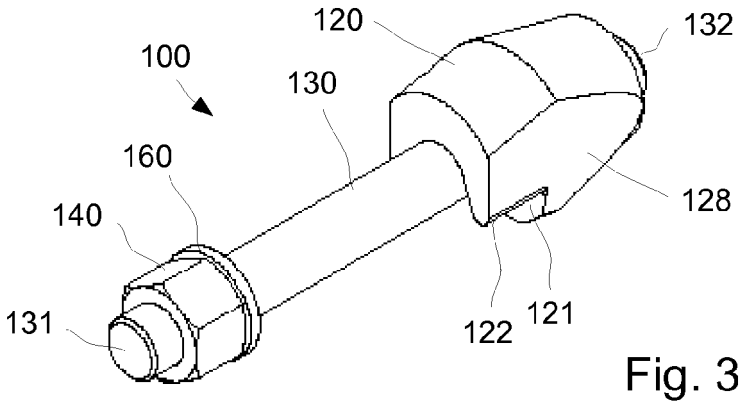

Fig. 3

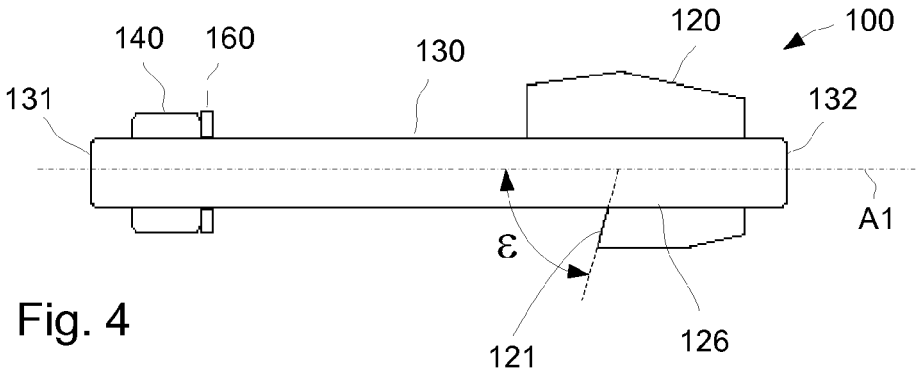

Fig. 4

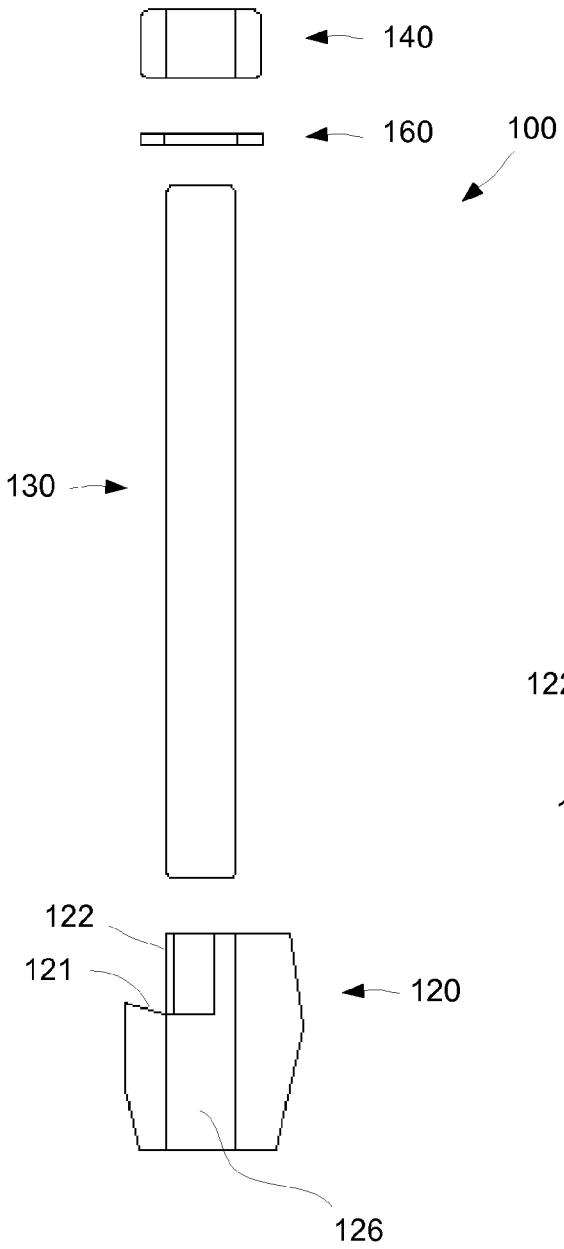

Fig. 5

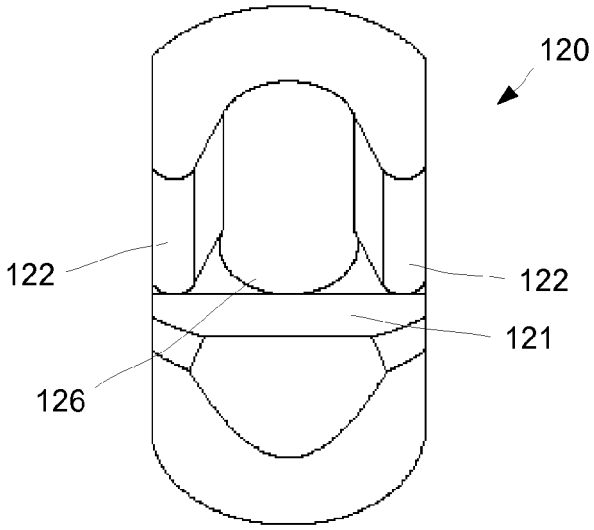

Fig. 6

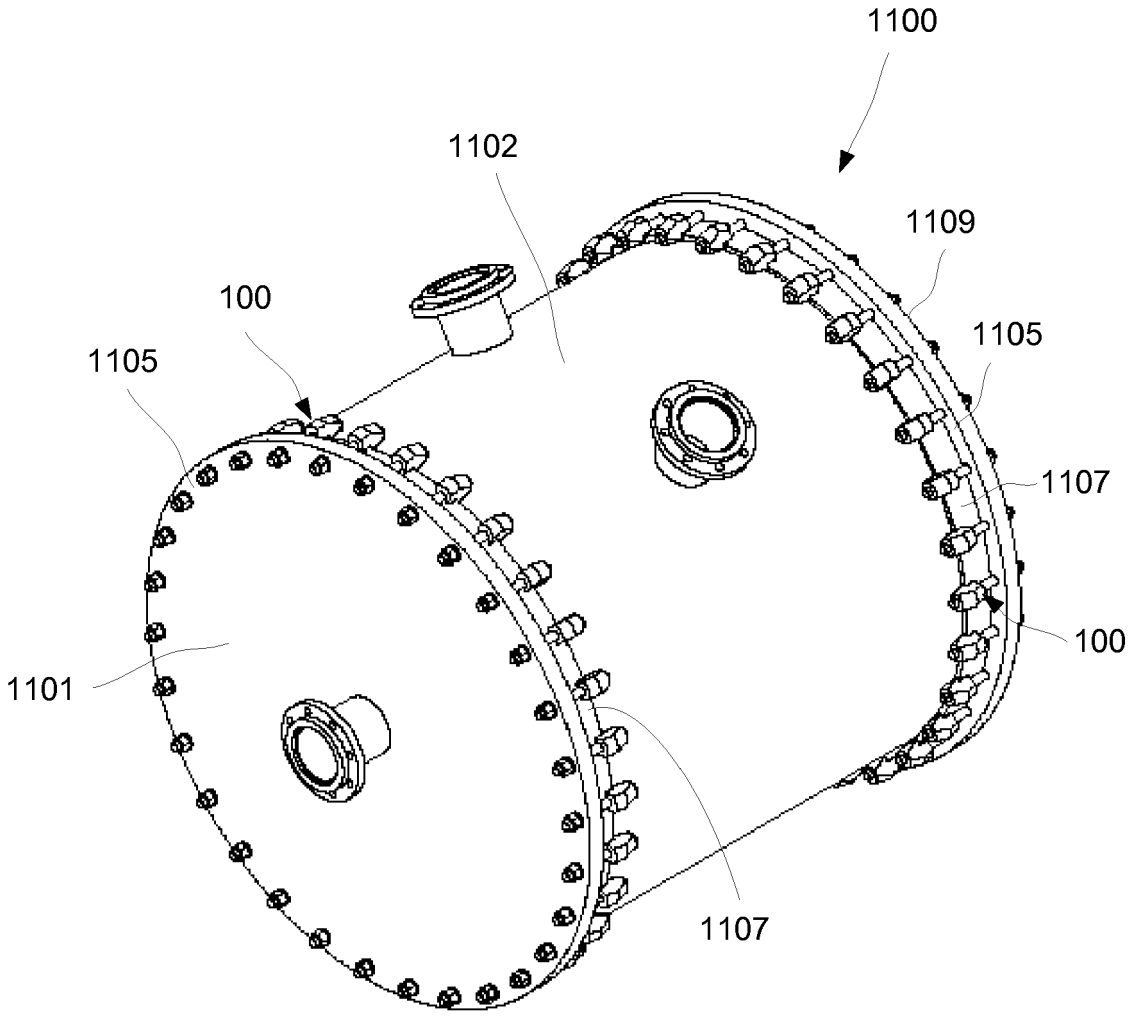

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 17 19 0103

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	GB 2 165 933 A (APV INT LTD) 23 April 1986 (1986-04-23) * abstract * * page 1, line 109 - page 2, line 14 *	1-13	INV. F28F9/00
X	WO 99/23434 A1 (ALFA LAVAL AB [SE]; WESSLEN PER OLOF [SE]; MINARIK PAVEL [SE]; PERSSON) 14 May 1999 (1999-05-14) * figure 5 *	1-13	
X	US 2017/016683 A1 (CECIL JR JAMES A [US] ET AL) 19 January 2017 (2017-01-19) * figures 15,16 *	1-13	

TECHNICAL FIELDS SEARCHED (IPC)

F28F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 February 2018	Bain, David

CATEGORY OF CITED DOCUMENTS

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