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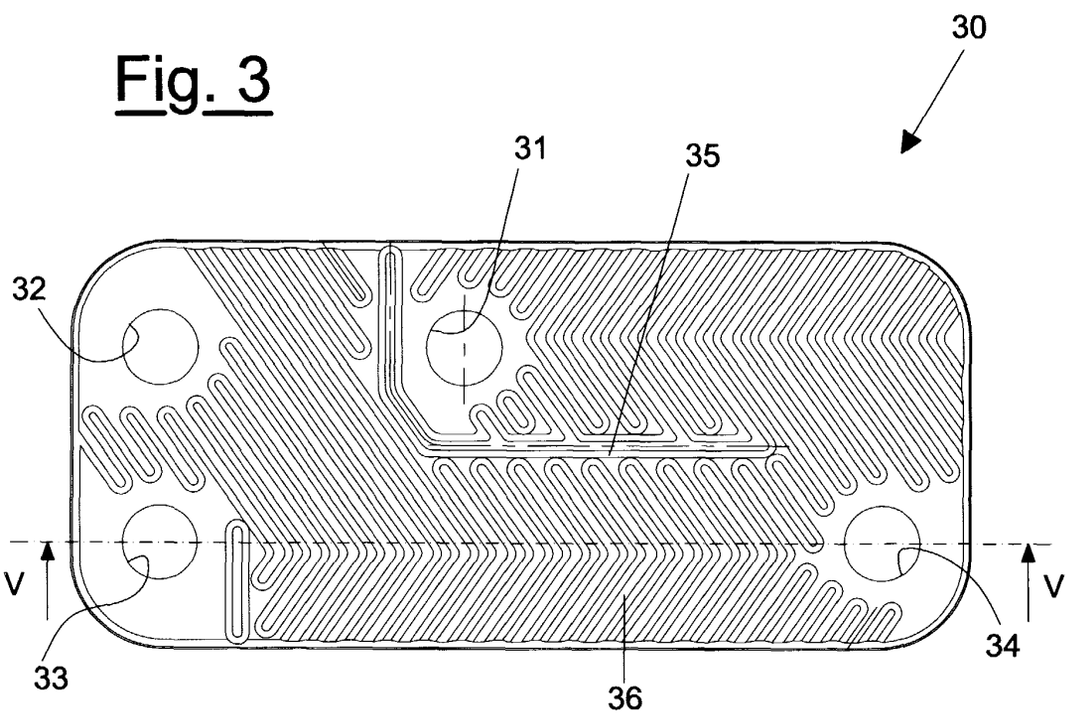
(54) Plated heat exchanger with simplified production

(57) Heat exchanger (10) with plates (20, 30) with simplified production, of the type comprising a plurality of said plates (20, 30) substantially quadrangular in shape, juxtaposed and joined together to define a series of alternating distribution chambers for a primary fluid and a secondary fluid respectively, where such plates (20, 30) are each equipped with at least four through openings (21, 22, 23, 24, 31, 32, 33, 34) corresponding to each other, through such through openings (21, 22, 23, 24, 31, 32, 33, 34) realising a connection between the distribution chambers of the primary fluid and between the distribution chambers of the secondary fluid, respectively; on each plate (20, 30) of the heat exchanger (10) at least three of the through openings (22, 23, 24, 32, 33, 34) are foreseen positioned near to three corners of the quadrangle of the plate (20, 30) and at least one of the through openings (21, 31) is realised distant from the remaining fourth corner of the quadrangle of the plate (20, 30).

Fig. 3



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Description

[0001] The present invention refers to a plated heat exchanger with simplified production.

[0002] In technology heat exchangers are widely used: the addition or removal of heat is indeed necessary in a large number of production applications and processes.

[0003] In an exchanger there is an energy transfer between a fluid at a certain temperature and one or more fluids at different temperatures. In general, there is no mixing in an exchanger: the fluids, normally in liquid or gas state, are isolated from each other and one of the fluids can consist of atmospheric air.

[0004] According to the ways in which the exchange takes place a multitude of apparatuses have been studied, having constructive types dependent upon the characteristics of the fluids. Limiting ourselves to those most widely used we recall exchangers with a tube nest, with plates, with finned batteries, with a double tube, with scraping rakes, etc.

[0005] The selection of one constructive type rather than another depends upon many factors such as the characteristics of the fluids dealt with, the space available for installation, the cost of the apparatus, etc.

[0006] Plated heat exchangers have become widespread relatively recently and offer different advantages including, with the same heat exchanged, substantial containment of the outer size.

[0007] Such heat exchangers comprise a series of distribution chambers in which the fluids circulate, the characteristic size and the number of chambers being selected according to the type of exchange process.

[0008] The distribution chambers are realised by juxtaposing a series of plates: a certain distance is foreseen between one plate and the next, so as to create a series of stacked chambers.

[0009] In the juxtaposition of the distribution chambers, two groups of chambers can be identified, alternating with each other. One group is crossed by a primary fluid, whereas in the other a flow of secondary fluid is foreseen, also known as sanitary fluid, with particular reference to the case in which the exchanger is used in domestic boilers.

[0010] The distribution chambers of each group are connected together. This is realised by foreseeing on each plate at least four openings peripherally equipped with necks which extend in a direction substantially perpendicular to the plate itself.

[0011] More specifically, in a plated heat exchanger, there are two types of plate. On a first plate a first pair of necks is foreseen which extends in one direction and a second pair which extends in the opposite direction. On a second plate, having the four openings of a size analogous to those at the first plate, a first pair of necks is foreseen, which extends in an opposite direction to that of the first pair of necks of the first plate and a second pair of necks, which extends in an opposite direction to that of the second pair of necks of the first plate.

[0012] By juxtaposing the aforementioned two types of plates in an alternating manner and by joining, for example by brazing or welding, the respective necks which extend one against the other, the series of two groups of distribution chambers is obtained connected together.

[0013] The purpose of the present invention is thus that of improving plated heat exchangers mentioned previously and in particular that of realising a plated heat exchanger with simplified production.

[0014] Another purpose of the present invention is that of realising a plated heat exchanger with simplified production which is particularly reliable, simple and functional.

[0015] These and other purposes according to the present invention are accomplished by realising a plated heat exchanger with simplified production as outlined in claim 1.

[0016] Further characteristics are foreseen in the subsequent claims.

[0017] The characteristics and advantages of a plated heat exchanger with simplified production according to the present invention shall become clearer from the following description, given as an example and not for limiting purposes, referring to the attached schematic drawings, in which:

Figure 1 is a side view of a plated heat exchanger with simplified production, according to the present invention;

Figure 2 shows a plan view from above of the exchanger of figure 1;

Figure 3 is a plan view from above of a first type of plate used in the exchanger of figure 1;

Figure 4 shows a plan view from above of a second type of plate used in the exchanger of figure 1;

Figure 5 is a side section view of the plate of figure 3, carried out according to a line V-V of figure 3 itself;

Figure 6 shows a side section view of the plate of figure 4, carried out according to a line VI-VI of figure 3 itself;

Figure 7 illustrates a step of juxtaposing the plate of figure 5 on the plate of figure 6, when the joining position has not yet been reached;

Figure 8 is a plan view from above of a first type of plate used in a second embodiment of an exchanger according to the invention;

Figure 9 shows a plan view from above of a second type of plate used in the second embodiment of the exchanger of figure 8;

Figure 10 is a plan view from above of a first type of plate used in a third embodiment of an exchanger according to the invention;

Figure 11 shows a plan view from above of a second type of plate used in the third embodiment of the exchanger of figure10.

[0018] With reference to the figures, a plated heat exchanger with simplified production is shown, wholly indicated with 10, which in the illustrated example, according to the present invention, is realised by juxtaposing a plurality of plates 20 and 30, alternating with each other.

[0019] Figure 4 shows a first type of plate 20, also known as a primary circuit plate or heating circuit plate: it is substantially quadrangular, generally rectangular with rounded corners, and it has at least four through openings 21, 22, 23 and 24.

[0020] More specifically, a first opening 21 is realised near to a longer side of the rectangle, in an intermediate position of such side. A second opening 22, a third opening 23 and a fourth opening 24 are, on the other hand, realised near to three corners of the rectangle.

[0021] Figure 3 shows a second type of plate 30, also known as a secondary circuit plate or sanitary circuit plate: it is substantially quadrangular, generally rectangular with rounded corners, it is of a size analogous to that of the primary circuit plate 20 and it has at least four through openings 31, 32, 33 and 34, of an analogous size and realised at respective through openings 21, 22, 23 and 24 of the primary circuit plate 20 itself.

[0022] More specifically, a first opening 31 is realised near to a longer side of the rectangle, in an intermediate position of such side. A second opening 32, a third opening 33 and a fourth opening 34 are, on the other hand, realised near to three corners of the rectangle.

[0023] The through openings 21, 22, 23 and 24 of the primary circuit plate 20 and the through openings 31, 32, 33 and 34 of the secondary circuit plate 30 are foreseen on the respective plates 20 and 30 on planes which are at two different heights.

[0024] More specifically, on the primary circuit plate 20 a first pair of openings 21 and 23 which is situated on a plane at a first height and a second pair of openings 22 and 24 which is situated on a plane at a second different height lower than the first height is foreseen.

[0025] On the secondary circuit plate 30 a first pair of openings 32 and 34 which is situated on a plane at a first height and a second pair of openings 31 and 33 which is situated on a plane at a second different height lower than the first height is foreseen.

[0026] The primary and secondary circuit plates 20 and 30 are equipped with a series of ribs 26 and 36, respectively, generally obtained with a drawing operation on the plates 20 and 30 themselves. Such ribs 26 and 36 have a depth which approximately reaches the second height of the plates 20 and 30, respectively.

[0027] The ribs 26 and 36 advantageously have a rectilinear direction or a skew direction. The orientation of the ribs 26 of the primary circuit plate 20 is different from that of the ribs 36 of the secondary circuit plate 30.

[0028] Moreover, the primary and secondary circuit plates 20 and 30 are equipped with addressing profiles 25 and 35 respectively, which extend in a direction substantially perpendicular to the plates 20 and 30.

[0029] The operation of the plated heat exchanger 10 with simplified production according to the invention is clear from that which is described above with reference to the figures, and in brief is the following.

[0030] The heat exchanger 10 is realised by juxtaposing a series of plates 20 and 30, alternating a primary circuit plate 20 and a secondary circuit plate 30.

[0031] The plates 20 and 30 are joined together by connecting, generally by brazing or welding, the planes surrounding the pairs of opening 21 and 31, 22 and 32, 23 and 33, 24 and 34, which in juxtaposition are situated at coinciding heights. This connection is clear if one looks at figure 5 and one thinks of further lowering the plate 30 on the plate 20 until the hole 33 coincides with the hole 23.

[0032] Moreover, as one can understand, the ribs 26 and 36 of the plates 20 and 30 are brazed or welded together in a discrete series of points of contact, deriving from the different orientation of the ribs 26 and 36 of two contiguous plates 20 and 30.

[0033] After the joining of the plates 20 and 30, from that which has been stated above, it is clear that a certain distance is created between a plate 20 and a contiguous plate 30: a series of stacked distribution chambers is thus created.

[0034] In the juxtaposition of the distribution chambers, two groups of chambers can be identified, alternating with each other. One group is crossed by a primary fluid, whereas in the other group a flow of secondary fluid is foreseen, also known as sanitary fluid, with particular reference to the case in which the exchanger is used in domestic boilers.

[0035] The distribution chambers of each group are connected together through the joining of the planes surrounding the pairs of openings 21 and 31, 22 and 32, 23 and 33, as explained above.

[0036] It should be noted that at the contact points of the ribs 26 and 36 turbulence is created in the flow of primary and secondary fluid, which improves the heat exchange.

[0037] The addressing profiles 25 and 35 are foreseen in identical positions of the two plates 20 and 30 respectively: in the joining of two contiguous plates 20 and 30, the respective addressing profiles 25 and 35 extend towards each other and are for example brazed together. In this way paths for a flow of fluid are created which makes the fluid itself cross a path which mostly covers the whole surface of the plates 20 and 30 which are contiguous.

[0038] For example, a flow of secondary fluid can go from the first opening 31 to the third opening 33 making it also pass near to the fourth opening 34: this is obtained by placing an L-shaped addressing profile 35 around the first opening 31, which prevents direct passage of the secondary fluid from the first opening 31 to the third opening 33.

[0039] It should be noted how, in the aforementioned case, a primary fluid can go from the second opening

22 to the fourth opening 24.

[0040] It is clear that the present invention also refers to cases in which the path of the primary and secondary fluids is opposite to that which has just been described above.

[0041] It should be remembered that a plate without openings, which thus closes the first two distribution chambers of the exchanger, is placed at the base of the plated heat exchanger 10.

[0042] The plate which closes the heat exchanger 10 at the top, on the other hand, has four through openings at the openings 21, 22, 23 and 24 of the primary circuit plates 20 and at the openings 31, 32, 33 and 34 of the secondary circuit plates 30. Such openings, where the primary and secondary fluids which exchange heat enter and exit, are connected, generally with threaded joints, or even without, to respective primary or heating and secondary or sanitary circuits.

[0043] Figures 8 and 9 illustrate a second possible practical embodiment of the invention, where components which are the same as and/or equivalent to those illustrated in figures 1-7 carry the same reference numerals increased by 100.

[0044] Also in this second embodiment of the heat exchanger 110, the primary and secondary circuit plate 120 and 130 are equipped with addressing profiles 125 and 135 respectively, which extend in a direction substantially perpendicular to the plates 120 and 130 and which are foreseen in identical positions as the two plates 120 and 130 respectively.

[0045] In this case, the addressing profiles 125 and 135 are L-shaped and are placed between the first opening 121 and 131 and the fourth opening 124 and 134, preventing direct passage for example of the secondary fluid from the first opening 131 to the fourth opening 134.

[0046] Figures 10 and 11 illustrate a third possible practical embodiment of the invention, where components which are the same as and/or equivalent to those illustrated in figures 1-7 carry the same reference numerals increased by 200.

[0047] In this example a first opening 221 is realised near to a longer side of the rectangle, in an intermediate position of such a side. A second opening 222, a third opening 223 and a fourth opening 224 are, on the other hand, realised near to three corners of the rectangle: more specifically, the second opening 222 and the fourth opening are positioned at the longer side opposite the one at which the first opening 221 is realised, whereas the third opening 223 is realised at the shorter side of the second opening 222.

[0048] Also in this third embodiment of the heat exchanger 210, the primary and secondary circuit plate 220 and 230 are equipped with addressing profiles 225 and 235 respectively, which extend in a direction substantially perpendicular to the plates 220 and 230 and which are foreseen in identical positions as the two plates 220 and 230 respectively.

[0049] In particular, the addressing profiles 225 and 235 are arranged around the first opening 221 and 231, with one wall open towards the corner without openings, preventing direct passage for example of the secondary fluid from the first opening 231 to the second opening 232.

[0050] The characteristics of the plated heat exchanger with simplified production, object of the present invention, are clearly outlined in the description provided, as are also the advantages. In particular, they consist of:

- simple and reliable use;
- reduction of costs in the construction of the primary and secondary circuit plates;
- simplification of the upper closing plate of the exchanger.

[0051] Finally, it is clear that the plated heat exchanger with simplified production thus conceived is susceptible to numerous modifications and variants, all covered by the invention. Moreover, all of the details can be replaced with technically equivalent elements.

[0052] In practice, the materials used, as well as the shapes and sizes, can be whatever according to the technical requirements.

[0053] The scope of protection of the invention is therefore defined by the attached claims.

Claims

1. Heat exchanger (10, 110, 210) with plates (20, 120, 220; 30, 130, 230) with simplified production, of the type comprising a plurality of said plates (20, 120, 220; 30, 130, 230) substantially quadrangular in shape, juxtaposed and joined together to define a series of alternating distribution chambers for a primary fluid and a secondary fluid respectively, said plates (20, 120, 220; 30, 130, 230) each being equipped with at least four through openings (21, 22, 23, 24, 31, 32, 33, 34; 121, 122, 123, 124, 131, 132, 133, 134; 221, 222, 223, 224, 231, 232, 233, 234) corresponding to each other, through said through openings (21, 22, 23, 24, 31, 32, 33, 34; 121, 122, 123, 124, 131, 132, 133, 134; 221, 222, 223, 224, 231, 232, 233, 234) realising a connection between said distribution chambers of said primary fluid and between said distribution chambers of said secondary fluid, respectively, **characterised in that** on each plate (20, 120, 220; 30, 130, 230) at least three of said through openings (22, 23, 24, 32, 33, 34; 122, 123, 124, 132, 133, 134; 222, 223, 224, 232, 233, 234) are foreseen positioned near to three corners of the quadrangle of said plate (20, 120, 220; 30, 130, 230) and **in that** at least one of said through openings (21, 31; 121, 131; 221, 231) is realised distant from the remaining fourth corner of the quadrangle of said plate (20, 120, 220; 30, 130,

230).

2. Heat exchanger (10, 110, 210) according to claim 1, **characterised in that** said plates (20, 120, 220; 30, 130, 230) are rectangular, with rounded corners.

3. Heat exchanger (10, 110, 210) according to claim 2, **characterised in that** said at least one through opening (21, 31; 121, 131; 221, 231) is realised near to a longer side of the rectangle of said plates (20, 120, 220; 30, 130, 230), in an intermediate position of such a side.

4. Heat exchanger (10, 110, 210) according to claim 1, **characterised in that** said openings (21, 22, 23, 24, 31, 32, 33, 34; 121, 122, 123, 124, 131, 132, 133, 134; 221, 222, 223, 224, 231, 232, 233, 234) of said plate (20, 120, 220; 30, 130, 230) are foreseen on planes of said plate (20, 120, 220; 30, 130, 230) which are at two different heights.

5. Heat exchanger (10, 110, 210) according to claim 4, **characterised in that** said plates (20, 120, 220; 30, 130, 230) are of two types and are juxtaposed alternating with each other in the exchanger (10, 110, 210), on a first type of plate or primary circuit plate (20, 120, 220) being foreseen a first pair of openings (21, 23; 121, 123; 221, 223) which is situated on a plane at a first height and a second pair of openings (22, 24; 122, 124; 222, 224) which is situated on a plane at a second different height lower than said first height, on a second type of plate or secondary circuit plate (30, 130, 230) being foreseen a first pair of openings (32, 34; 132, 134; 232, 234) which is situated on a plane at a first height and a second pair of openings (31, 33; 131, 133; 231, 233) which is situated on a plane at a second different height lower than said first height, said plates (20, 120, 220; 30, 130, 230) being joined together by connecting said planes surrounding pairs of said openings (21, 22, 23, 24, 31, 32, 33, 34; 121, 122, 123, 124, 131, 132, 133, 134; 221, 222, 223, 224, 231, 232, 233, 234) which in juxtaposition are situated at coinciding heights.

6. Heat exchanger (10, 110, 210) according to claim 5, **characterised in that** said primary and secondary circuit plates (20, 120, 220; 30, 130, 230) are equipped with a series of ribs (26, 36; 126, 136; 226, 236).

7. Heat exchanger (10, 110, 210) according to claim 6, **characterised in that** said ribs have a rectilinear or skew direction.

8. Heat exchanger (10, 110, 210) according to claim 7, **characterised in that** one orientation of said ribs of the primary circuit plate (20, 120, 220) is different from that of said ribs of the secondary circuit plate (30, 130, 230).

9. Heat exchanger (10, 110, 210) according to claim 8, **characterised in that** said ribs (26, 36; 126, 136; 226, 236) have a depth which approximately reaches said second height of said plates (20, 120, 220; 30, 130, 230), said plates (20, 120, 220; 30, 130, 230) being joined together by connecting said planes surrounding pairs of said openings (21, 22, 23, 24, 31, 32, 33, 34; 121, 122, 123, 124, 131, 132, 133, 134; 221, 222, 223, 224, 231, 232, 233, 234) which in juxtaposition are situated at coinciding heights, said ribs (26, 36; 126, 136; 226, 236) of the plates (20, 120, 220; 30, 130, 230) being contextually joined together in a discrete series of contact points.

10. Heat exchanger (10, 110, 210) according to claim 1 or 9, **characterised in that** said primary and secondary circuit plates (20, 120, 220; 30, 130, 230) are equipped with addressing profiles (25, 35; 125, 135; 225, 235), which extend in a direction substantially perpendicular to said plates (20, 120, 220; 30, 130, 230), said addressing profiles (25, 35; 125, 135; 225, 235) being foreseen in identical respective positions of said plates (20, 120, 220; 30, 130, 230), in a joining of two contiguous plates (20, 120, 220; 30, 130, 230) said respective addressing profiles (25, 35; 125, 135; 225, 235) extending towards each other and being joined together.

11. Heat exchanger (10) according to claim 1, **characterised in that** a flow of secondary fluid goes from said at least one through opening (31) to one (33) of said at least three through openings (32, 33, 34) passing near to another (34) of said at least three through openings (32, 33, 34), having placed an L-shaped addressing profile (35) around said at least one through opening (31).

12. Heat exchanger (10) according to claim 11, **characterised in that** a primary fluid goes from one (22) of said at least three through openings (22, 23, 24) to another (24) of said at least three through openings (22, 23, 24).

13. Heat exchanger (10, 110, 210) according to claim 1, **characterised in that** a plate without openings, which closes first distribution chambers of said exchanger (10, 110, 210), is arranged at the base of said heat exchanger (10, 110, 210).

14. Heat exchanger (10, 110, 210) according to claim 1, **characterised in that** a plate which closes said heat exchanger (10, 110, 210) at the top has four through openings at said at least three through openings (22, 23, 24, 32, 33, 34; 122, 123, 124, 132,

133, 134; 222, 223, 224, 232, 233, 234) and at said at least one through opening (21, 31; 121, 131; 221, 231), said openings being connected to a primary circuit and a secondary circuit.

15. Heat exchanger (10, 110, 210) according to claim 5 or 9, **characterised in that** the joining of said plates (20, 120, 220; 30, 130, 230) takes place by welding or brazing.

16. Heat exchanger (110) according to claim 10, **characterised in that** a flow of secondary fluid goes from said at least one through opening (131) to another (134) of said at least three through openings (132, 133, 134) passing near to a further (132) one of said at least three through openings (132, 133, 134), having arranged an L-shaped addressing profile (135) between said opening (131) and said other opening (134) of said at least three through openings (132, 133, 134).

17. Heat exchanger (210) according to claim 10, **characterised in that** a first opening (221) is realised near to a longer side of the rectangle, in an intermediate position of said side, near to three corners of the rectangle being formed a second opening (222), a third opening (223) and a fourth opening (224), said second opening (222) and said fourth opening (224) being positioned at the longer side of the rectangle opposite that at which said first opening (221) is realised, said third opening (223) being realised at the smaller side of said second opening (222).

18. Heat exchanger (210) according to claim 17, **characterised in that** said addressing profile (225) is arranged around said first opening (221), with one wall open towards the corner of the rectangle without openings.

Fig. 1

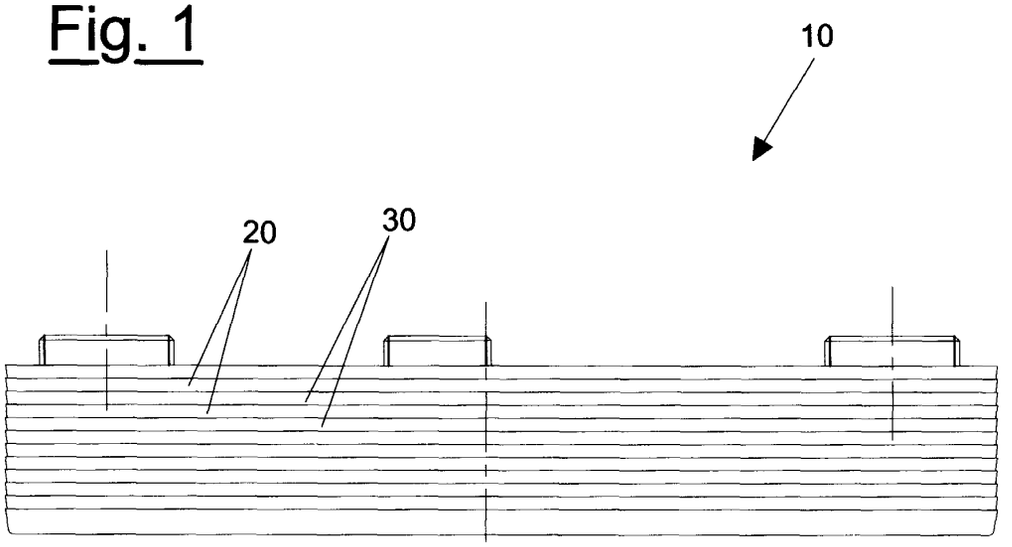

Fig. 2

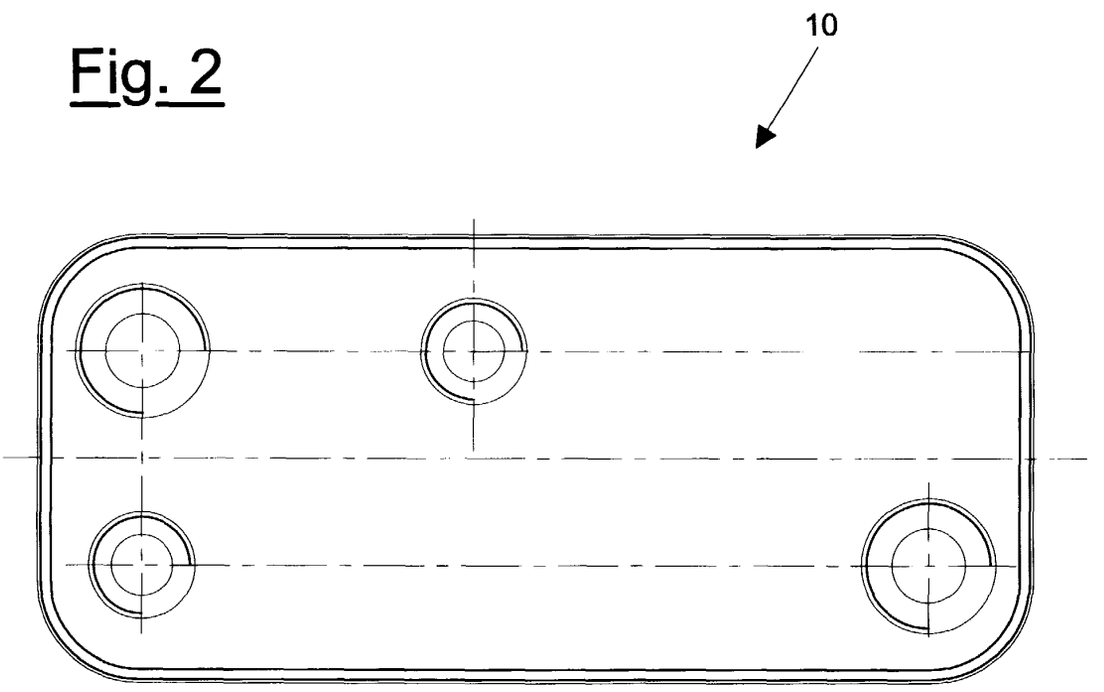

Fig. 3

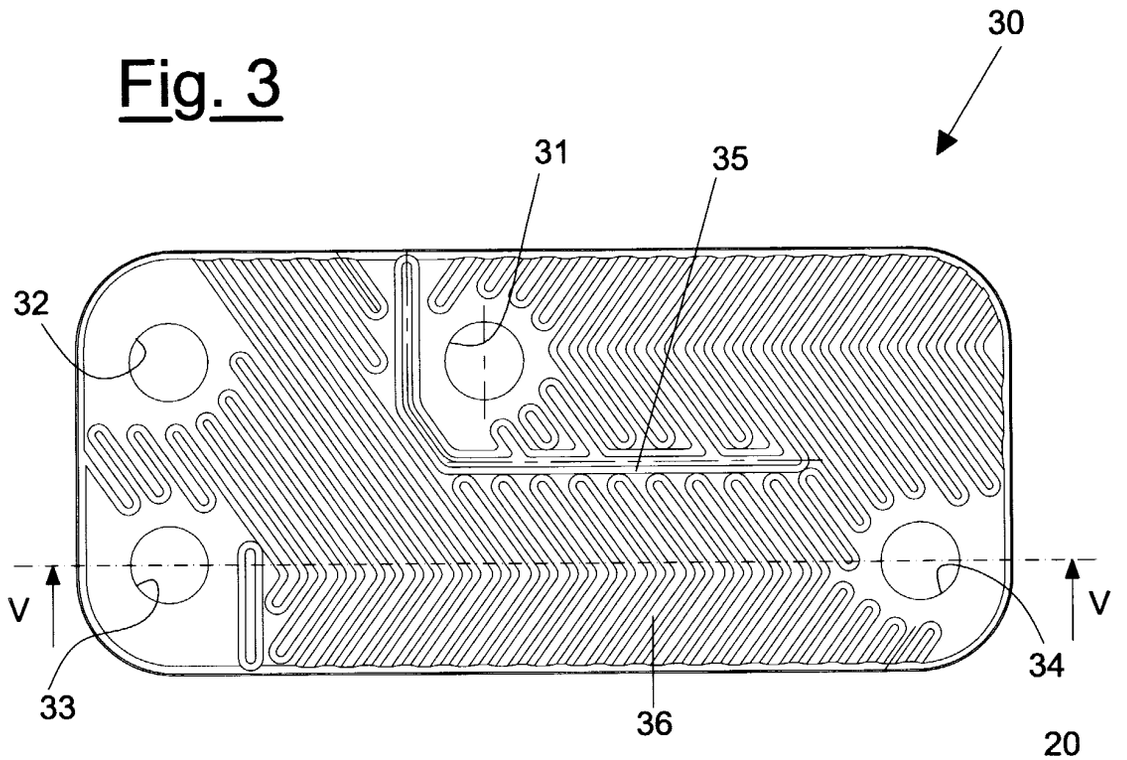

Fig. 4

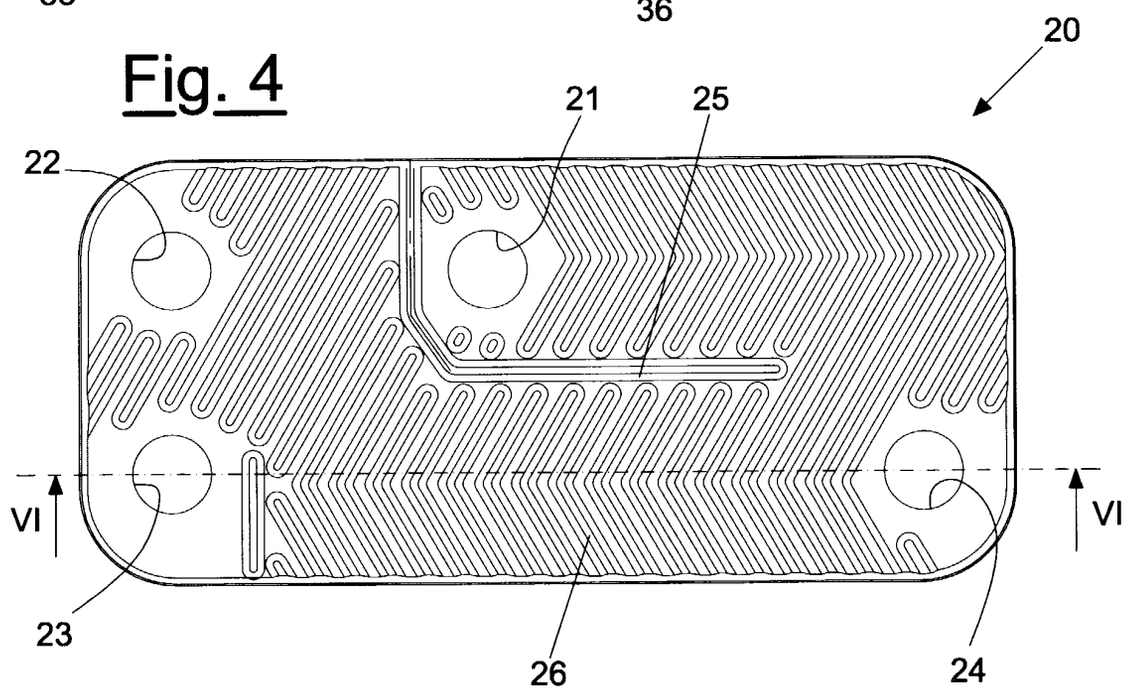

Fig. 5

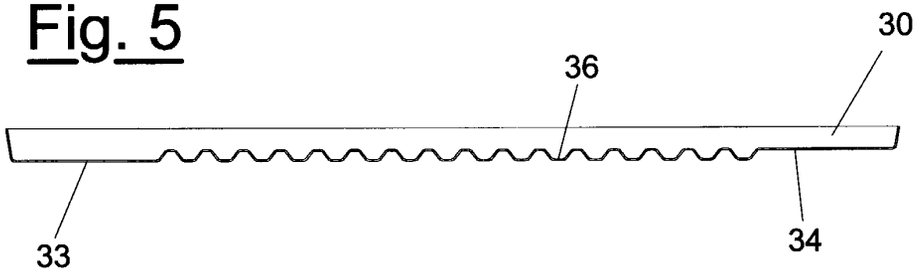

Fig. 6

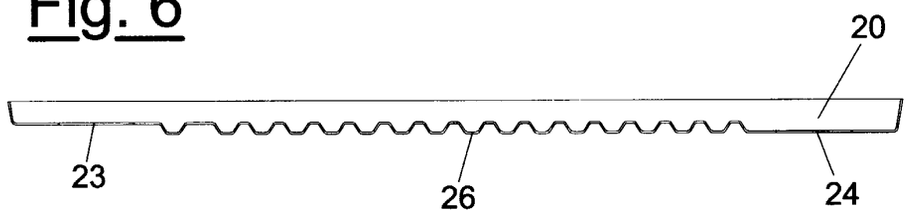

Fig. 7

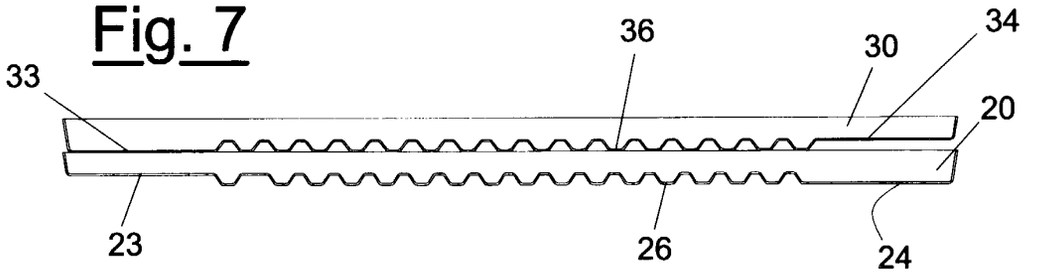

Fig. 8

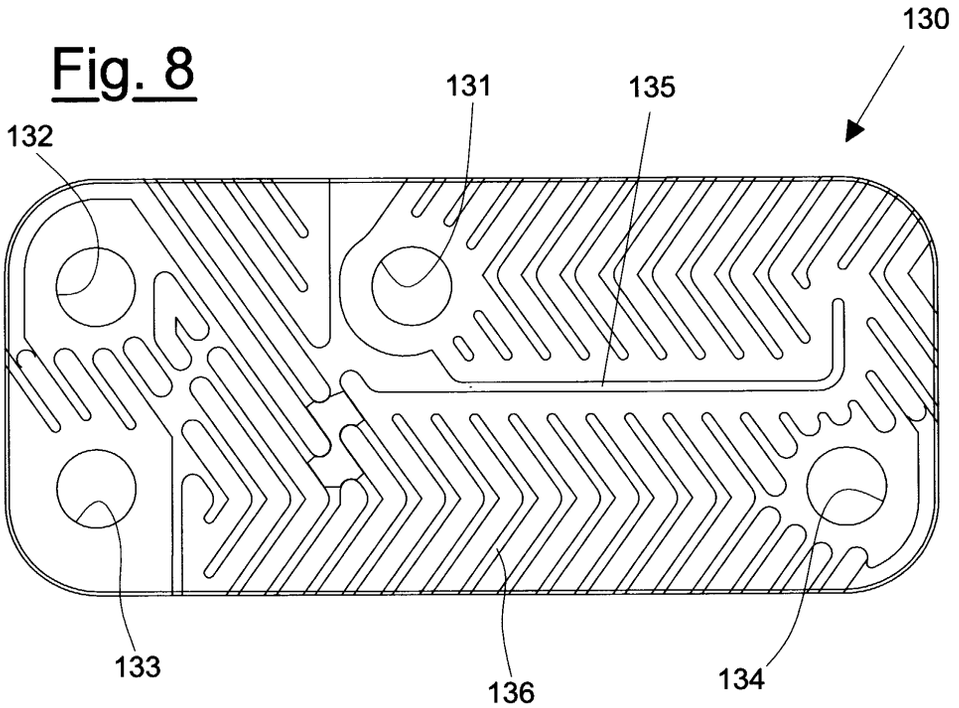

Fig. 9

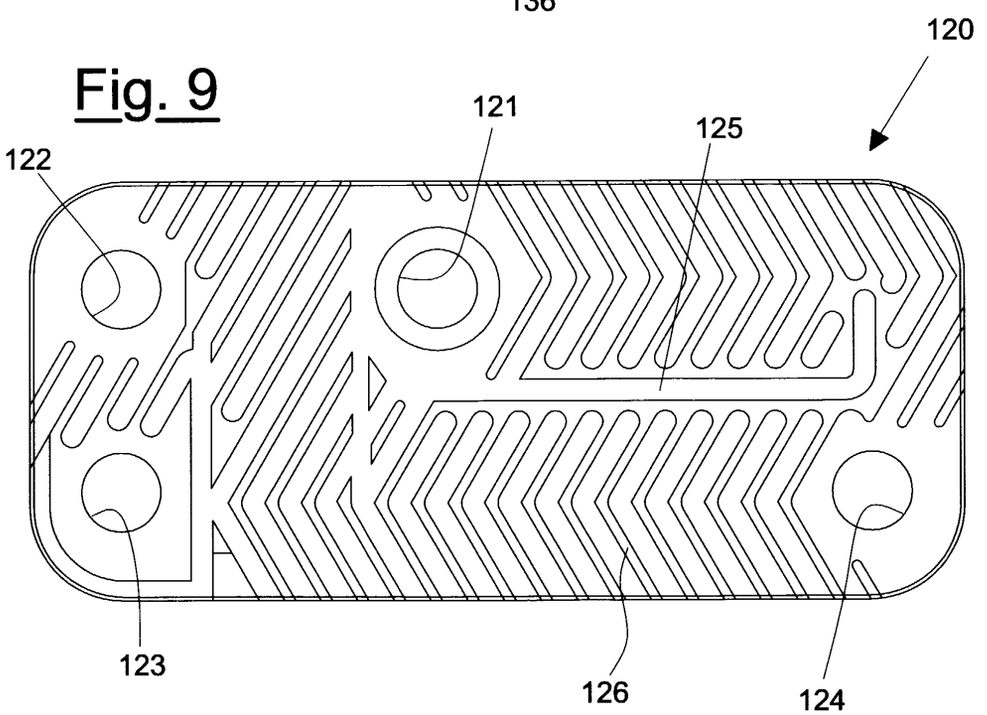

Fig. 10

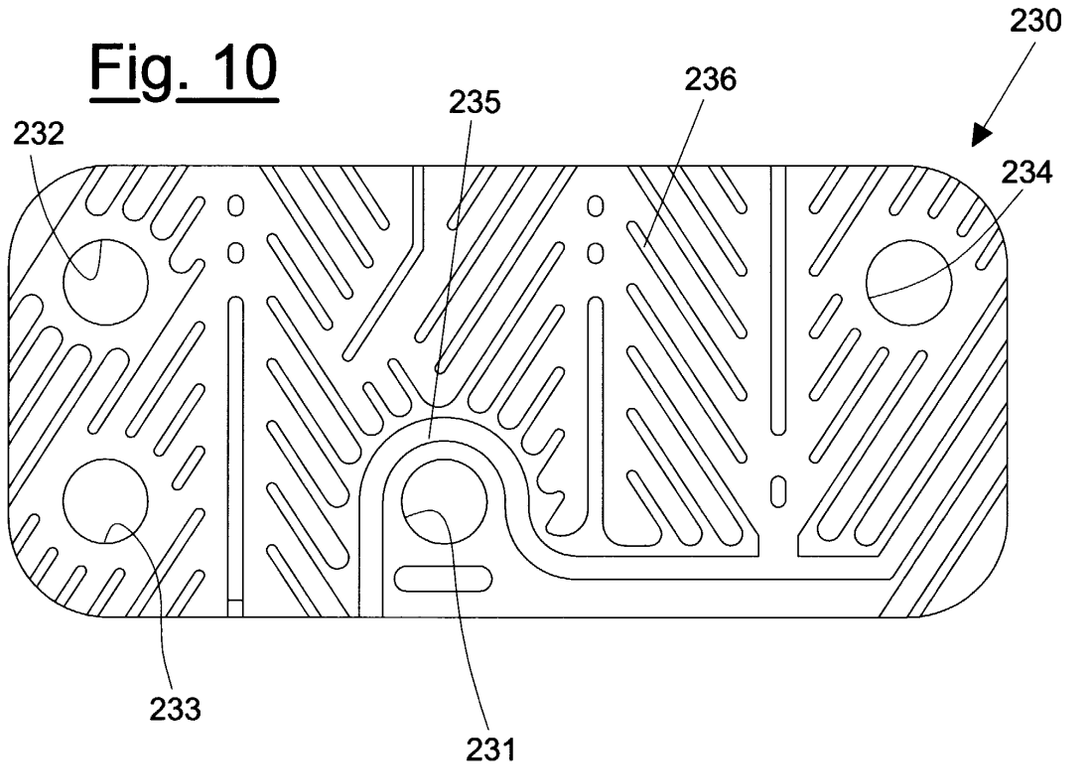

Fig. 11