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(54) **GASKET ARRANGEMENT**

(57) A gasket arrangement (G) for sealing between two corrugated heat transfer plates (5) is provided. The gasket arrangement (G) comprises an annular field gasket part (41) enclosing a field gasket area (A1), and a plurality of annular ring gasket parts (47c, 47d, 47e, 47f) arranged outside said field gasket area (A1). Each of said plurality of annular ring gasket parts (47c, 47d, 47e, 47f) encloses a ring gasket area (A2) which is smaller than the field gasket area (A1) and extends in a central extension plane (p2) of the ring gasket parts (47c, 47d, 47e, 47f). A third and a fourth ring gasket part (47c, 47d) of said plurality of annular ring gasket parts (47c, 47d, 47e, 47f) are arranged on opposite sides of a transverse center axis (T1) of the field gasket area (A1). The gasket arrangement (G) is characterized in that a fifth ring gasket part (47e) of said plurality of annular ring gasket parts (47c, 47d, 47e, 47f) is arranged on the same side of the transverse center axis (T1) as the third ring gasket part (47c). Further, the third and fifth ring gasket parts (47c, 47e) are arranged on opposite sides of a longitudinal center axis (L1) of the field gasket area (A1). Further, the longitudinal center axis (L1) of the field gasket area (A1) extends through ≤ 1 of said plurality of annular ring gasket parts (47c, 47d, 47e, 47f).

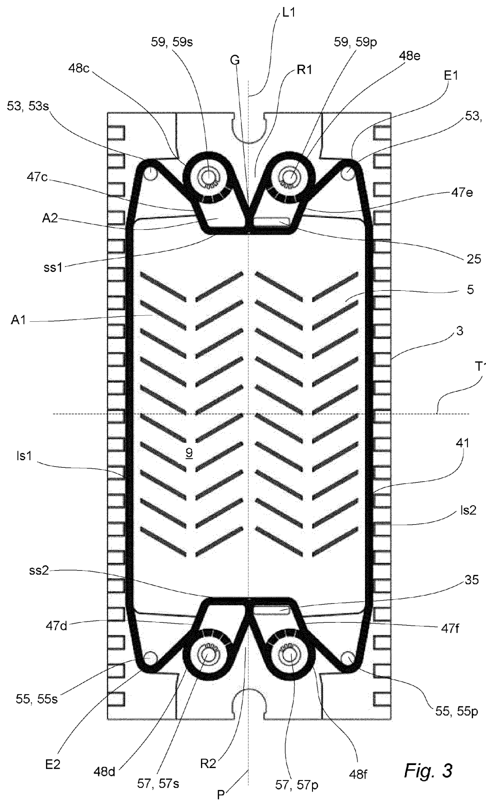

Fig. 3

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Description

Technical Field

[0001] The invention relates to a gasket arrangement configured to seal between two corrugated heat transfer plates. The heat transfer plates and the gasket arrangement may be comprised in a device used for a heat generating process, such as electrolysis.

Background Art

[0002] Electrolysis is a well known process of using electricity to chemically decompose an electrolyte. For example, electrolysis can be used to split water contained in an electrolyte into hydrogen and oxygen. During electrolysis, heat may be generated, which heat may have to be diverted for maintained electrolysis efficiency.

[0003] EP 4012070 discloses a heat exchanger comprising a stack of heat transfer plates. The heat exchanger is adapted for connection to an electrolyzing device such that fluids circulating in the electrolyzing device are made to pass the heat exchanger for regulation of their temperatures. Typically, the temperature of the fluids gradually increases inside the electrolyzing device. Thus, the heat exchanger receives fluids of relatively high temperature from the electrolyzing device and delivers fluids of relatively low temperature to the electrolyzing device, which means that there will be a temperature difference across the electrolyzing device. This may result in an uneven and non-optimal electrolysis process inside the electrolyzing device. The heat exchanger in EP 4012070 is a so called plate-and-shell heat exchanger. Several other types of heat exchangers exist, for example so-called plate heat exchangers. A plate heat exchanger typically comprises a number of corrugated heat transfer plates arranged aligned in a stack or pack. Sealings between the heat transfer plates define parallel flow channels between the heat transfer plates, one flow channel between each pair of adjacent heat transfer plates. Two fluids of initially different temperatures can be fed alternately through every second flow channel for transferring heat from one fluid to the other.

Summary

[0004] An object of the present invention is to provide a gasket arrangement for sealing between two corrugated heat transfer plates so as to enable realization of a reliable and mechanically uncomplicated device comprising said heat transfer plates as part of a stack of corrugated heat transfer plates forming alternately arranged first and second plate interspaces, which device may be used for a heat generating process, such as electrolysis, and which device may allow a more uniform and effective cooling of a fluid, such as an electrolyte, and the products formed therefrom, so as to enable a maintained high process efficiency. The basic concept of the invention is to offer a gasket arrangement that may enable a reliable sealing, and thus cooling, in the first interspaces such that a heat generating process can be effectively maintained in the second interspaces, which gasket arrangement allows use of the first interspaces to feed fluids into, and out of, the second interspaces. Thus, the basic concept of the invention is to offer a gasket arrangement that enables a device for performing a heat generating process, such as electrolysis, which device, at the same time, may function as a traditional heat exchanger so as to provide cooling "integrated" in the heat generating process.

[0005] The gasket arrangement may be used in a device for production of hydrogen.

[0006] Since the gasket arrangement according to the invention is not arranged for use on its own, but as a component of a device as described above, the advantages of different features and embodiments of the gasket arrangement appears first when the gasket arrangement is installed in the device.

[0007] A gasket arrangement according to the invention is for sealing between two corrugated heat transfer plates which may be of the same or different types. It comprises an annular field gasket part enclosing a field gasket area, and a plurality of annular ring gasket parts arranged outside the field gasket area. Each of said plurality of annular ring gasket parts encloses a ring gasket area, which is smaller than the field gasket area and extends in a central extension plane of the ring gasket parts. A third and a fourth ring gasket part of said plurality of annular ring gasket parts are arranged on opposite sides of a transverse center axis of the field gasket area. The gasket arrangement is characterized in that a fifth ring gasket part of said plurality of annular ring gasket parts is arranged on the same side of the transverse center axis as the third ring gasket part, the third and fifth ring gasket parts being arranged on opposite sides of a longitudinal center axis of said field gasket area, and that the longitudinal center axis of said field gasket area extends through ≤ 1 of said plurality of annular ring gasket parts.

[0008] It should be stressed that "annular" not necessarily is circular but may be any "closed" shape, such as oval, polygonal or any combination thereof. Similarly, "ring" does not necessarily mean circular but may mean any "closed" shape, such as oval, polygonal or any combination thereof. Accordingly, the field gasket area and the ring gasket areas may have any shape. Further, the ring gasket areas may or may not be similar.

[0009] The field gasket area may be "empty", i.e. enclose no gasket part.

[0010] The central extension plane of the ring gasket parts extends through a center, as seen in a thickness direction, of at least one, and possibly all, of the ring gasket parts. Similarly, a central extension plane of the field gasket part extends through a center, as seen in a thickness direction, of the field gasket part and may coincide with the central extension plane of the ring gasket parts.

[0011] By "plurality" is meant two or more. The gasket arrangement according to the invention comprises at least three ring gasket parts which may be configured to separately enclose at least, three portholes of each of the two heat transfer plates. Further, the field gasket part may typically be configured to enclose at least two portholes of each of the two heat transfer plates. Thus, the inventive gasket arrangement enables a device comprising at least five ports which may be necessary for performing a heat generating process, such as electrolysis, with integrated cooling.

[0012] The gasket arrangement may be such that a sixth ring gasket part of said plurality of annular ring gasket parts is arranged on the same side of the transverse center axis as the fourth ring gasket part. The fourth and sixth ring gasket parts may be arranged on opposite sides of the longitudinal center axis of the field gasket area. Such a gasket arrangement enables a device comprising at least six ports which may be beneficial for performing a heat generating process, such as electrolysis, with "integrated" cooling.

[0013] The gasket arrangement may be so configured that the field gasket part, at a first end of the gasket arrangement, extends between the third and the fifth ring gasket part, and, at an opposing second end of the gasket arrangement, extends between the fourth and the sixth ring gasket part. The first and second ends of the gasket arrangement may be arranged on opposite sides of the transverse center axis of said field gasket area. If the field gasket part is arranged to enclose two, transversally centrally arranged, portholes in each of the two heat transfer plates and define a flow channel, in the device, for a cooling fluid, this configuration may enable a device with efficient "integrated" cooling.

[0014] Alternatively, the gasket arrangement may be so configured that the field gasket part, at a first end of the gasket arrangement, extends on an outside of the third ring gasket part and on an outside the fifth ring gasket part, and, at an opposing second end of the gasket arrangement, extends on an outside of the fourth ring gasket part and on an outside of the sixth ring gasket part. The first and second ends of the gasket arrangement may be arranged on opposite sides of the transverse center axis of said field gasket area. If the field gasket part is arranged to enclose four, corner-close, portholes in each of the two heat transfer plates and define a flow channel, in the device, for a cooling fluid, this configuration may enable a device with efficient "integrated" cooling.

[0015] The field gasket part of the gasket arrangement may comprise separated first and second long side portions extending along, and possibly, along at least a major part of their longitudinal extensions, essentially parallel to, the longitudinal center axis of the field gasket area. The field gasket part may further comprise separated first and second short side portions which each connects the long side portions. The first and second short side portions may be bulging towards each other so as to form a first recess and a second recess on an outside of the first short side portion and the second short side portion, respectively. Further, at least one of said plurality of annular ring gasket parts arranged on each side of the transverse center axis of the field gasket area may at least partly extend in one of the first and second recesses. Such an embodiment of the gasket arrangement may enable a device with a maximized size of the field gasket area. If the field gasket part is arranged to define a flow channel, in the device, for a cooling fluid, this configuration may enable a device with efficient "integrated" cooling.

[0016] The gasket arrangement may be so designed that the longitudinal center axis of the field area extends only outside said plurality of annular ring gasket parts, i.e. such that the longitudinal center axis of the field area does not extend through the ring gasket parts.

[0017] The field gasket part and the ring gasket parts may be separately formed parts. However, according to one embodiment of the inventive gasket arrangement, the field gasket part and at least one of said plurality of annular ring gasket parts are integrally formed. This may enable a relatively simple handling and positioning in the device of the gasket arrangement.

[0018] The field gasket part, and thus the field gasket area, may be symmetrical with respect to the transverse center axis of the field gasket area. Alternatively or additionally, the field gasket part, and thus the field gasket area, may be symmetrical with respect to the longitudinal center axis of the field gasket area. Further, the complete gasket arrangement may be symmetrical with respect to the transverse center axis of the field gasket area. Alternatively or additionally, the complete gasket arrangement may be symmetrical with respect to the longitudinal center axis of the field gasket area. Symmetry of the gasket arrangement may enable symmetry of the heat transfer plates of the device and, as a result, a minimum number of different components in the device.

[0019] The gasket arrangement may have such a configuration that at least one of said plurality of annular ring gasket areas arranged on each side of the transverse center axis of the field gasket area is elongate, for example has an extension parallel to the longitudinal center axis of the field gasket part that exceeds an extension parallel to the transverse center axis of the field gasket part. Such a configuration may enable for the corresponding ring gasket parts to easily enclose, not only one porthole in each of the two heat transfer plates, but also additional holes in the two heat transfer plates which may enable a device wherein first plate interspaces may be used to feed fluids into, and out of, second plate interspaces, which will be further discussed below.

[0020] The gasket arrangement may further comprise an annular fifth porthole gasket part enclosing a porthole gasket area which is smaller than the ring gasket areas. The fifth porthole gasket part may be enclosed by the fifth ring gasket part and comprise an annular inner portion, an annular intermediate portion enclosing the inner portion, an annular outer portion enclosing the intermediate portion, and a number of fluid flow grooves extending through the outer portion in a direction from the porthole gasket area to an outside of the fifth porthole gasket part.

[0021] The provision of the porthole gasket part enables integration, in the gasket arrangement, of features and functions beneficial, or even possibly necessary, for the operation of the device comprising the gasket arrangement, such as short circuit prevention, as will be further discussed below.

[0022] The grooves may extend "radially" in a direction from the porthole gasket area and the number of grooves may be one or more. The grooves may be seen as a reduced thickness of the outer portion of the fifth porthole gasket part. As indicated by the name, the fluid flow grooves are arranged to enable a fluid flow through the outer portion of the fifth porthole gasket part, from the porthole gasket area to the ring gasket area enclosed by the fifth ring gasket part outside the fifth porthole gasket part.

[0023] The gasket arrangement may comprise more than one porthole gasket part, such as an annular sixth porthole gasket part enclosed by the sixth ring gasket part, in addition to the fifth porthole gasket part, or even a porthole gasket part for each one of the ring gasket parts.

[0024] The porthole gasket part(s) and corresponding ring gasket part(s) may be separately or integrally formed parts.

[0025] The inner portion of the fifth porthole gasket part may project from the central extension plane of the ring gasket parts in a first direction which is perpendicular to the central extension plane of the ring gasket parts. Further, the inner portion may project more from the central extension plane of the ring gasket parts in the first direction than the intermediate and outer portions. Such a design may enable a sealing between the gasket arrangement and a sealing arrangement positioned in the device, as will be further discussed below.

[0026] The outer portion of the fifth gasket part of the gasket arrangement may project more from the central extension plane of the ring gasket parts in the first direction than intermediate portion. Further, the outer portion may project from the central extension plane of the ring gasket parts in a second direction which is opposite to said first direction. The outer portion may project more from the central extension plane of the ring gasket parts in the second direction than the intermediate and inner portions. Such an outer portion may seal against both of the two heat transfer plates when arranged in the device.

[0027] 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

[0028] The invention will now be described in more detail with reference to the appended schematic drawings, in which

Figs. 1a and 1b are essentially similar perspective views schematically illustrating a part of a device, which comprises a gasket arrangement according to the invention, in a disassembled state, and different fluid paths through the device,

Fig. 2 is a schematic plan view of a heat transfer plate of the device in Fig. 1a,

Fig. 3 is a schematic plan view of a part of the device in Fig. 1a,

Fig. 4 is a schematic plan view of a part of the device in Fig. 1a,

Figs. 5a and 5b are essentially similar perspective views schematically illustrating a part of a device, which comprises a gasket arrangement according to another embodiment of the invention, in a disassembled state, and different fluid paths through the device,

Fig. 6 is a schematic plan view of a heat transfer plate of the device in Fig. 5a,

Fig. 7 is a simplified schematic plan view of a part of the device in Fig. 5a,

Fig. 8 is a schematic plan view of a part of the device in Fig. 5a,

Fig. 9 is an enlargement of an upper portion of Fig. 3, and

Fig. 10 is a partial cross section, in perspective, taken along the line C in Fig. 4.

Detailed Description

[0029] Fig. 1a illustrates a part of a device 1 used for producing hydrogen through electrolysis, here alkaline water electrolysis. The device 1 comprises a stack 3 (only partly illustrated) of heat transfer plates 5 of first and second types which each has a front side 7 and an opposing back side 9. In the stack 3, the heat transfer plates 5 are flipped in relation to each other, i.e. arranged front side 7 to front side 7 and back side 9 to back side 9 with every second one of the heat transfer plates 5 turned upside down with respect to the rest of the heat transfer plates 5. This means that every second one of the heat transfer plates 5 is rotated 180 degrees around a respective heat transfer plate longitudinal center axis L, and then rotated 180 degrees around a respective heat transfer plate normal axis N (Fig. 2), with respect to the rest of the heat transfer plates 5.

[0030] One of the heat transfer plates 5 is separately illustrated in Fig. 2 and described in further detail below. It has a first end portion 11, a center portion 13 and a second end portion 15 arranged in succession along the longitudinal center axis L of the heat transfer plate 5, which longitudinal center axis L extends perpendicular to a transverse center axis T of the heat transfer plate 5.. The first end portion 11 comprises a first porthole 17, a third porthole 19, a fifth porthole 21, a seventh porthole 23 and a first transfer hole 25, while the second end portion 15 comprises a second porthole 27, a fourth porthole 29, a sixth porthole 31, an eighth porthole 33 and a second transfer hole 35. Every second one of the heat transfer plates 5 in the stack 3 is of the first type illustrated in figure 2, while the rest of the heat transfer plates 5 in the stack 3 are of the second type which is similar to the first type except for that it has the first and second transfer holes 25 and 35 arranged on the opposite side of the longitudinal center axis L.

[0031] As heat transfer plates normally are, the heat transfer plate 5 is pressed with corrugation patterns of ridges and valleys in relation to a respective central extension plane of the heat transfer plate 5, which central extension plane is parallel to the figure plane of Fig. 2. The corrugation patterns within different areas of the heat transfer plate 5 are different. For example, the center portion 13 is pressed with a corrugation pattern of so-called herringbone type. As another example, an edge portion 37 of the heat transfer plate 5 is pressed with alternately arranged ridges and valleys extending from an outer edge 39 of the heat transfer plate 5.

[0032] With reference again to Fig. 1a, the stack 3 of heat transfer plates 5 is arranged between two frame plates F, of which only one is illustrated. The heat transfer plates 5 within the stack 3 are arranged in pairs, wherein heat transfer plates 5b and 5c form one of these pairs, while heat transfer plate 5d forms one of the heat transfer plates of another adjacent one of these pairs. The heat transfer plates of each pair form between them a first interspace 11. Further, a second interspace I2 is formed between each two adjacent pairs of heat transfer plates 5. An outer heat transfer plate 5x, which is similar to the heat transfer plates 5 except for that it lacks the first and second transfer holes 25 and 35, is arranged between the stack 3 and the frame plate F visible in Fig. 1a to form an additional first interspace 11, denoted I1X, as well as a plate pair, with the heat transfer plate 5a. An additional second interspace I2, denoted I2X, is thus formed between the heat transfer plate 5a and the heat transfer plate 5b. An outer heat transfer plate completely lacking holes may be arranged between the stack 3 and the other frame plate which is not visible in Fig. 1a. Further, gaskets, which are not illustrated, may be arranged on the inside of the frame plates F.

[0033] An annular field gasket part 41 is arranged within each of the first interspaces I1 to define a first flow channel C1 therein. An annular field sealing part 43 is arranged within each of the second interspaces I2 to define a second flow channel C2 therein. A separation means, which closes a field sealing area enclosed by the field sealing part 43, comprises a hydroxide ion permeable membrane 45. The membrane 45 extends within the field sealing part 43 and essentially parallel to the heat transfer plates 5 to split the corresponding second flow channel C2 in a second primary sub channel C2P and a second secondary sub channel C2S, which sub channels are parallel and extend on opposite sides of the membrane 45.

[0034] With reference to Fig. 3, the field gasket part 41 is part of a gasket arrangement G of rubber. The field gasket part 41 encloses a field gasket area A1 having a transverse center axis T1 and a longitudinal center axis L1 and it extends in a central extension plane p1 which is illustrated in Fig. 10 and which is parallel to the figure plane of Fig. 3. The field gasket part 41 comprises first and second long side portions ls1 and ls2, which extend along the longitudinal center axis L1 of the field gasket area A1, and first and second short side portions ss1 and ss2. The first short side portion ss1 connects the long side portions ls1 and ls2 at a first end E1 of the gasket arrangement G, while the second short side portion ss2 connects the long side portions ls1 and ls2 at a second end E2 of the gasket arrangement G. The first and second short side portions ss1 and ss2 are bulging towards each other so as to form a first recess R1 on an outside of the first short side portion ss1 and a second recess R2 on an outside of the second short side portion ss2.

[0035] The gasket arrangement G also comprises annular elongate third, fourth, fifth and sixth ring gasket parts 47c, 47d, 47e and 47f, respectively. Each of the third, fourth, fifth and sixth ring gasket parts 47c, 47d, 47e and 47f encloses an elongate ring gasket area A2 which is arranged outside, and is smaller than, the field gasket area A1. The ring gasket areas A2 extend in a central extension plane p2, illustrated in Fig. 10, which coincides with central extension plane p1 of the field gasket part 41. The third and fifth ring gasket parts 47c and 47e are arranged within the recess R1 of the field gasket part 41 such that the field gasket part 41 extends on an outside of the third and fifth ring gasket parts 47c and 47e at the first end E1 of the gasket arrangement G. Similarly, the fourth and sixth ring gasket parts 47d and 47f are arranged within the recess R2 of the field gasket part 41 such that the field gasket part 41 extends on an outside of the fourth and sixth ring gasket parts 47d and 47f at the second end E2 of the gasket arrangement G.

[0036] Thus, the third and fifth ring gasket parts 47c and 47e are arranged on the same side of the transverse center axis T1 of the field gasket area A1, while the fourth and sixth ring gasket parts 47d and 47f are arranged on the same, opposite, side of the transverse center axis T1 of the field gasket area A1. Further, the third and fourth ring gasket parts 47c and 47d are arranged on the same side of the longitudinal center axis L1 of the field gasket area A1, while the fifth and sixth ring gasket parts 47e and 47f are arranged on the same, opposite, side of the longitudinal center axis L1 of the field gasket area A1. Accordingly, the transverse and longitudinal center axes T1 and L1 of the field gasket area A1 extend outside all the ring gasket parts 47c, 47d, 47e, 47f.

[0037] The gasket arrangement G also comprises annular third, fourth, fifth and sixth porthole gasket parts 48c, 48d, 48e and 48f, respectively. With reference to Fig. 9, as illustrated for the porthole gasket part 48e, each of the third, fourth, fifth and sixth porthole gasket parts 48c, 48d, 48e and 48f comprises an annular inner portion

50, an annular intermediate portion 52 enclosing the inner portion 50, and an annular outer portion 54 enclosing the intermediate portion 52. The inner, intermediate and outer portions 50, 52 and 54 are integrally formed. Each of the third, fourth, fifth and sixth porthole gasket parts 48c, 48d, 48e and 48f, and more particularly the inner portions 50 thereof, encloses a circular porthole gasket area A3 which is smaller than the ring gasket area A2. As illustrated in Fig. 3, the third, fourth, fifth and sixth porthole gasket parts 48c, 48d, 48e and 48f are enclosed by the third, fourth, fifth and sixth ring gasket parts 47c, 47d, 47e and 47f, respectively.

[0038] The third, fourth, fifth and sixth porthole gasket parts 48c, 48d, 48e and 48f are all designed in the same way. One of them, the fifth porthole gasket part 48e, will now be further described with reference to Figs. 9 and 10. As said above, the fifth porthole gasket part 48e comprises an inner portion 50, an intermediate portion 52 and an outer portion 54. These different portions project differently from the central extension plane p2 of the third, fourth, fifth and sixth ring gasket parts 47c, 47d, 47e and 47f. More precisely, the inner portion 50, which has the shape of a thick-walled circular cylinder, projects more from the central extension plane p2, in a first direction D1 perpendicular to the central extension plane p2, than the outer portion 54. In turn, the outer portion 54 projects more from the central extension plane p2, in the first direction D1, than the intermediate portion 52. Further, the outer portion 54 projects more from the central extension plane p2, in a second direction D2 which is opposite to the first direction D1, than the inner portion 50 and the intermediate portion 52. The fifth porthole gasket part 48e further comprises a plurality of fluid flow grooves 56 extending radially from the porthole gasket area A3 enclosed by the fifth porthole gasket part 48e to an outside of the fifth porthole gasket part 48e. Thus, the fluid flow grooves 56 extend through the inner, intermediate and outer portions 50, 52 and 54. The fluid flow grooves 56 extend from a front side of the gasket arrangement G (illustrated in Fig. 9) towards a backside of the gasket arrangement G. Since the inner, intermediate and outer portions 50, 52 and 54 project differently from the central extension plane p2, the fluid flow grooves 56 will have different depths within the inner, intermediate and outer portions 50, 52 and 54. More particularly, the fluid flow grooves 56 will be deeper within the inner portion 50 than within the intermediate and outer portions 52 and 54. Further, the fluid flow grooves 56 will be deeper within the outer portion 54 than within the intermediate portion 52. In fact, here, the dept of the fluid flow grooves 56 is zero within the intermediate portion 52 since the thickness of the intermediate portion 52 is equal to the thickness of the inner portion 50 within the fluid flow grooves 56.

[0039] As is clear from Fig. 3, some portions of the gasket arrangement G form part of the field gasket part 41 as well as of one of the ring gasket parts 47c, 47d, 47e and 47f, other portions of the gasket arrangement G form part of two of the ring gasket parts 47c, 47d, 47e and 47f, other portions of the gasket arrangement G form part of one of the ring gasket parts 47c, 47d, 47e and 47f as well as of one of the porthole gasket parts 48c, 48d, 48e and 48f, and other portions of the gasket arrangement G form part of the field gasket part 41 as well as of one of the ring gasket parts 47c, 47d, 47e and 47f and as well as of one of the porthole gasket parts 48c, 48d, 48e and 48f. Thereby, the field and ring and porthole gasket parts 41, 47c, 47d, 47e, 47f, 48c, 48d, 48e and 48f are integrally formed and the gasket arrangement G is one single component. As is also clear from Fig. 3, the gasket arrangement G is symmetrical with respect to both the transverse and the longitudinal center axis T1 and L1 of the field gasket area A1.

[0040] With reference to Fig. 4, the field sealing part 43 and separation means comprising the membrane 45 (not illustrated in Fig. 4) are parts of a sealing arrangement S of rubber (except for the membrane) which also comprises annular first, second, third, fourth, fifth, sixth, seventh and eighth porthole sealing parts 49a, 49b, 49c, 49d, 49e, 49f, 49g and 49h and an insulating outer sheet 51 connecting the field sealing part 43 and the porthole sealing parts 49a-h. The first, second, seventh and eighth porthole sealing parts 49a, 49b, 49g and 49h are all designed in the same way which will not be further described herein. The third, fourth, fifth and sixth porthole sealing parts 49c, 49d, 49e and 49f all have a similar design. Each of them comprises an annular inner portion 60, an annular intermediate portion 62 enclosing the inner portion 60, and an annular outer portion 64 enclosing the intermediate portion 62. The inner, intermediate and outer portions 60, 62 and 64 are integrally formed. Each of the porthole sealing parts 49c, 49d, 49e and 49f, and more particularly the inner portions 60 thereof, encloses a circular porthole sealing area A4 which is similar to the porthole gasket area A3 enclosed by each of the porthole gasket parts 48c, 48d, 48e and 48f of the gasket arrangement G.

[0041] With reference to Fig. 10, the inner, intermediate and outer portions 60, 62 and 64 of the porthole sealing parts 49c, 49d, 49e and 49f project differently from a central extension plane p3 of the field sealing part 43. More precisely, the inner portion 60, which has the shape of a thick-walled circular cylinder, projects more from the central extension plane p3, in a third direction D3 perpendicular to the central extension plane p3, than the outer portion 64. In turn, the outer portion 64 projects more from the central extension plane p3, in the third direction D3, than the intermediate portion 62. Further, the outer portion 64 projects more from the central extension plane p3, in a fourth direction D4 which is opposite to the third direction D3, than the inner portion 60 and the intermediate portion 62.

[0042] In the device 1, each of the heat transfer plates 5 engages with a gasket arrangement G on the back side 9 and with a sealing arrangement S on the front side 7. The gasket arrangements G and the sealing arrangements S are, at least partly, arranged in grooves of the heat transfer plates 5, which are not illustrated or further described herein. With reference to Figs. 2 and 3 and the gasket arrangement G, the field gasket part 41 encloses the first, second, seventh and eight portholes 17, 27, 23 and 33 of the heat transfer plate 5, while the third, fourth, fifth and sixth porthole gasket parts 48c, 48d, 48e and 48f are arranged at a respective one of the third, fourth, fifth and sixth portholes 19, 29, 21 and 31 of the heat transfer plate 5, and two of the third, fourth, fifth and sixth ring gasket parts 47c, 47d, 47e, 47f enclose a respective one of the first and second transfer holes 25 and 35 of the heat transfer plate 5. With reference to Figs. 2 and 4 and the sealing arrangement S, the first, second, seventh and eighth porthole sealing parts 49a, 49b, 49g and 49h are arranged at a respective one of the first, second, seventh and eight portholes 17, 27, 23 and 33 of the heat transfer plate 5, while the third, fourth, fifth and sixth porthole sealing parts 49c, 49d, 49e and 49f are arranged at a respective one of the third, fourth, fifth and sixth portholes 19, 29, 21 and 31 of the heat transfer plate 5.

[0043] Fig. 10 illustrates what it looks like when several heat transfer plates 5, several gasket arrangements G and several sealing arrangements S engage properly with each other in the device 1, at one of the third, fourth, fifth and sixth portholes 19, 29, 21 and 31 of the heat transfer plates 5. Each of the third, fourth, fifth and sixth portholes 19, 29, 21 and 31 of the heat transfer plate 5 encloses a circular plate porthole area A5 (Fig. 2) which has a diameter that is larger than an outer diameter of the inner portions 50 of the porthole gasket parts 48c, 48d, 48e and 48f of the gasket arrangement G and an outer diameter of the inner portions 60 of the porthole sealing parts 49c, 49d, 49e and 49f of the sealing arrangement S. The inner portions 50 of the porthole gasket parts 48c, 48d, 48e and 48f of a gasket arrangement G' arranged, as described above, on a heat transfer plate 5', project through a respective one of the third, fourth, fifth and sixth portholes 19, 29, 21 and 31 of another heat transfer plate 5" so as to contact a respective one of the inner portions 60 of the porthole sealing parts 49c, 49d, 49e and 49f of a sealing arrangement S' arranged, as described above, on the heat transfer plate 5". In turn, the inner portions 60 of the porthole sealing parts 49c, 49d, 49e and 49f of the sealing arrangement S' arranged on the heat transfer plate 5", project through a respective one of the third, fourth, fifth and sixth portholes 19, 29, 21 and 31 of yet another heat transfer plate 5‴ so as to contact a respective one of the inner portions 50 of the porthole gasket parts 48c, 48d, 48e and 48f of another gasket arrangement G" arranged, as described above, on the heat transfer plate 5‴, and so on. Thereby, as illustrated in Fig. 10, the inner portions 50 and 60 of the porthole gasket parts 48c, 48d, 48e and 48f and the porthole sealing parts 49c, 49d, 49e and 49f, respectively, form four rubber tunnels or ports (only one of them illustrated in Fig. 10) through the device 1, more particularly a second primary inlet port 57p, a second secondary inlet port 57s, a second primary outlet port 59p and a second secondary outlet port 59s, which will be further discussed below. The fluid flow grooves 56 of the third, fourth, fifth and sixth porthole gasket parts 48c, 48d, 48e and 48f will allow fluid passage into, and out of, these rubber tunnels, i.e. the second primary inlet port 57p, the second secondary inlet port 57s, the second primary outlet port 59p and the second secondary outlet port 59s. Further, the diameter of the plate porthole area A5 (Fig. 2) enclosed by each of the third, fourth, fifth and sixth portholes 19, 29, 21 and 31 of the heat transfer plate 5 is smaller than an inner diameter of the outer portions 54 of the porthole gasket parts 48c, 48d, 48e and 48f of the gasket arrangement G and an inner diameter of the outer portions 64 of the porthole sealing parts 49c, 49d, 49e and 49f of the sealing arrangement S. As is clear from Fig. 10, the outer portions 54 and 64 of the porthole gasket parts 48c, 48d, 48e and 48f and the porthole sealing parts 49c, 49d, 49e and 49f are aligned with each other so as to be able to support each other on the opposite sides of the heat transfer plate 5.

[0044] When the device 1 is ready for use, the heat transfer plates 5 and the interposed gasket arrangements G and sealing arrangements S are compressed between the frame plates F so as to form the first and second flow channels C1 and C2 and also port means for conveying first and second fluids through the device 1. Compressed like that, the heat transfer plates 5 of each of the pairs, such as the heat transfer plates 5b and 5c, abut each other in contact areas, while contact between adjacent pairs of heat transfer plates 5, such as the heat transfer plates 5c and 5d, is prevented by the presence of the sealing arrangements S between the plate pairs. This separation or insulation between the plate pairs is necessary for the device 1 to work properly for electrolysis, which will be further discussed below. The compression is achieved by some kind of tightening means, such as bolts and nuts, which are not illustrated or further described herein. With reference to Fig. 3 which illustrates the heat transfer plates 5 of the device 1 of which only one is visible, the port means comprise first inlet port means 53 and first outlet port means 55 for the first fluid and second inlet port means 57 and second outlet port means 59 for the second fluid. In turn, the first inlet port means 53 comprises a first primary inlet port 53p and a first secondary inlet port 53s, the first outlet port means 55 comprises a first primary outlet port 55p and a first secondary outlet port 55s, the second inlet port means 57 comprises the second primary inlet port 57p and the second secondary inlet port 57s, and the second outlet port means 59 comprises the second primary outlet port 59p and the second secondary outlet port 59s.

[0045] With reference to Fig. 1a, the first fluid, which is a cooling fluid, for example deionized water, is fed into the device 1 via first inlet means 61 and out of the device 1 via first outlet means 63. The first inlet means 61 comprises a first primary inlet 61p and a first secondary inlet 61s, while the first outlet means 63 comprises a first primary outlet 63p and a first secondary outlet 63s. With reference to Fig. 1b, the second fluid, which is an electrolyte, for example a mixture of water and an alkaline agent, such as potassium hydroxide, is fed into the device 1 via second inlet means 65 and out of the device 1 via second outlet means 67. The second inlet means 65 comprises a second primary inlet 65p and a second secondary inlet 65s, while the second outlet means 67 comprises a second primary outlet 67p and a second secondary outlet 67s.

[0046] A first fluid path P1 for conveying the first fluid through the device 1 comprises a first primary fluid path P1p and a first secondary fluid path P1s. With reference to Figs. 1a and 3, and the dashed lines, the first primary fluid path P1p extends from the first primary inlet 61p, into the first primary inlet port 53p, through the first flow channels C1, into the first primary outlet port 55p and to the first primary outlet 63p. The first secondary fluid path P1s extends from the first secondary inlet 61s, into the first secondary inlet port 53s, through the first flow channels C1, into the first secondary outlet port 55s and to the first secondary outlet 63s. A second fluid path P2 for conveying the second fluid through the device 1 comprises a second primary fluid path P2p and a second secondary fluid path P2s. With reference to Figs.1b and 3, and the dashed lines, the second primary fluid path P2p extends from the second primary inlet 65p, into the second primary inlet port 57p, into the first interspaces I1 outside the first flow channels C1, through the respective first transfer hole 25 of every second one of the heat transfer plates, i.e. plates 5a, 5c,..., into the second primary sub channels C2P, through the second primary sub channels C2P, through the respective second transfer hole 35 of every second one of the heat transfer plates, i.e. plates 5a, 5c... , into the first interspaces I1 outside the first flow channels C1, into the second primary outlet port 59p and to the second primary outlet 67p. The second secondary fluid path P2s extends from the second secondary inlet 65s, into the second secondary inlet port 57s, into the first interspaces I1 outside the first flow channels C1, through the respective second transfer hole 35 of every second one of the heat transfer plates, i.e. plates 5b, 5d,..., into the second secondary sub channels C2S, through the second secondary sub channels C2S, through the respective first transfer hole 25 of every second one of the heat transfer plates, i.e. plates 5b, 5d,..., into the first interspaces I1 outside the first flow channels C1, into the second secondary outlet port 59s and to the second secondary outlet 67s.

[0047] With reference again to Fig. 3, the first fluid, i.e. the cooling fluid, is conveyed through the device 1 in the ports 53s, 53p, 55s and 55p, while the second fluid, i.e. the electrolyte, is conveyed through the device 1 in the ports 57p, 57s, 59p and 59s. The ports 53s, 53p, 55s and 55p are arranged on a larger distance from a longitudinal center plane P of the device 1 than the ports 57p, 57s, 59p and 59s. This means that the cooling fluid is conveyed on the outside of the electrolyte.

[0048] Thus, a method for electrolysis is performed by means of the device 1. The method comprises the step of applying a current to the device 1 to turn every second one of the heat transfer plate of the device 1, including the heat transfer plates 5a and 5c, into anodes and the rest of the heat transfer plates of the device 1, including the heat transfer plates 5b and 5d, into cathodes. As mentioned above, sealing arrangements S insulating between the heat transfer plates 5 are arranged in the second interspaces I2 of the device 1, i.e. between the heat transfer plates 5a and 5b, and between the heat transfer plates 5c and 5d, etc., and split the second flow channels C2 into second primary sub channels C2P and second secondary sub channels C2S. Thereby, electrolysis may be performed within the second flow channels C2 of the device 1. As also explained above, the ports 57p, 57s, 59p and 59s for the second fluid, i.e. the electrolyte, are "lined" with rubber which minimizes the risk of short circuits between the heat transfer plates 5, which short circuits could cause malfunctioning of the device 1.

[0049] As described above, there are two fluid paths for the second fluid, i.e. the electrolyte, through the device 1. Accordingly, the method comprises the step of feeding a first part of the second fluid into the first interspaces I1 outside the first flow channels C1 and through the first transfer holes 25 of the heat transfer plates 5a, 5c, etc., into the second primary sub channels C2P, and feeding a second part of the second fluid into the first interspaces I1 outside the first flow channels C1 and through the second transfer holes 35 of the heat transfer plates 5b, 5d, etc., into the second secondary sub channels C2S. Further, the method comprises the step of feeding the first and second parts of the second fluid through the second flow channels C2, whereby water in the electrolyte is split into hydrogen and oxygen and a primary fraction is formed in the second primary sub channels C2P and a secondary fraction is formed in the second secondary sub channels C2S, the primary fraction containing more oxygen and less hydrogen than the second fraction. The primary fraction of the second fluid is fed through the second transfer holes 35 of the heat transfer plates 5a, 5c, etc. into the first interspaces I1 outside the first flow channels C1, while the secondary fraction of the second fluid is fed through the first transfer holes 25 of the heat transfer plates 5b, 5d, etc. into the first interspaces I1 outside the first flow channels C1. The primary and secondary fractions are separately discharged from the device 1 via the second primary outlet 67p and the second secondary outlet 67s, respectively. When electrolysis is performed in the second flow channels C2, heat is generated. The method comprises the step of feeding the first fluid, i.e. the deionized water, through the first flow channels C1, i.e. on both sides of the electrolysis channels C2, to effectively and uniformly divert the heat generated through the electrolysis from the device 1.

[0050] It should be stressed that the second fluid is referred to as second fluid even if its characteristics changes when it is fed through the device, and that both the primary fraction and the secondary fraction of the second fluid are referred to as second fluid even if their separate compositions vary and differ from each other and from the original second fluid.

[0051] It should be stressed that all components necessary to make the device work properly, such as power sources, connections, wiring, control units, valves, pumps, gaskets, sensors, pipes, dosing equipment, etc., are not described herein or illustrated in the figures. Further, characteristics of the different components of the device which are not relevant to the present invention are not described or illustrated herein.

[0052] Fig. 5a illustrates a part of another device 2 used for producing hydrogen through electrolysis. There are a lot of similarities between the devices 1 and 2 and the above description is, to a large extent, valid also for the device 2. Therefore, hereinafter, the differences of the device 2 as compared to the device 1 will be focused on. The device 2 comprises a stack 3 (only partly illustrated) of heat transfer plates 5 of which one is separately illustrated in Fig. 6. A first end portion 11 of the heat transfer plate 5 comprises a first porthole 17, a third porthole 19 a fifth porthole 21 and a first transfer hole 25, while a second end portion 15 of the heat transfer plate 5 comprises a second porthole 27, a fourth porthole 29, a sixth porthole 31 and a second transfer hole 35.

[0053] With reference again to Fig. 5a, just like in the device 1, the heat transfer plates 5 of the device 2 define first interspaces I1 and second interspaces I2. An annular field gasket part 41 is arranged within each of the first interspaces I1 to define a first flow channel C1 therein. An annular field sealing part 43 is arranged within each of the second interspaces I2 to define a second flow channel C2 therein. A membrane 45 within each of the second interspaces 12splits the second flow channel C2 in a second primary sub channel C2P and a second secondary sub channel C2S.

[0054] With reference to Fig. 7, the field gasket part 41 is part of a gasket arrangement G also comprising third, fourth, fifth and sixth ring gasket parts 47c, 47d, 47e and 47f. The field gasket part 41 comprises first and second long side portions Is1 and Is2, and first and second short side portions ss1 and ss2 connecting the first and second long side portions Is1 and Is2 at a first end E1 and a second end E2, respectively, of the gasket arrangement G. At the first end E1 of the gasket arrangement G, the field gasket part 41, or more particularly the first short side portion ss1 thereof, is bent so as to extend between the third and fifth ring gasket parts 47c and 47e. At the second end E2 of the gasket arrangement G, the field gasket part 41, or more particularly the second short side portion ss2 thereof, is bent so as to extend between the fourth and sixth ring gasket parts 47d and 47f.

[0055] Although not illustrated in Fig. 7, the gasket arrangement G comprises annular third, fourth, fifth and sixth porthole gasket parts, which are enclosed by a respective one of the ring gasket parts 47c, 47d, 47e and 47f and which resemble the porthole gasket parts illustrated in Figs. 3, 9 and 10.

[0056] With reference to Fig. 8, the field sealing part 43 and the membrane 45 are parts of a sealing arrangement S also comprising first, second, third, fourth, fifth and sixth porthole sealing parts 49a, 49b, 49c, 49d, 49e and 49f and an insulating outer sheet 51 connecting the field sealing part 43 and the porthole sealing parts 49a-f. The first and second porthole sealing parts 49a and 49b are designed in the same way while the third, fourth, fifth and sixth porthole sealing parts 49c, 49d, 49e and 49f all have the same design resembling the design of the third, fourth, fifth and sixth porthole sealing parts 49c, 49d, 49e and 49f in Fig. 4.

[0057] In the device 2, each of the heat transfer plates 5 engages with a gasket arrangement G on the back side 9 and with a sealing arrangement S on the front side 7. With reference to Figs. 6 and 7 and the gasket arrangement G, the field gasket part 41 encloses the first and second portholes 17 and 27 of the heat transfer plate 5, while the third, fourth, fifth and sixth ring gasket parts 47c, 47d, 47e, 47f enclose a respective one of the third, fourth, fifth and sixth portholes 19, 29, 21 and 31 and two of the third, fourth, fifth and sixth ring gasket parts 47c, 47d, 47e, 47f also enclose a respective one of the first and second transfer holes 25 and 35 of the heat transfer plate 5. With reference to Figs. 6 and 8 and the sealing arrangement S, the first and second porthole sealing parts 49a and 49b are arranged at a respective one of the first and second potholes 17 and 27, while the third, fourth, fifth and sixth porthole sealing parts 49c, 49d, 49e and 49f are arranged at a respective one of the third, fourth, fifth and sixth portholes 19, 29, 21 and 31 of the heat transfer plate 5.

[0058] Thus, in the device 2, the porthole gasket parts (not illustrated) of the gasket arrangements G and the porthole sealing parts 49c, 49d, 49e and 49f of the sealing arrangements S form four rubber tunnels or ports (not illustrated) through the device 2, more particularly a second primary inlet port 57p, a second secondary inlet port 57s, a second primary outlet port 59p and a second secondary outlet port 59s.

[0059] The device 2 comprises port means for conveying first and second fluids through the device 2. With reference to Fig. 7, the port means comprise first inlet port means 53 and first outlet port means 55 for the first fluid and second inlet port means 57 and second outlet port means 59 for the second fluid. Here, the first inlet port means 53 do not comprise first primary and secondary inlet ports, but only one single inlet port. Similarly, here, the first outlet port means 55 do not comprise first primary and secondary outlet ports, but only one single outlet port. However, the second inlet port means 57 comprises the second primary inlet port 57p and the second secondary inlet port 57s, and the second outlet port means 59 comprises the second primary outlet port 59p and the second secondary outlet port 59s.

[0060] With reference to Fig. 5a, the first fluid is fed into the device 2 via first inlet means 61 and out of the device 2 via first outlet means 63. Here, the first inlet means 61 do not comprise first primary and secondary inlets, but only one single inlet. Similarly, here, the first outlet means 63 do not comprise first primary and secondary outlets, but only one single outlet. With reference to Fig. 5b, the second fluid is fed into the device 2 via second inlet means 65 and out of the device 1 via second outlet means 67. The second inlet means 65 comprises a second primary inlet 65p and a second secondary inlet 65s, while the second outlet means 67 comprises a second primary outlet 67p and a second secondary outlet 67s.

[0061] There is one single first fluid path P1 for conveying the first fluid through the device 2. With reference to Figs. 5a and 7, and the dashed lines, the first fluid path P1 extends from the first inlet 61, into the first inlet port 53, through the first flow channels C1, into the first outlet port 55 and to the first outlet 63. A second fluid path P2 for conveying the second fluid through the device 1 comprises a second primary fluid path P2p and a second secondary fluid path P2s. With reference to Figs. 5b and 7, and the dashed lines, the second primary fluid path P2p extends from the second primary inlet 65p, into the second primary inlet port 57p, into the first interspaces I1 outside the first flow channels C1, through the respective first transfer hole 25 of every second one of the heat transfer plates, i.e. plates 5a, 5c,..., into the second primary sub channels C2P, through the second primary sub channels C2P, through the respective second transfer hole 35 of every second one of the heat transfer plates, i.e. plates 5a, 5c..., into the first interspaces I1 outside the first flow channels C1, into the second primary outlet port 59p and to the second primary outlet 67p. The second secondary fluid path P2s extends from the second secondary inlet 65s, into the second secondary inlet port 57s, into the first interspaces I1 outside the first flow channels C1, through the respective second transfer hole 35 of every second one of the heat transfer plates, i.e. plates 5b, 5d,..., into the second secondary sub channels C2S, through the second secondary sub channels C2S, through the respective first transfer hole 25 of every second one of the heat transfer plates, i.e. plates 5b, 5d,..., into the first interspaces I1 outside the first flow channels C1, into the second secondary outlet port 59s and to the second secondary outlet 67s.

[0062] With reference again to Fig. 7, the first fluid is conveyed through the device 2 in the ports 53 and 55, while the second fluid is conveyed through the device 2 in the ports 57p, 57s, 59p and 59s. The ports 57p, 57s, 59p and 59s are arranged on a larger distance from a longitudinal center plane P of the device 2 than the ports 53 and 55. This means that the second fluid is conveyed on the outside of the first fluid.

[0063] The above described embodiments of the present invention should only be seen as examples. A person skilled in the art realizes that the embodiments discussed can be varied in a number of ways without deviating from the inventive conception.

[0064] In the above described embodiments, the gasket arrangements comprises four ring gasket parts. The gasket arrangement could, however, comprise more or less ring gasket parts, even an odd number of ring gasket parts, for example in connection with devices having a second inlet port means that doesn't comprise second primary and secondary inlet ports, like in the above described embodiments, but one single second inlet port only communicating with the second primary and secondary outlet ports. Such a gasket arrangement could be such that the longitudinal center axis of the field gasket area extends through one of the ring gasket parts.

[0065] As said above, some portions of the gasket arrangement G illustrated in Fig. 3 form part of two of the ring gasket parts 47c, 47d, 47e and 47f. More particularly, the ring gasket parts 47c and 47e, just like the ring gasket parts 47d and 47f, are integrally formed. In an alternative embodiment, the ring gasket parts 47c and 47e, just like the ring gasket parts 47d and 47f, could instead be separated from each other to minimize the risk of fluid leakage between the areas A2 enclosed by the ring gasket parts 47c, 47d, 47e and 47f.

[0066] The gasket arrangement may be comprised in a device used for another type of electrolysis than alkaline water electrolysis, for example chlor-alkali electrolysis. Further, the gasket arrangement may be comprised in a device for other applications than electrolysis, for example a device in the form of a fuel cell.

[0067] It should be stressed that the attributes first, second, third, ... , primary, secondary, and A, B, C, ... , etc. are used herein just to distinguish between species and not to express any kind of mutual order between, or attribute any special characteristics to, the species.

[0068] It should be stressed that "receiving", "feeding", "communicating" etc., throughout the text, means "receiving directly or indirectly" and "feeding directly or indirectly" and "communicating directly or indirectly", respectively.

[0069] It should be stressed that a description of details not directly relevant to the present invention has been omitted and that the figures are just schematic and not drawn according to scale. It should also be said that some of the figures have been more simplified than others. Therefore, some components may be illustrated in one figure but left out on another figure.

Claims

1. A gasket arrangement (G) for sealing between two corrugated heat transfer plates (5), the gasket arrangement (G) comprising an annular field gasket part (41) enclosing a field gasket area (A1), and a plurality of annular ring gasket parts (47c, 47d, 47e, 47f) arranged outside said field gasket area (A1), each of said plurality of annular ring gasket parts (47c, 47d, 47e, 47f) enclosing a ring gasket area (A2) which is smaller than the field gasket area (A1) and

extends in a central extension plane (p2) of the ring gasket parts (47c, 47d, 47e, 47D, a third and a fourth ring gasket part (47c, 47d) of said plurality of annular ring gasket parts (47c, 47d, 47e, 47f) being arranged on opposite sides of a transverse center axis (T1) of said field gasket area (A1), **characterized in that** a fifth ring gasket part (47e) of said plurality of annular ring gasket parts (47c, 47d, 47e, 47f) is arranged on the same side of the transverse center axis (T1) as the third ring gasket part (47c), the third and fifth ring gasket parts (47c, 47e) being arranged on opposite sides of a longitudinal center axis (L1) of said field gasket area (A1), and that the longitudinal center axis (L1) of said field gasket area (A1) extends through ≤ 1 of said plurality of annular ring gasket parts (47c, 47d, 47e, 47D.

2. A gasket arrangement (G) according to claim 1, wherein a sixth ring gasket part (47f) of said plurality of annular ring gasket parts (47c, 47d, 47e, 47f) is arranged on the same side of the transverse center axis (T1) as the fourth ring gasket part (47d), the fourth and sixth ring gasket parts (47d, 47f) being arranged on opposite sides of the longitudinal center axis (L1) of said field gasket area (A1).

3. A gasket arrangement (G) according to claim 2, wherein the field gasket part (41), at a first end (E1) of the gasket arrangement (G), extends between the third and the fifth ring gasket part (47c, 47e), and, at an opposing second end of the gasket arrangement (G), extends between the fourth and the sixth ring gasket part (47d, 47f), the first and second ends (E1, E2) of the gasket arrangement (G) being arranged on opposite sides of the transverse center axis (T1) of said field gasket area (A1).

4. A gasket arrangement (G) according to claim 2, wherein the field gasket part (41), at a first end (E1) of the gasket arrangement (G), extends on an outside of the third ring gasket part (47c) and on an outside the fifth ring gasket part (47e), and, at an opposing second end (E2) of the gasket arrangement (G), extends on an outside of the fourth ring gasket part (47d) and on an outside of the sixth ring gasket part (47f), the first and second ends (E1, E2) of the gasket arrangement (G) being arranged on opposite sides of the transverse center axis (T1) of said field gasket area (A1).

5. A gasket arrangement (G) according to any of the preceding claims, wherein the field gasket part (41) comprises separated first and second long side portions (ls1, ls2) extending along the longitudinal center axis (L1) of the field gasket area (A1), and separated first and second short side portions (ss1, ss2) which each connects the long side portions (ls1, ls2), wherein the first and second short side portions (ss1, ss2) are bulging towards each other so as to form a first recess (R1) and a second recess (R2) on an outside of the first short side portion (ss1) and the second short side portion (ss2), respectively.

6. A gasket arrangement (G) according to claim 5, wherein at least one of said plurality of annular ring gasket parts (47c, 47d, 47e, 47f) arranged on each side of the transverse center axis (T1) of said field gasket area (A1) at least partly extends in one of the first and second recesses (R1, R2).

7. A gasket arrangement (G) according to any of the preceding claims, wherein the longitudinal center axis (L1) of said field area (A1) extends only outside said plurality of annular ring gasket parts (47c, 47d, 47e, 47D.

8. A gasket arrangement (G) according to any of the preceding claims, wherein the field gasket part (41) and at least one of said plurality of annular ring gasket parts (47c, 47d, 47e and 47f) are integrally formed.

9. A gasket arrangement (G) according to any of the preceding claims, wherein the field gasket part (41) is symmetrical with respect to the transverse center axis (T1) and/or to the longitudinal center axis (L1) of the field gasket area (A1).

10. A gasket arrangement (G) according to any of the preceding claims, the gasket arrangement (G) being symmetrical with respect to the transverse center axis (T1) and/or to the longitudinal center axis (L1) of the field gasket area (A1).

11. A gasket arrangement (G) according to any of the preceding claims, wherein at least one of said plurality of annular ring gasket areas (A2) arranged on each side of the transverse center axis (T1) of said field gasket area (A1) is elongate.

12. A gasket arrangement (G) according to any of the preceding claims, further comprising an annular fifth porthole gasket part (48e) enclosing a porthole gasket area (A3) which is smaller than the ring gasket areas (A2), the fifth porthole gasket part (48e) being enclosed by the fifth ring gasket part (47e) and comprising an annular inner portion (50), an annular intermediate portion (52) enclosing the inner portion (50), an annular outer portion (54) enclosing the intermediate portion (52), and a number of fluid flow grooves (56) extending through the outer portion (54) in a direction from the porthole gasket area (A3) to an outside of the fifth porthole gasket part (48e).

13. A gasket arrangement (G) according to claim 12, wherein the inner portion (50) projects from the cen-

tral extension plane (p2) of the ring gasket parts (47c, 47d, 47e, 47f) in a first direction (D1) which is perpendicular to the central extension plane (p2) of the ring gasket parts (47c, 47d, 47e, 47D, and the inner portion (50) projects more from the central extension plane (p2) of the ring gasket parts (47c, 47d, 47e, 47f) in said first direction (D1) than the intermediate and outer portions (52, 54).

14. A gasket arrangement (G) according to claim 13, wherein the outer portion (54) projects more from the central extension plane (p2) of the ring gasket parts (47c, 47d, 47e, 47f) in said first direction (D1) than the intermediate portion (52).

15. A gasket arrangement (G) according to any of claims 13-14, wherein the outer portion (54) projects from the central extension plane (p2) of the ring gasket parts (47c, 47d, 47e, 47f) in a second direction (D2) which is opposite to said first direction (D1), and the outer portion (54) projects more from the central extension plane (p2) of the ring gasket parts (47c, 47d, 47e, 47f) in said second direction (D2) than the intermediate and inner portions (52, 50).

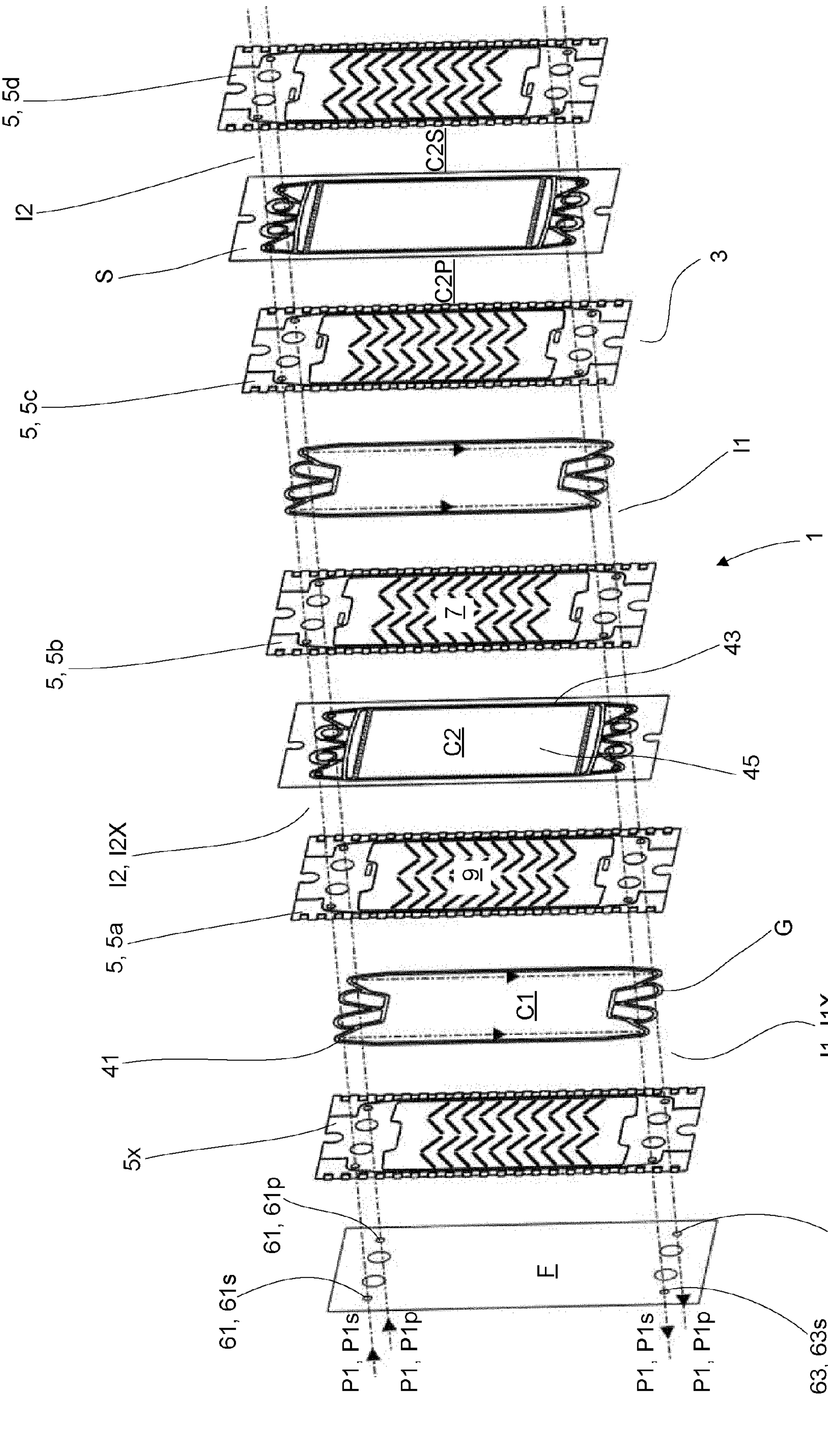
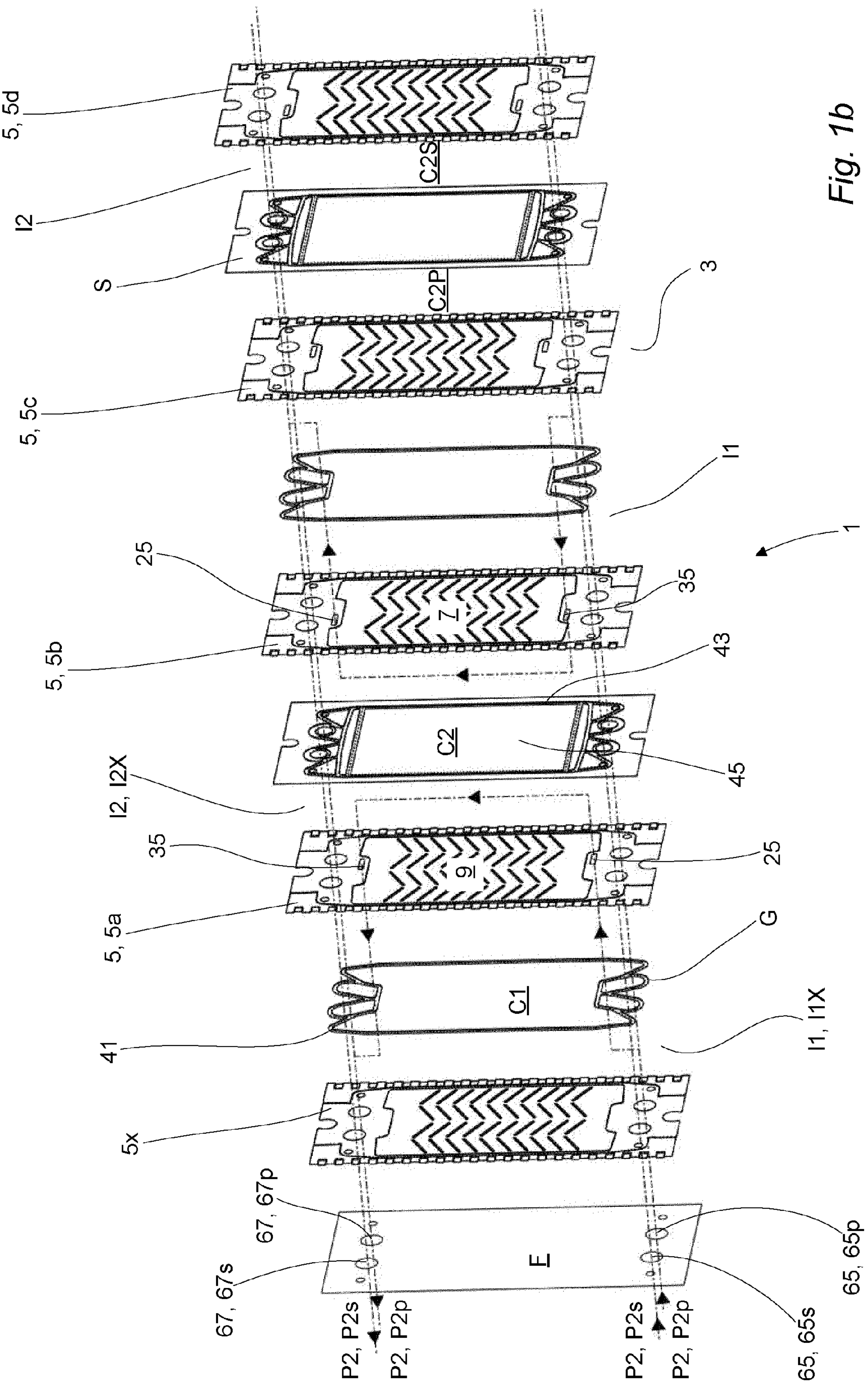

5, 5d
I2
S
C2S
C2P
3
5, 5c
I1
1
5, 5b
7
43
C2
45
I2, I2X
6
5, 5a
G
C1
I1, I1X
41
5x
61, 61p
61, 61s
E
63, 63p
63, 63s
P1, P1s
P1, P1p
P1, P1s
P1, P1p

Fig. 1a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I2
S
C2S
C2P
3
5, 5c
I1
1
25
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5, 5b
43
C2
45
I2, I2X
35
9
25
5, 5a
G
C1
41
I1, I1X
5x
67, 67p
67, 67s
E
65, 65p
65, 65s
P2, P2s
P2, P2p
P2, P2s
P2, P2p

Fig. 1b

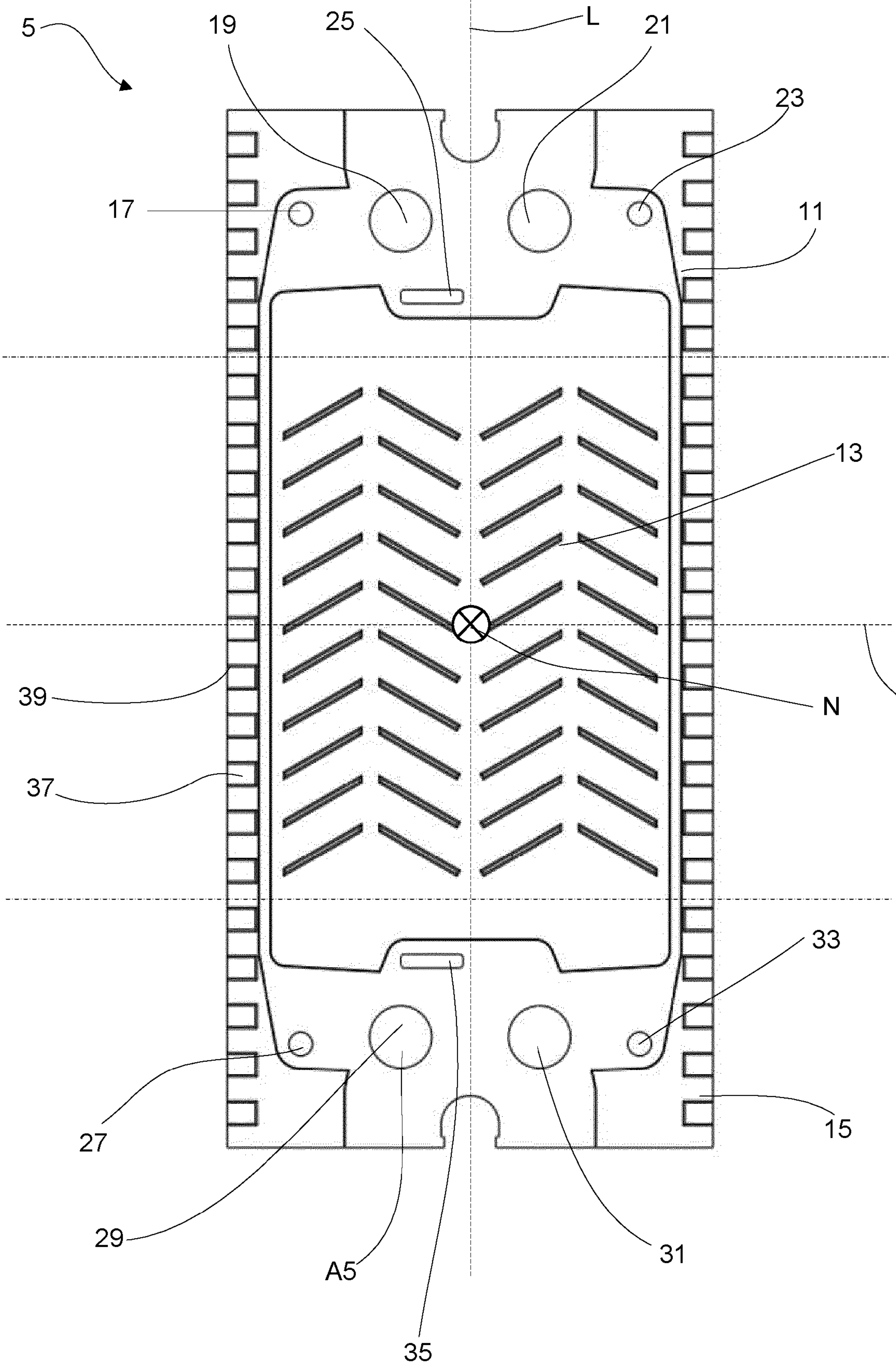
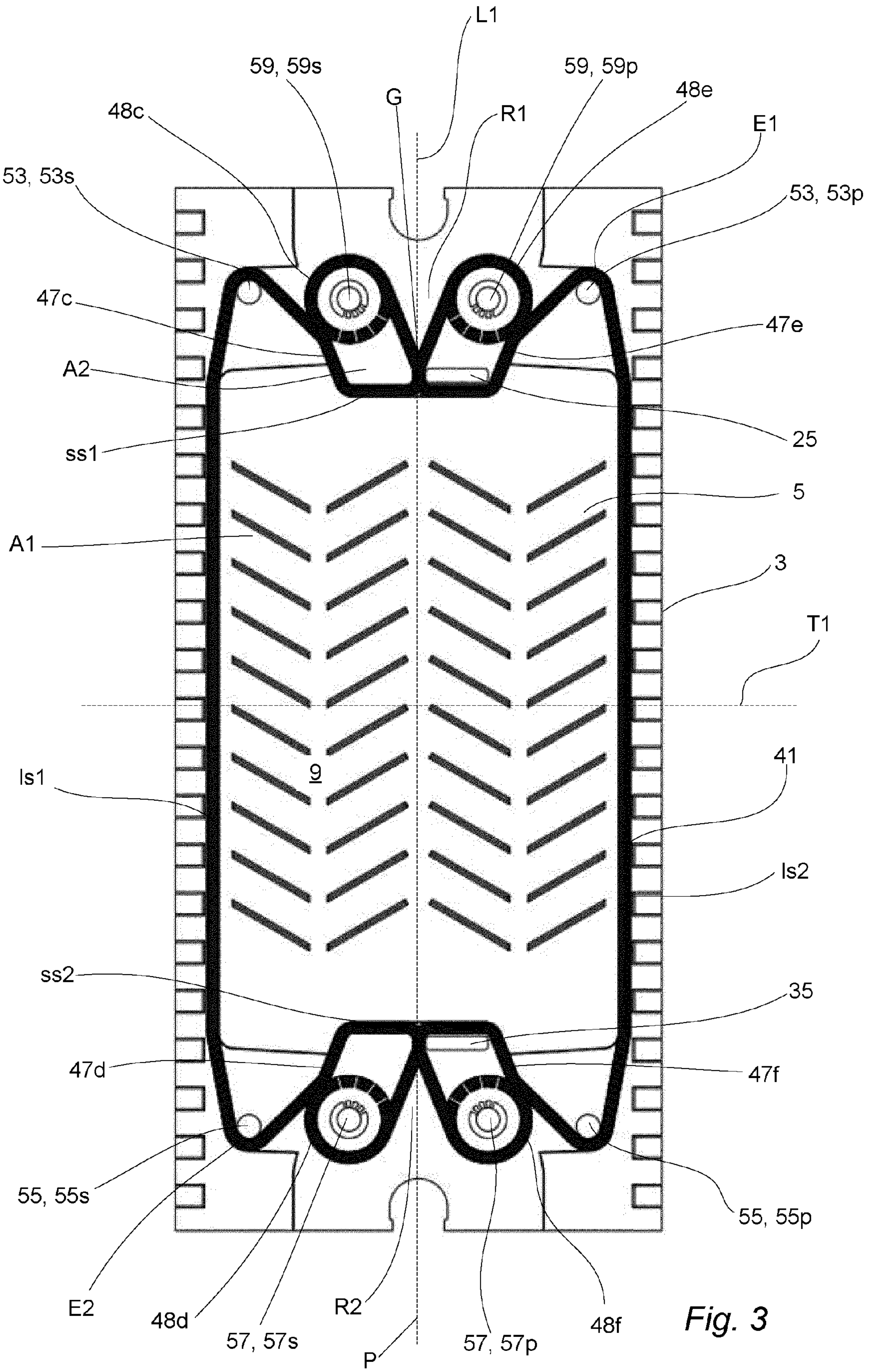


Fig. 2


L1
59, 59s
G
59, 59p
48e
48c
R1
E1
53, 53s
53, 53p
47c
47e
A2
25
ss1
5
A1
3
T1
9
ls1
41
ls2
ss2
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47d
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55, 55p
E2
48d
57, 57s
R2
P
57, 57p
48f

Fig. 3

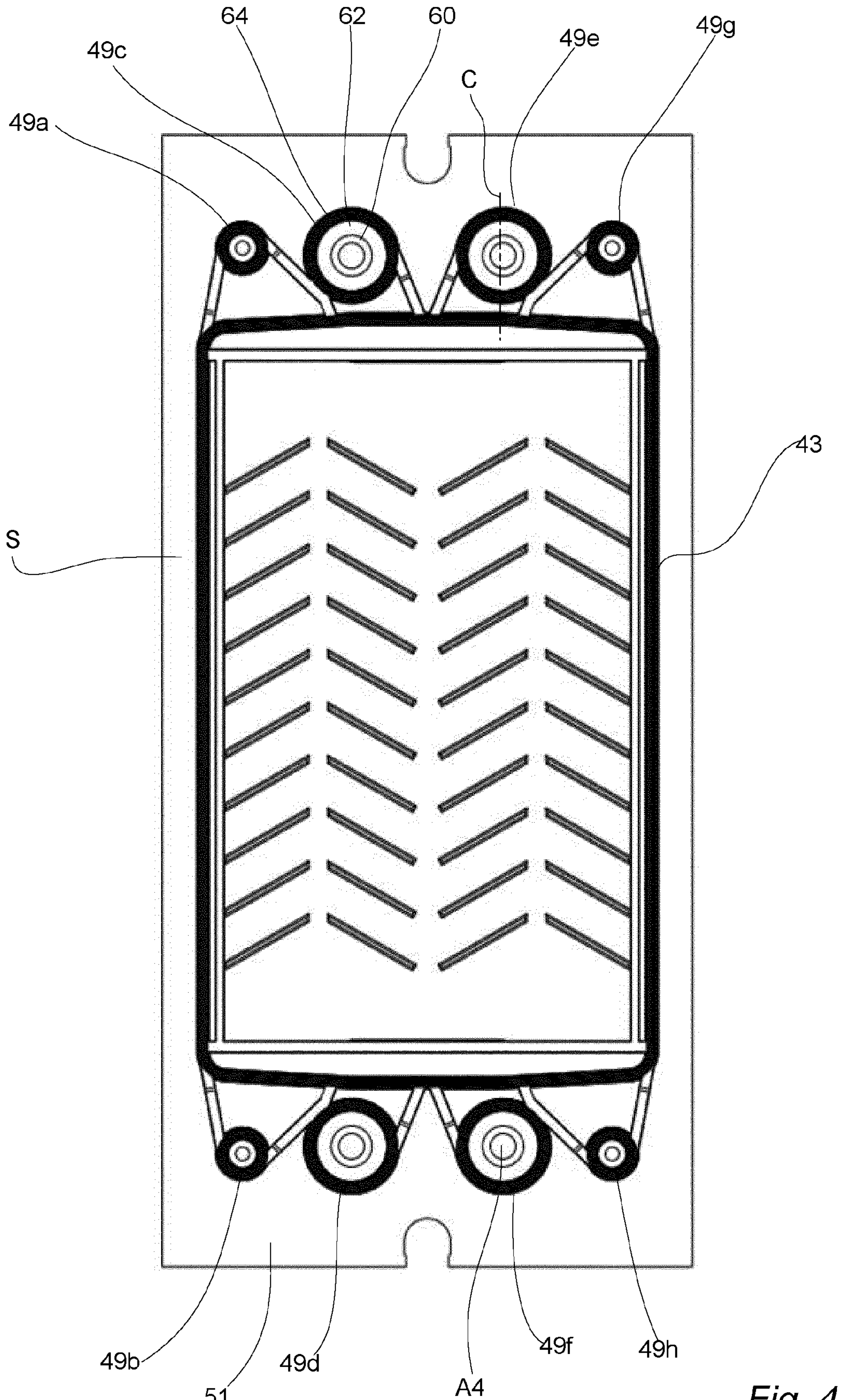
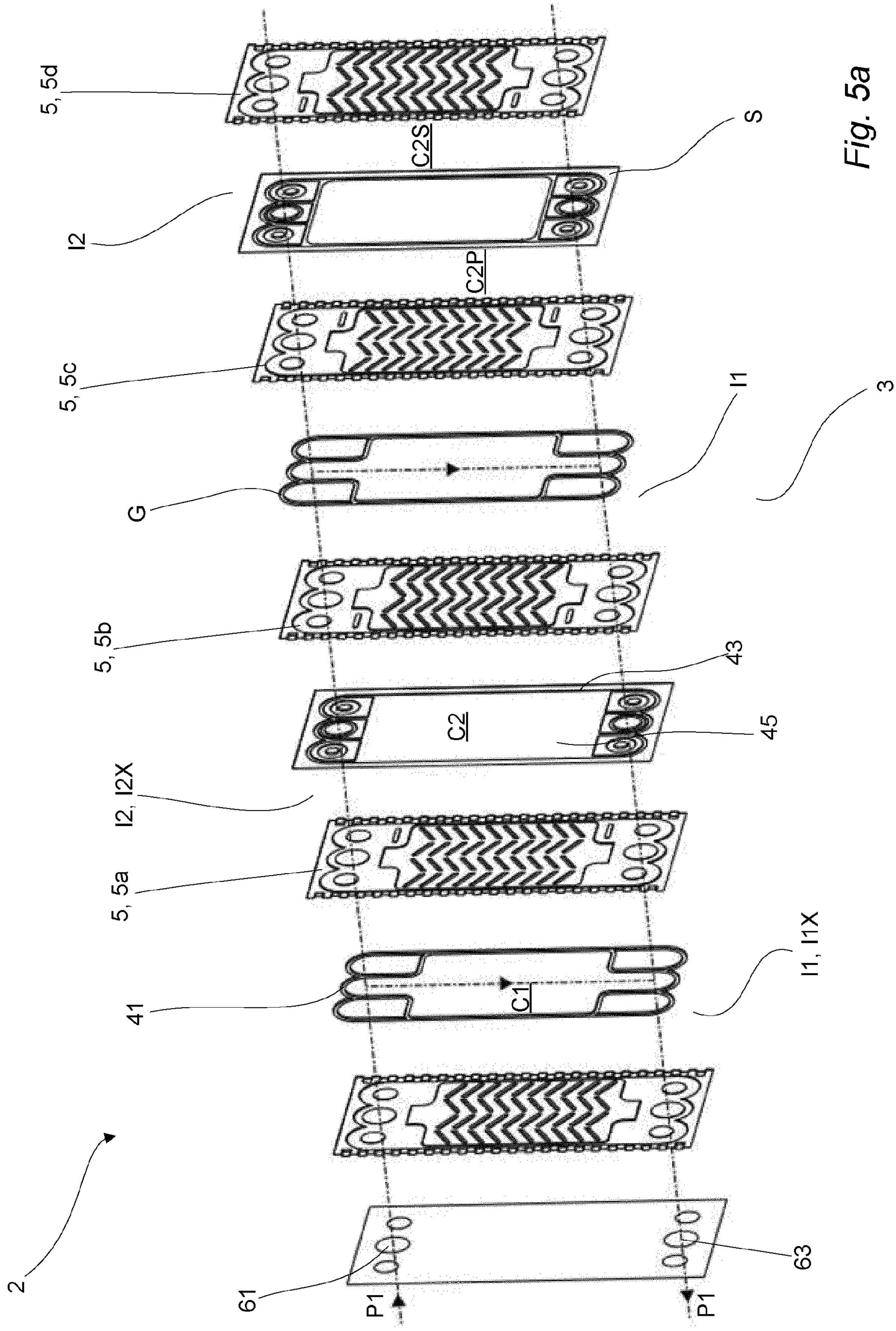


Fig. 4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I2
C2P
5, 5c
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C2
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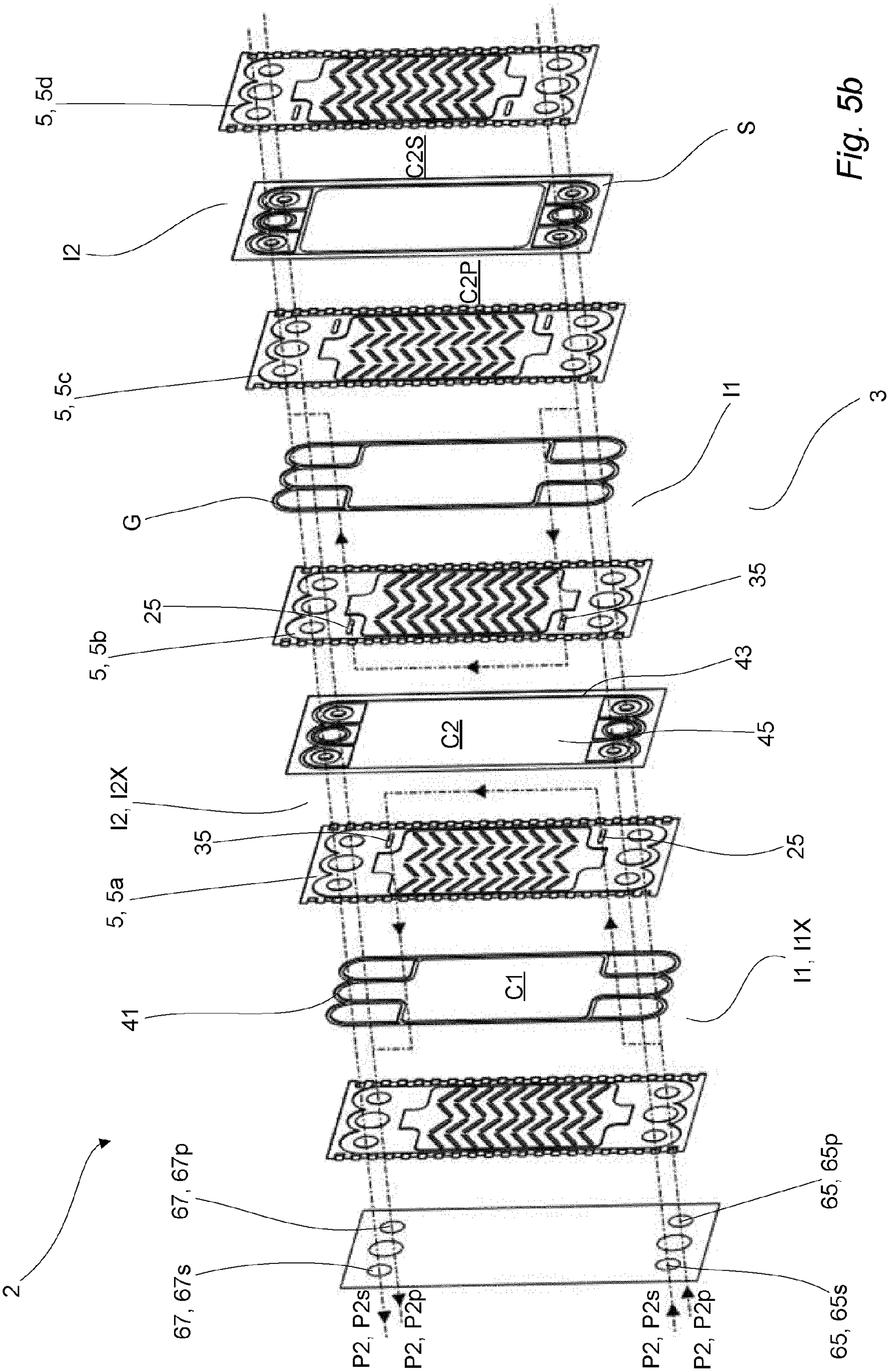
I2, I2X
5, 5a
I1, I1X
41
C1
2
61
63
P1
P1

Fig. 5a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C2P
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I1, I1X
C1
41
2
67, 67p
67, 67s
65, 65p
65, 65s
P2, P2s
P2, P2p
P2, P2s
P2, P2p

Fig. 5b

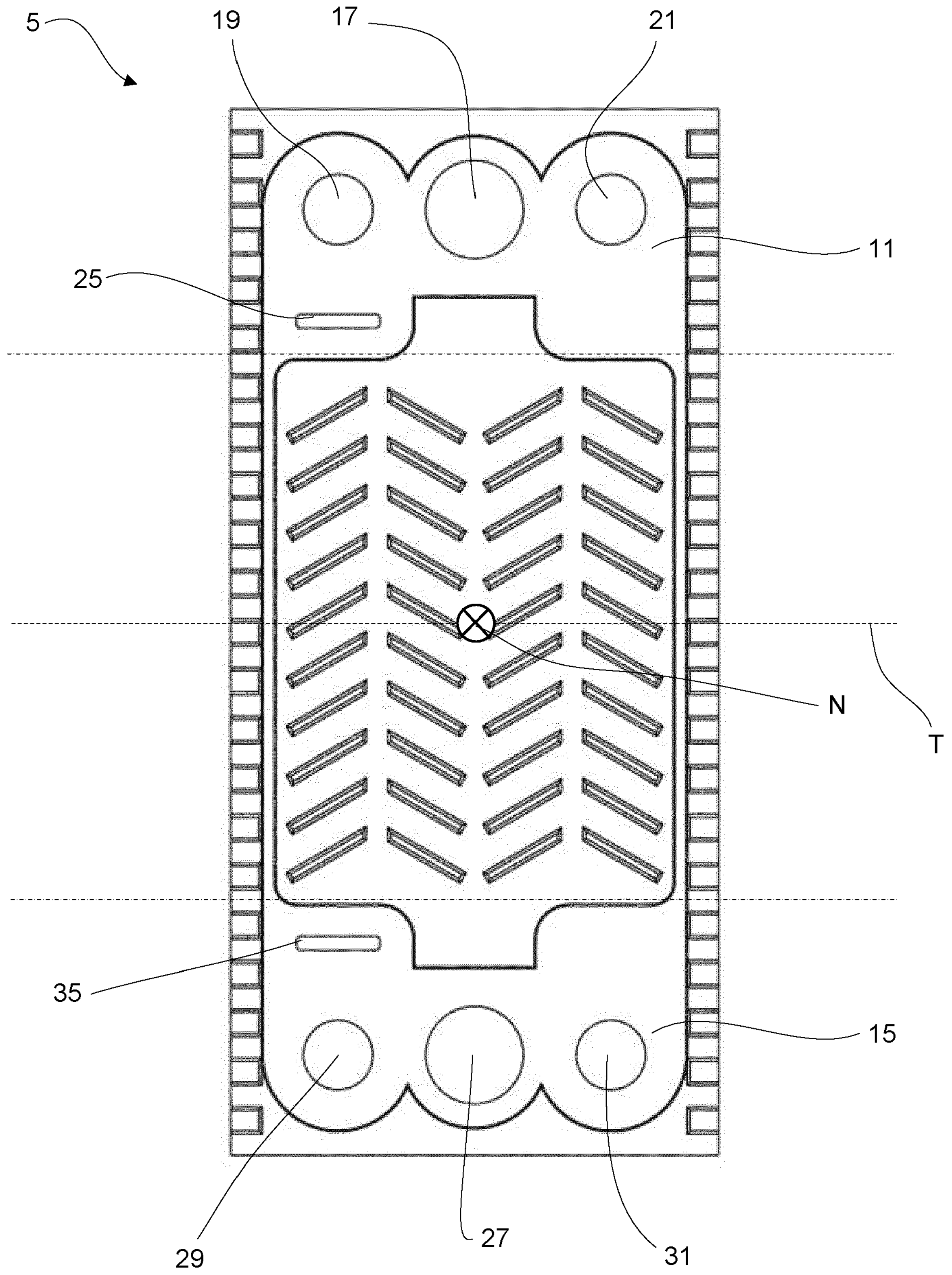
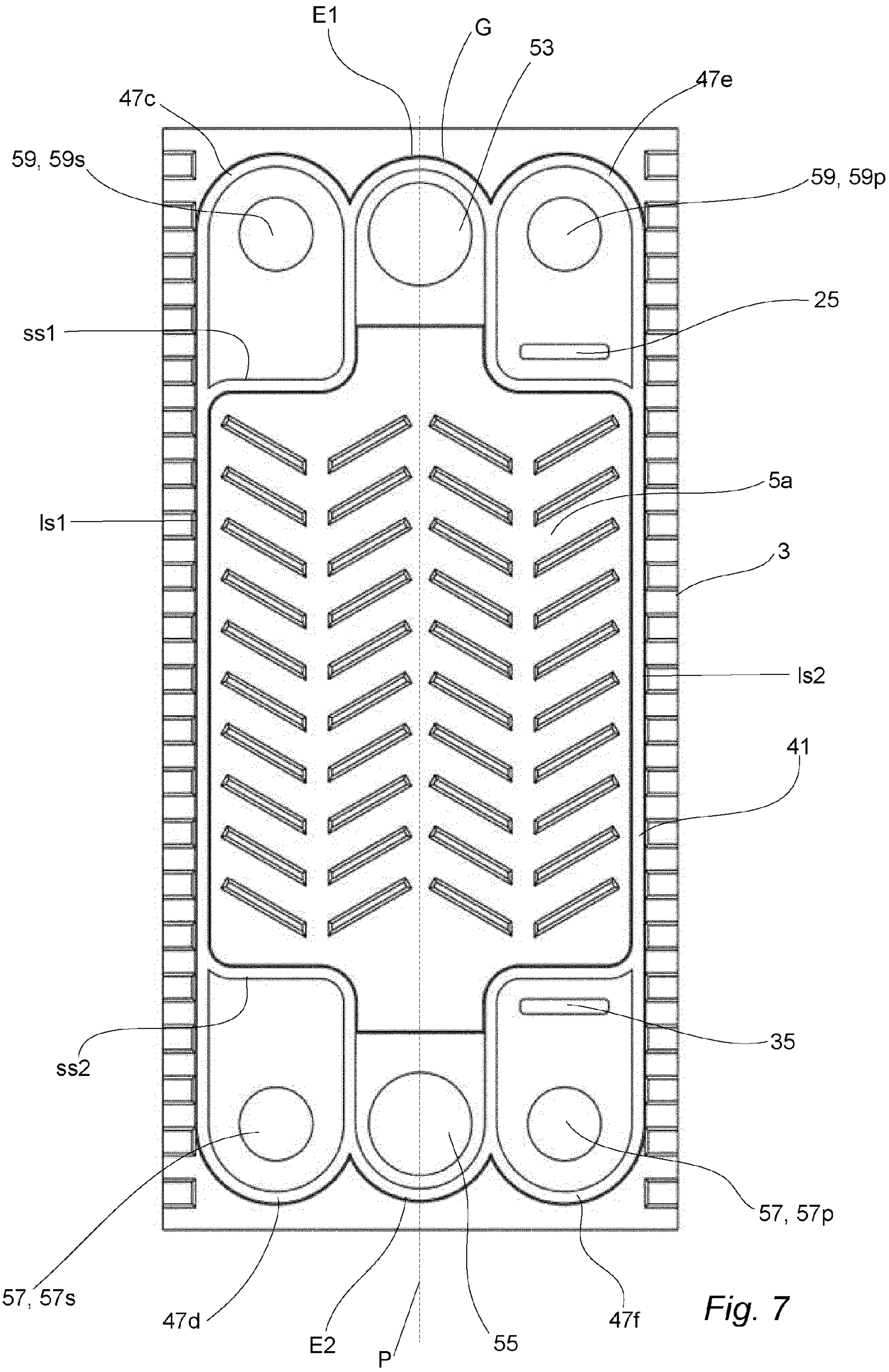


Fig. 6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ls1
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ls2
41
35
ss2
57, 57p
57, 57s
47d
E2
P
55
47f

Fig. 7

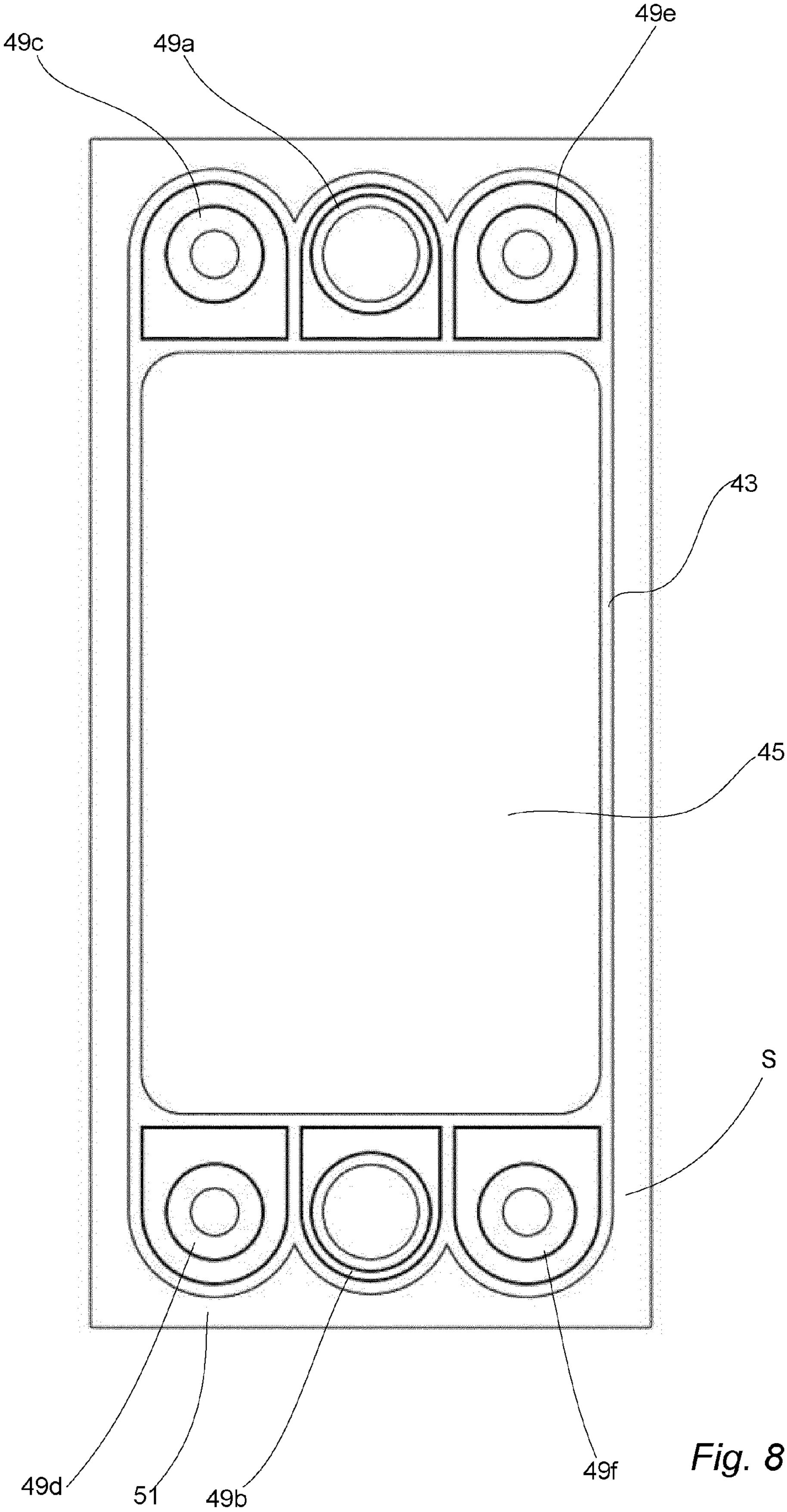

Fig. 8

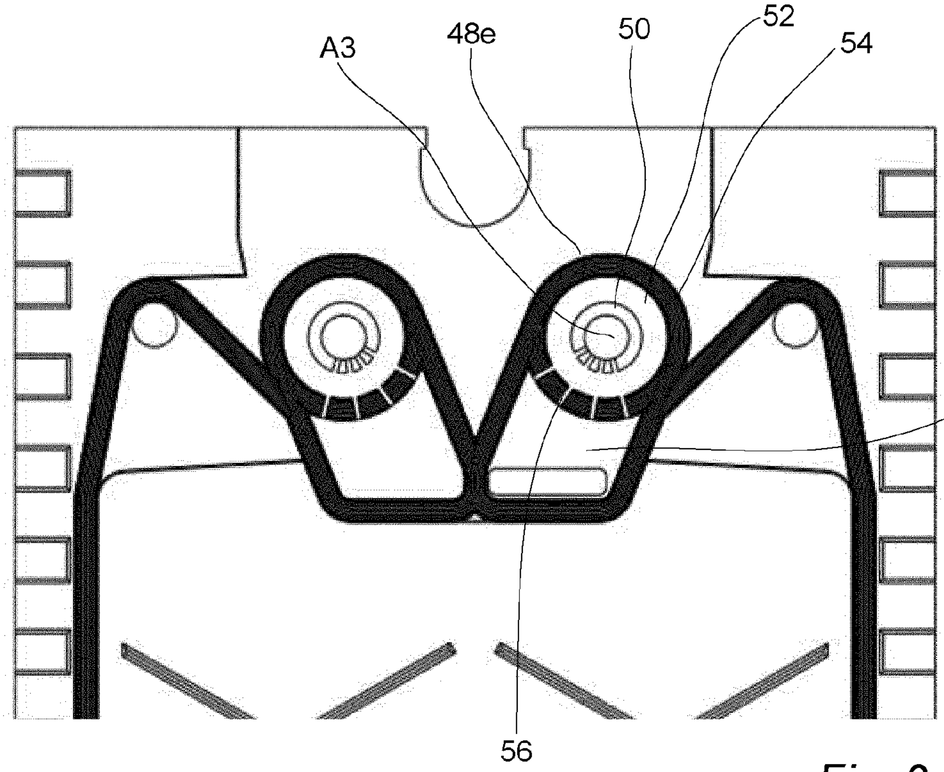
A3
48e
50
52
54
A2
56

Fig. 9

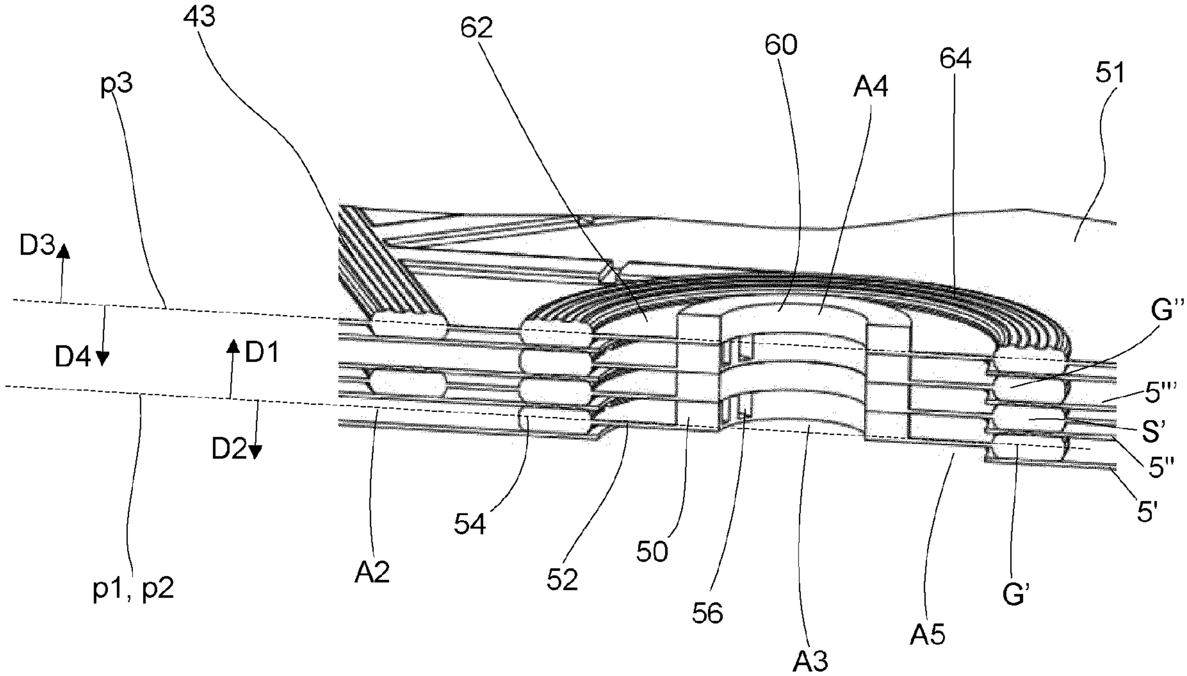
43
62
60
64
51
p3
A4
D3
G''
D4
D1
5'''
S'
D2
5''
5'
54
A2
52
50
56
A3
A5
G'
p1, p2

Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 22 21 5790

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Place of search	Date of completion of the search	Examiner
Munich	28 October 2023	Leu, Oana

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