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(54) **PLATE HEAT EXCHANGER**

PLATTENWÄRMETAUSCHER

ECHANGEUR THERMIQUE A PLAQUES

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Description

[0001] The present invention refers to a plate heat exchanger for at least two heat exchanging fluids which heat exchanger is permanently joined and comprises at least one core of plates with a plurality of inner heat exchanging plates, at least two outer heat exchanging plates and at least two end plates, the heat exchanging plates creating plate interspaces between each other and each one of the outer heat exchanging plates being situated between the inner heat exchanging plates on one hand and one of the end plates on the other.

Prior art

[0002] WO 88/09473 shows a permanently joined plate heat exchanger. Every heat exchanging plate in the core of plates shows four port sections. To make a smooth assembly of the core of plates possible two of these four port sections are mainly in one plane and two are mainly in another one. Thus a problem must arise in the ends of the core of plates when it comes to connecting this with planar end plates. A distance is created between an outer heat exchanging plate and an end plate around two of the port sections. The distance is overbridged with the aid of a spacer ring 20 situated in the joining area 12a and 12b respectively of the heat exchanging plate 2. The spacer ring 20 also serves as a sealing between the heat exchanging plate 2 and the end plate 4a. Such a solution for the sealing problem is expensive.

Summary of the invention

[0003] The purpose of the invention is to create a less expensive plate heat exchanger with in other respects comparable performance in comparison with the described construction. Thus the invention comprises a plate heat exchanger for at least two heat exchanging fluids which heat exchanger is permanently joined and contains at least one core of plates with a plurality of inner heat exchanging plates, at least two outer heat exchanging plates and at least two end plates. The heat exchanging plates create plate interspaces between each other and each one of the outer heat exchanging plates is situated between the inner heat exchanging plates on one hand and one of the end plates on the other hand.

[0004] Each one of the heat exchanging plates is equipped with one or several corrugations vertically extending within an area bounded by two at a distance from each other situated parallel first and second planes respectively, both mainly in parallel with all the heat exchanging plates as well as the end plates of the plate heat exchanger. The first plane is closer to a first end plate in one end of the heat exchanger than the second plane is, and the second plane is closer to a second end plate in the second end of the plate heat exchanger than

the first plane is.

[0005] Each one of the heat exchanging plates is further equipped with at least four port holes being parts of an inlet channel and an outlet channel through the core of plates for each one of the fluids. Each port hole is surrounded by a first sealing area situated close to the periphery of the port hole, each heat exchanging plate showing at least four such first sealing areas.

[0006] At least one of the end plates has a plurality of port holes each one communicating with one of the inlet channels or one of the outlet channels, and the inlet channels and the outlet channels for a first and a second fluid respectively are in fluid communication with a first and a second set of plate interspaces respectively.

[0007] At least all except one of the mentioned first sealing areas on a first outer heat exchanging plate are situated in the mentioned first plane and bear on and seal against the mentioned first end plate extending in this plane.

[0008] The characteristics in other respects of the present invention are clear from the following patent claims.

[0009] The plate heat exchanger will now be closer described in connection with forms of execution of the invention and with reference to the accompanying drawings.

List of drawings

[0010] Figure 1 shows, in a cross-section through two port channels, a part of a plate heat exchanger according to the prior art.

[0011] Figure 2 shows, in a cross-section through two port channels, a part of a plate heat exchanger according to the invention.

[0012] Figure 3 shows, in a front view, a part of an outer heat exchanging plate being a part of the plate heat exchanger according to figure 2.

[0013] Figure 4 shows, in a cross-section through two port channels, a plate heat exchanger according to an alternate mode of execution of the invention.

Description of modes of execution

[0014] From figure 1 a part of a plate heat exchanger according to the prior art is evident, the heat exchanger comprising a planar end plate 1, an outer heat exchanging plate 2a and two inner heat exchanging plates 2b and 2c where the plates 2a and 2c are identical and thus of one type and the plate 2b of another one. Usually both more heat exchanging plates and one further end plate are used. From the figure are furthermore two channels 3, 4 for two heat exchanging fluids evident, whereby it is considered understood that further two channels are needed for these fluids.

[0015] Each one of the heat exchanging plates is pressed such that the areas closest around the port holes respectively are in different planes. Thus for the

outer heat transferring plate 2a, the area closest around the port hole being a part of the channel 3 is in a lower plane and the area closest around the port hole being a part of the channel 4 is in an upper plane. This leads to problems when connecting the core of plates to a planar end plate 1. According to the prior art, a sealing washer/ spacer ring 5 is used to overbridge the distance between the outer heat exchanging plate and the end plate within the channel 3.

[0016] From figure 2 a part of the plate heat exchanger according to the invention is evident, the heat exchanger comprising a planar end plate 11, an outer heat exchanging plate 12a (see also figure 3) and two inner heat exchanging plates 12b and 12c where all the plates may be of different types. Usually also here more heat exchanging plates and a further end plate are used. Two channels 13, 14 for two heat exchanging fluids are present in the figure, but further two channels through the core of plates are needed for these fluids.

[0017] The outer heat exchanging plate 12a shows differences in comparison with the inner heat exchanging plate 12c. For at least three of and preferably all of the port holes around and nearby the port holes situated areas for bearing and sealing between the outer heat exchanging plate 12a and the end plate 11 are in the same plane. This can be made possible without the need at the pressing of the heat exchanging plates for treating the plates aimed at service in the position 12a on one hand and the position 12c on the other hand differently. The plates are plainly formed with two concentric sealing areas in different planes around at least one and preferably every critical port hole, i.e. such port holes where the preferences regarding the plane of the sealing area vary with the use of the plate. The port holes are then punched or cut up in the plates in an subsequent operation. (In fact it is possible to think of the order of the operative steps being the reversed, i.e. punching or cutting precedes the pressing of the plate.)

[0018] By varying the size of the cut up holes the position for the plane of the sealing areas is also varied. If one for instance cuts a hole with the diameter C in figure 2, one gets a port hole for the channel 13 in a lower plane and the plate becomes suitable for use in the position 12c (or in the position 12a together with a sealing washer or equivalent). However, if one cuts a smaller hole - of the diameter A - one gets a port hole for the channel 13 in an upper plane, which plane thus directly connects to the end plate 11 without the need for using any sealing washer or equivalent and the plate becomes directly suitable for use in the position 12a.

[0019] From the figure 4 is evident how the situation appears in a case with two end plates 21 and 22, two outer heat exchanging plates 22a and 22d as well as two inner heat exchanging plates 22b and 22c. The number of inner heat exchanging plates is usually greater. The outer heat exchanging plate 22a and the inner heat exchanging plate 22c are identical after the pressing - the difference is created by the cutting of the port

hole for the channel 23 in the respective plate to different sizes. The inner heat exchanging plate 22b and the outer heat exchanging plate 22d are also identical after the pressing - the difference is also in this case created by the cutting of the port hole for the channel 23 in the respective plate to different sizes. Since analogue conditions are present in the other end of the core of plates, all the sealing areas around the port holes in the outer heat exchanging plates conform well to the respective end plate. (Also in this connection the operative moments may be executed in the reversed order.)

[0020] If desired, a heat exchanging plate of the type 12c or 22c with existing port holes may afterwards be converted to a heat exchanging plate of the type 12a or 22a (not demanding any sealing washer or equivalent). In a comparable way a heat exchanging plate of the type 22b with existing port holes may afterwards be converted to a heat exchanging plate of the type 22d. The conversion is created by simply edge-raising the port hole for the channel 13, 23 to the same height as the port hole for the channel 14, 24 so that the sealing areas consequently will be situated in the same plane. The edge-raising may be done in any known proper way, for example in a transfer tool or the like.

[0021] The port holes in an outer heat exchanging plate may be of different sizes. The most common situation is probably using two heat exchanging fluids and four channels through the core of plates, whereby the port holes in an outer heat exchanging plate may be pairwise of the same size. In this case two of the port holes in every outer heat exchanging plate may still, after the joining together of the plate heat exchanger, each one be surrounded by two concentric sealing areas where consequently one of them is circumferentially situated outside the other one.

[0022] Each one of all the heat exchanging plates, irrespective of the type of execution, may be executed with a flange-like edge section around the whole circumference of the plate, which edge section makes an angle with the main plane of extension of the plate and which bears on the corresponding edge sections on adjacent plates in the core of plates. On each other bearing surfaces in the core of plates, e.g. areas of the newly mentioned flange-like edge sections, may be fluid tightly joined for example by brazing.

[0023] The plates are often created of a thin steel plate, but also other materials may be used such as for example titanium.

[0024] The invention is not restricted to the forms of execution shown here but may be varied in accordance with the following patent claims.

Claims

1. A plate heat exchanger for at least two heat exchanging fluids which heat exchanger is permanently joined and comprises at least one core of

plates with a plurality of inner heat exchanging plates (12b, 12c, 22b, 22c), at least two outer heat exchanging plates (12a, 22a, 22d) and at least two end plates (11, 21, 22), the heat exchanging plates (12a, 12b, 12c, 22a, 22b, 22c, 22d) creating plate interspaces between each other and each one of the outer heat exchanging plates (12a, 22a, 22d) being situated between the inner heat exchanging plates (12b, 12c, 22b, 22c) on one hand and one of the end plates (11, 21, 22) on the other hand and with which

each one of the heat exchanging plates (12a, 12b, 12c, 22a, 22b, 22c, 22d) is equipped with one or several corrugations vertically extending within an area bounded by two at a distance from each other situated parallel first and second planes respectively and which both are mainly in parallel with all the heat exchanging plates (12a, 12b, 12c, 22a, 22b, 22c, 22d) as well as the end plates (11, 21, 22) of the plate heat exchanger, the first plane being closer than the second plane to a first end plate (11, 21) in one end of the heat exchanger and the second plane being closer than the first plane to a second end plate (22) in the second end of the heat exchanger,

each one of the heat exchanging plates (12a, 12b, 12c, 22a, 22b, 22c, 22d) is equipped with at least four port holes being parts of an inlet channel (13, 14, 23, 24) and an outlet channel (13, 14, 23, 24) through the core of plates for each one of the fluids, each port hole being surrounded by a first sealing area situated near the periphery of the port hole, each heat exchanging plate (12a, 12b, 12c, 22a, 22b, 22c, 22d) showing at least four such first sealing areas,

at least one of the end plates (11, 21, 22) has a plurality of port holes each communicating with one of the inlet channels (13, 14, 23, 24) or one of the outlet channels (13, 14, 23, 24) and the inlet channels (13, 14, 23, 24) and the outlet channels (13, 14, 23, 24) for a first and a second fluid respectively are in fluid communication with a first and a second set of plate interspaces respectively,

characterized in that

at least all except one of the mentioned first sealing areas on a first outer heat exchanging plate (12a, 22a) are situated in the mentioned first plane and bear on and seal against the mentioned first end plate (11, 21) extending in this plane.

2. A plate heat exchanger according to claim 1 at which the port holes in the mentioned first outer heat exchanging plate (12a, 22a) are of different sizes.
3. A plate heat exchanger according to claim 1 at which the port holes in the mentioned first outer heat exchanging plate (12a, 22a) are pairwise of the

same size.

4. A plate heat exchanger according to any of the preceding claims at which at least one of the port holes in the mentioned first outer heat exchanging plate (12a, 22a) is surrounded by a second sealing area circumferentially situated outside the first sealing area, the mentioned first outer heat exchanging plate (12a, 22a) showing at least one such second sealing area.
5. A plate heat exchanger according to claim 4 at which the mentioned second sealing area is situated in the mentioned second plane.
6. A plate heat exchanger according to any of the preceding claims at which at least all except one of the mentioned first sealing areas on a second outer heat exchanging plate (22d) are situated in the mentioned second plane and bear on and seal against the mentioned second end plate (22) extending in this plane.
7. A plate heat exchanger according to claim 6 at which the port holes in the mentioned second outer heat exchanging plate (22d) are of different sizes.
8. A plate heat exchanger according to claim 6 at which the port holes in the mentioned second outer heat exchanging plate (22d) are pairwise of the same size.
9. A plate heat exchanger according to any of the claims 6-8 at which at least one of the port holes in the mentioned second outer heat exchanging plate (22d) is surrounded by a second sealing area circumferentially situated outside the first sealing area, the mentioned second outer heat exchanging plate (22d) showing at least one such second sealing area.
10. A plate heat exchanger according to claim 9 at which the mentioned second sealing area is situated in the mentioned first plane.

Patentansprüche

1. Plattenwärmetauscher für mindestens zwei Wärmetauschfluide, wobei der Wärmetauscher dauerhaft verbunden ist und mindestens einen Kern von Platten mit einer Mehrzahl von inneren Wärmetauschplatten (12b, 12c, 22b, 22c) umfaßt sowie mindestens zwei äußere Wärmetauschplatten (12a, 22a, 22d) und mindestens zwei Endplatten (11, 21, 22), wobei die Wärmetauschplatten (12a, 12b, 12c, 22a, 22b, 22c, 22d) zwischen einander Plattenzwischenräume erzeugen und wobei jede

der äußeren Wärmetauschplatten (12a, 22a, 22d) zwischen den inneren Wärmetauschplatten (12a, 12c, 22b, 22c) auf der einen Seite und einer der Endplatten (11, 21, 22) auf der anderen Seite angeordnet ist und wobei

jede der Wärmetauschplatten (12a, 12b, 12c, 22a, 22b, 22c, 22d) mit einer oder mehreren Rippen versehen ist, die sich vertikal innerhalb eines Bereiches erstrecken, der durch zwei voneinander beabstandete und parallel angeordnete erste bzw. zweite Ebenen begrenzt wird, die beide vorwiegend parallel zu allen Wärmetauschplatten (12a, 12b, 12c, 22a, 22b, 22c, 22d) und den Endplatten (11, 21, 22) des Plattenwärmetauschers verlaufen, wobei die erste Ebene näher an der ersten Endplatte (11, 21) an einem Ende des Wärmetauschers liegt als die zweite Ebene und die zweite Ebene näher an einer zweiten Endplatte (22) am zweiten Ende des Wärmetauschers als die erste Ebene, wobei jede der Wärmetauschplatten (12a, 12b, 12c, 22a, 22b, 22c, 22d) mit mindestens vier Durchgangslöchern versehen ist, die Teile eines Einlaßkanals (13, 14, 23, 24) und eines Auslaßkanals (13, 14, 23, 24) durch den Kern der Platten für jedes der Fluide sind, wobei jedes Durchgangsloch von einem ersten Abdichtbereich umgeben ist, der in der Nähe des Randes des Durchgangsloches angeordnet ist, wobei jede Wärmetauschplatte (12a, 12b, 12c, 22a, 22b, 22c, 22d) mindestens vier solcher ersten Abdichtbereiche aufweist, wobei mindestens eine der Endplatten (11, 21, 22) eine Mehrzahl von Durchgangslöchern aufweist, die jeweils mit einem der Einlaßkanäle (13, 14, 23, 24) oder einem der Auslaßkanäle (13, 14, 23, 24) verbunden sind, und wobei die Einlaßkanäle (13, 14, 23, 24) und die Auslaßkanäle (13, 14, 23, 24) für ein erstes bzw. zweites Fluidum in Strömungsverbindung mit einem ersten bzw. einem zweiten Satz von Plattenzwischenräumen stehen,

dadurch gekennzeichnet, daß

mindestens alle bis auf einen der erwähnten ersten Abdichtbereiche an einer ersten äußeren Wärmetauschplatte (12a, 22a) in der erwähnten ersten Ebene angeordnet sind und auf der erwähnten ersten Endplatte (11, 21), die sich in dieser Ebene erstreckt, lagern und dagegen abdichten.

2. Plattenwärmetauscher nach Anspruch 1, wobei die Durchgangslöcher in der erwähnten ersten äußeren Wärmetauschplatte (12a, 22a) unterschiedliche Größen haben.
3. Plattenwärmetauscher nach Anspruch 1, wobei die Durchgangslöcher in der erwähnten ersten äußeren Wärmetauschplatte (12a, 22a) paarweise dieselbe Größe haben.

4. Plattenwärmetauscher nach einem der vorangehenden Ansprüche, wobei mindestens eines der Durchgangslöcher in der erwähnten ersten äußeren Wärmetauschplatte (12a, 22a) von einem zweiten Abdichtbereich umgeben ist, der sich umfangsmäßig außerhalb des ersten Abdichtbereiches befindet, wobei die erwähnte erste äußere Wärmetauschplatte (12a, 22a) mindestens einen solchen zweiten Abdichtbereich aufweist.

5. Plattenwärmetauscher nach Anspruch 4, wobei der erwähnte zweite Abdichtbereich in der erwähnten zweiten Ebene angeordnet ist.

6. Plattenwärmetauscher nach einem der vorangehenden Ansprüche, wobei mindestens alle bis auf einen der erwähnten ersten Abdichtbereiche an einer zweiten äußeren Wärmetauschplatte (22d) in der erwähnten zweiten Ebene angeordnet sind und gegen die erwähnte zweite Endplatte (22), die sich in dieser Ebene erstreckt, lagern und gegen sie abdichten.

7. Plattenwärmetauscher nach Anspruch 6, wobei die Durchgangslöcher in der erwähnten zweiten äußeren Wärmetauschplatte (22d) unterschiedliche Größen haben.

8. Plattenwärmetauscher nach Anspruch 6, wobei die Durchgangslöcher in der erwähnten zweiten äußeren Wärmeübertragungsplatte (22d) paarweise die gleiche Größe haben.

9. Plattenwärmetauscher nach einem der Ansprüche 6-8, wobei mindestens eines der Durchgangslöcher in der erwähnten zweiten äußeren Wärmetauschplatte (22d) von einem zweiten Abdichtbereich umgeben ist, der sich umfangsmäßig außerhalb des ersten Abdichtbereiches befindet, wobei die erwähnte zweite äußere Wärmetauschplatte (22d) mindestens einen solchen zweiten Abdichtbereich aufweist.

10. Plattenwärmetauscher nach Anspruch 9, wobei der erwähnte zweite Abdichtbereich in der erwähnten ersten Ebene angeordnet ist.

Revendications

1. Echangeur thermique à plaques pour au moins deux fluides de transfert de chaleur, lequel échangeur thermique est couplé en permanence et comprend au moins un noyau de plaques incluant une pluralité de plaques intérieures d'échange thermique (12b, 12c, 22b, 22c), au moins deux plaques extérieures d'échange thermique (12a, 22a, 22d) et au moins deux plaques de bout (11, 21, 22), les pla-

ques d'échange thermique (12a, 12b, 12c, 22a, 22b, 22c, 22d) créant des intervalles entre les plaques et chacune des plaques extérieures d'échange thermique (12a, 22a, 22d) étant située entre d'une part les plaques intérieures d'échange thermique (12b, 12c, 22b, 22c) et d'autre part l'une des plaques de bout (11, 21, 22), dans lequel chacune des plaques d'échange thermique (12a, 12b, 12c, 22a, 22b, 22c, 22d) est munie d'une ou plusieurs cannelures s'étendant verticalement dans une zone délimitée par deux premier et deuxième plans parallèles situés à une certaine distance l'un de l'autre et qui sont essentiellement parallèles à la fois à toutes les plaques d'échange thermique (12a, 12b, 12c, 22a, 22b, 22c, 22d) et aux plaques de bout (11, 21, 22) de l'échangeur thermique à plaques, le premier plan étant plus proche que le deuxième plan d'une première plaque de bout (11, 21) à une extrémité de l'échangeur thermique, et le deuxième plan étant plus proche que le premier plan d'une deuxième plaque de bout (22) à la deuxième extrémité de l'échangeur thermique, chacune des plaques d'échange thermique (12a, 12b, 12c, 22a, 22b, 22c, 22d) est munie d'au moins quatre ouvertures faisant partie d'un canal d'entrée (13, 14, 23, 24) et d'un canal de sortie (13, 14, 23, 24) traversant le noyau de plaques pour chacun des fluides, chaque ouverture étant entourée d'une première zone d'étanchéité située près de la périphérie de l'ouverture, chaque plaque d'échange thermique (12a, 12b, 12c, 22a, 22b, 22c, 22d) comportant au moins quatre premières zones d'étanchéité de ce type, au moins l'une des plaques de bout (11, 21, 22) comporte une pluralité d'ouvertures, chacune communiquant avec l'un des canaux d'entrée (13, 14, 23; 24) ou l'un des canaux de sortie (13, 14, 23, 24), et les canaux d'entrée (13, 14, 23, 24) et les canaux de sortie (13, 14, 23, 24), pour respectivement un premier fluide et un deuxième fluide, permettent respectivement le passage du fluide vers un premier et un deuxième ensembles d'intervalles entre les plaques,

caractérisé en ce que

au moins toutes les premières zones d'étanchéité mentionnées, sauf une, sur une première plaque extérieure d'échange thermique (12a, 22a) sont situées dans le premier plan indiqué et sont en contact étanche avec la première plaque de bout (11, 21) mentionnée s'étendant dans ce plan.

2. Echangeur thermique à plaques selon la revendication 1, dans lequel les ouvertures dans la première plaque extérieure d'échange thermique (12a, 22a) mentionnée sont de tailles différentes.
3. Echangeur thermique à plaques selon la revendication 1, dans lequel les ouvertures dans la première plaque extérieure d'échange thermique (12a, 22a) mentionnée sont de la même taille par paire.

cation 1, dans lequel les ouvertures dans la première plaque extérieure d'échange thermique (12a, 22a) mentionnée sont de la même taille par paire.

4. Echangeur thermique à plaques selon l'une quelconque des revendications précédentes, dans lequel au moins une des ouvertures dans la première plaque extérieure d'échange thermique (12a, 22a) mentionnée est entourée d'une deuxième zone d'étanchéité circonférentiellement située à l'extérieur de la première zone d'étanchéité, la première plaque extérieure d'échange thermique (12a, 22a) mentionnée présentant au moins une telle deuxième zone d'étanchéité.
5. Echangeur thermique à plaques selon la revendication 4, dans lequel la deuxième zone d'étanchéité mentionnée se trouve dans le deuxième plan indiqué.
6. Echangeur thermique à plaques selon l'une quelconque des revendications précédentes, dans lequel au moins toutes les premières zones d'étanchéité mentionnées, sauf une, sur une deuxième plaque extérieure d'échange thermique (22d) sont situées dans le deuxième plan indiqué et sont en contact étanche avec la deuxième plaque de bout (22) mentionnée s'étendant dans ce plan.
7. Echangeur thermique à plaques selon la revendication 6, dans lequel les ouvertures dans la deuxième plaque extérieure d'échange thermique (22d) mentionnée sont de tailles différentes.
8. Echangeur thermique à plaques selon la revendication 6, dans lequel les ouvertures dans la deuxième plaque extérieure d'échange thermique (22d) mentionnée sont de la même taille par paire.
9. Echangeur thermique à plaques selon l'une quelconque des revendications 6 à 8, dans lequel au moins une des ouvertures dans la deuxième plaque extérieure d'échange thermique (22d) mentionnée est entourée d'une deuxième zone d'étanchéité circonférentiellement située à l'extérieur de la première zone d'étanchéité, la deuxième plaque extérieure d'échange thermique (22d) mentionnée présentant au moins une telle deuxième zone d'étanchéité.
10. Echangeur thermique à plaques selon la revendication 9, dans lequel la deuxième zone d'étanchéité mentionnée se trouve dans le premier plan indiqué.

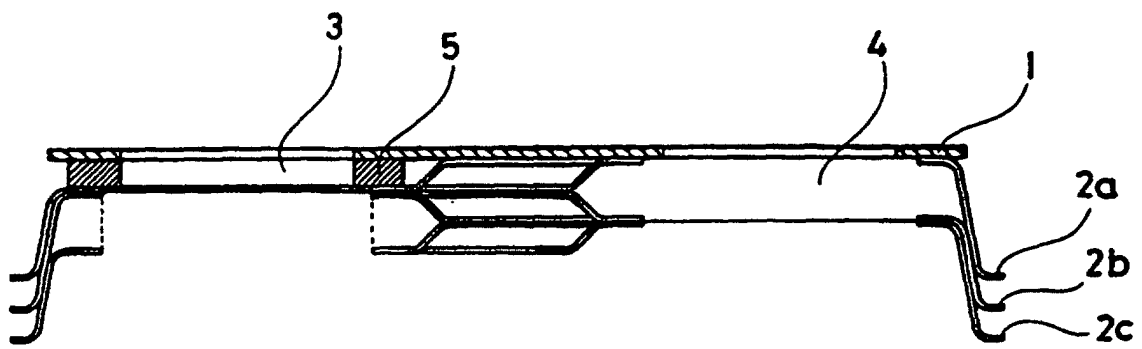


Fig.1

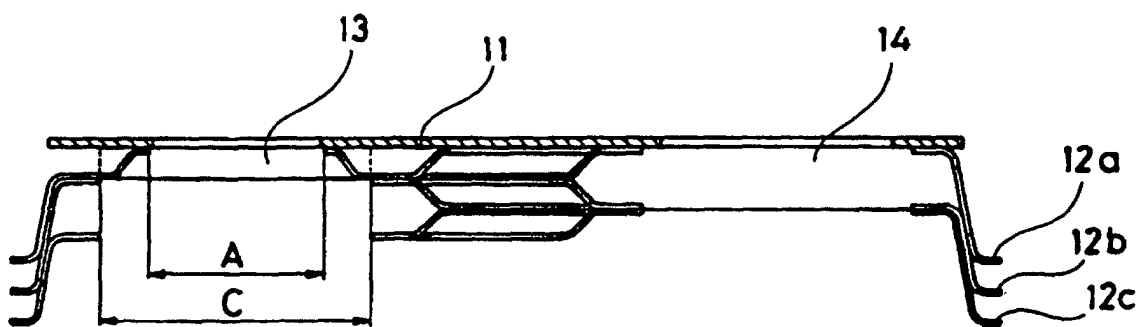


Fig.2

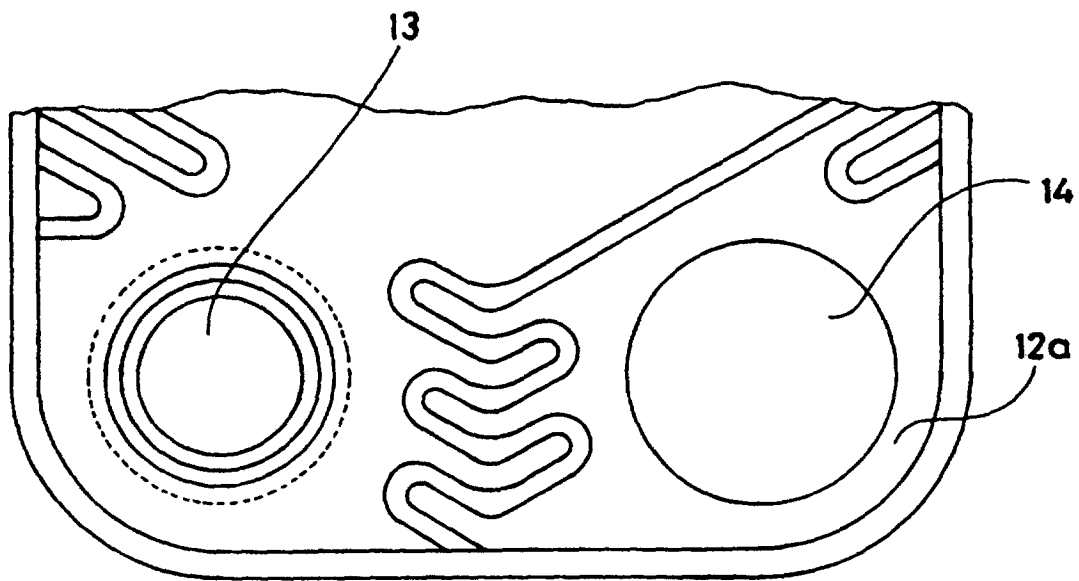


Fig. 3

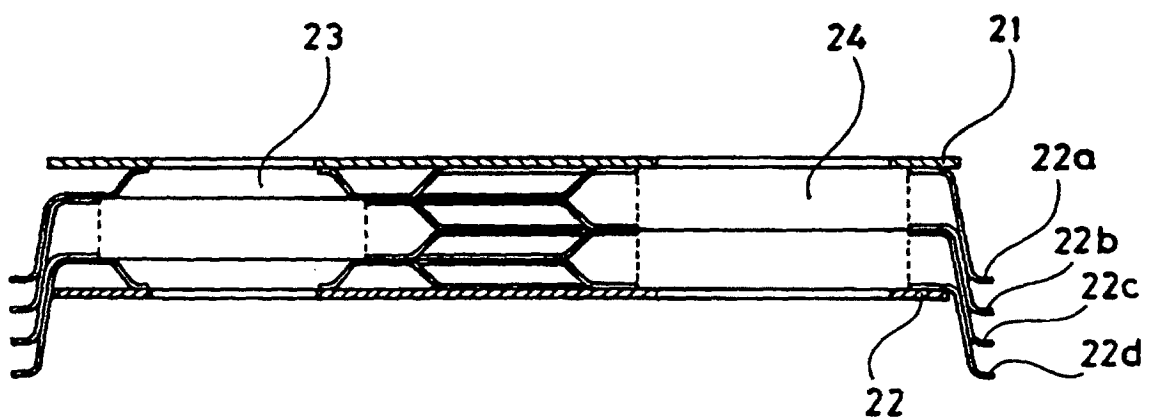


Fig. 4