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(54) **FRAME ARRANGEMENT FOR A PLATE HEAT EXCHANGER**

RAHMENANORDNUNG FÜR PLATTENWÄRMETAUSCHER

AGENCEMENT DE CADRE DESTINE A UN ECHANGEUR DE CHALEUR A PLAQUES

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GB-A- 755 265 **SE-B- 309 785**
SE-C- 171 499

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Description

[0001] The present invention refers to a plate heat exchanger comprising a frame plate, a pressure plate and a core of heat transferring plates placed between the frame plate and the pressure plate. A plurality of threaded tie bars extend between the frame plate and the pressure plate and are arranged to hold with the aid of nuts or the like these plates at a desired distance from each other in order to hold the core of heat transferring plates together.

Prior art

[0002] SE,C,171 499 shows a plate heat exchanger with a frame plate, a pressure plate, a core of heat transferring plates, two tie bars as well as a special supporting device 5. The frame plate 1 and the supporting device 5 are both provided with feet 3. Through influence from among other things the yokes 27 a pressure is created on the pressure plate and the core of plates is kept together.

[0003] The construction shows the disadvantage that both the supporting device 5 and the pressure plate 80 with necessity are created in the form of a very strong construction. Further on the auxiliary carrying bar 8 to support plates in connection with mounting and demounting of the heat exchanger constitutes an unnecessary complication.

Summary of the invention

[0004] The purpose of the present invention is to create a construction which is cheaper and less complicated to manufacture than the one described above. The advantages are attained by using the pressure plate as a carrying device for the plate heat exchanger during normal operation of the heat exchanger. The supporting device may in this way be much thinner executed with less of a material consumption.

[0005] The plate heat exchanger according to the invention thus comprises a frame plate, a pressure plate and a core of heat transferring plates placed between the frame plate and the pressure plate. A plurality of threaded tie bars extend between the frame plate and the pressure plate and are arranged to hold with the aid of nuts or the like these plates at a desired distance from each other in order to hold the core of heat transferring plates together.

[0006] At least one of the threaded tie bars constitutes a guiding element for the pressure plate and the heat transferring plates, which guiding element extends through a hole in the pressure plate and further on to an area situated at a substantial distance from this plate. The heat transferring plates have holes or notches situated in line with each other through which holes or notches the guiding element extends.

[0007] The guiding element is surrounded by a pro-

tecting sleeve extending from the frame plate to the pressure plate and protecting the threads of the guiding element from engagement with the heat transferring plates. The guiding element is surrounded by a centering sleeve in the area for the pressure plate, which sleeve is movable along the guiding element and is situated in a releasable engagement with the pressure plate in such a way that it centres the guiding element in the hole in the pressure plate. The guiding element is arranged to be connected to a supporting device in the mentioned area situated at a considerable distance from the pressure plate. The supporting device is arranged to carry together with the frame plate and the guiding element both the core of heat transferring plates and the pressure plate when the pressure plate is to be released from the core of heat transferring plates and be moved together with at least some of these along the guiding element.

[0008] The guiding element may, at least when it is connected to the mentioned supporting device, be surrounded by a releasable further sleeve extending from the pressure plate to the supporting device in order to protect the threads of the guiding element from engagement with the pressure plate and the heat transferring plates.

[0009] The characterizing matter for the present invention is clear from the following patent claims. Some forms of execution of the invention will be further described with reference to the accompanying drawings.

List of drawings

[0010] Figure 1 shows in front view a with angle irons as feet equipped end plate for a plate heat exchanger according to the invention.

[0011] Figure 2 shows in front view a supporting device which is used as an aid in connection with mounting, opening and demounting of a plate heat exchanger according to the invention.

[0012] Figure 3 shows in side view a frame which is tied together for a plate heat exchanger according to the invention, the frame comprising end plates in the form of a frame plate and a pressure plate according to figure 1 and a supporting device according to figure 2.

[0013] Figure 4 shows in side view and partly in cross-section the frame in figure 3 in an open service mode.

[0014] Figure 5 shows schematically in side view and partly in cross-section a threaded tie bar through the end plates in a heat exchanger according to the invention.

[0015] Figure 6 shows schematically in front view a heat transferring plate in the heat exchanger according to the invention.

Description of modes of execution

[0016] In the plate heat exchanger two identically alike end plates 1 are used, see figure 1, where the one is used as a frame plate 1a and the other one as a pres-

sure plate 1b. Each end plate 1 is, in the mounted heat exchanger, equipped with two angle irons 2 serving as feet. Further a certain number of heat transferring plates are present in the plate heat exchanger, see figure 6, the heat transferring plates each one being equipped with two edge notches 2a.

[0017] The construction of the mounted plate heat exchanger - i.e. the operational mode of the plate heat exchanger - will now be further described in connection with figure 3. Each one of two tie bars 3 extends through a hole 4 in each one of the end plates 1, i.e. one hole 4 in the frame plate 1a and one hole 4 in the pressure plate 1b, as well as through an edge notch 2a in each one of the heat transferring plates (not shown) situated between the frame plate 1a and the pressure plate 1b. Every tie bar 3 is surrounded by a protecting sleeve 5a. The sleeve 5a has, in a preferred mode of execution, a length that is slightly less than - and more precisely one percent less than - the length corresponding to the total thickness of all the heat transferring plates in the core of plates, which thickness thus does not include any part of the thickness of the end plates 1. Each tie bar 3 cooperates with a nut 6 and centering sleeves 7 for tying together of the core of plates, see figure 5. Further tie bars (not shown) are present in a usual way between the frame plate 1a and the pressure plate 1b and are placed in notches 8 in the edges of the frame plate 1a and the pressure plate 1b.

[0018] From figure 3 is further evident some further components which, when the heat exchanger is tied together, do not have a certain function to fill but may be stored on the free parts of the tie bars 3 in order to be at hand at a later opportunity when it is desired to open or demount the plate heat exchanger. The meant components are two further sleeves 5b, a supporting device 9 and two further nuts 10.

[0019] The further sleeves 5b show the same outer and inner dimensions as the sleeves 5a with the exception of the length which for each further sleeve 5b cannot be larger than the length of the free part of each tie bar 3, which free part thus is occupied neither by the sleeve 5a, the nut 6 nor any other possible detail. The supporting device 9 is equipped with holes aimed for the tie bars 3 but not for the sleeves 5b. The sleeves 5b and the supporting device 9 are fixed upon the tie bars 3 with the aid of the nuts 10 which may be much thinner than the nuts 6.

[0020] When it is desired to open the plate heat exchanger for for example cleaning this is done in the following manner, whereby the mode according to figure 3 gradually is transferred to the mode according to figure 4:

[0021] The nuts 10 are screwed off and the supporting device 9 and the sleeves 5b are taken away. The nuts 6 are screwed off and the sleeves 7 at the pressure plate 1 b are taken away - the core of plates is still kept together by the not shown further tie bars. The sleeves 5b are once again threaded on the free parts of the tie bars

3 and pushed to abutment against the sleeves 5a. The supporting device 9 is once again mounted, this time with a special foot end 9a downwards. The thicker nuts 6 are brought upon the tie bars 3 and tightened. The further tie bars which are not shown are demounted. Also the as feet serving angle irons 2 at the pressure plate 1b should be demounted, which pressure plate 1b may thereafter be moved along the tie bars 3/sleeves 5 since the sleeves 5b freely may pass through the hole 4 in the pressure plate 1b. Hereby an open mode of service is attained when the heat transferring plates situated between the end plates 1 may be separated for cleaning and one or several plates may be taken out and eventually new ones put in without the need for demounting of the rest of plates. Tying together of the heat exchanger is executed in an analogous way.

[0022] The supporting device 9 is a bar, a plate iron or the like with a sufficient length to be able to hold the tie bars 3 at a correct distance in relation to each other and at the same time in the open mode of service for the plate heat exchanger to be able to serve as a supporting device for the whole plate heat exchanger together with the frame plate 1a and its feet 2. As evident from the figures 2, 3 and 4 the supporting device 9 is designed in such a way that it may be turned in two different ways in connection with the mounting upon the tie bars 3, whereby the one way leads to a mere storing upon the plate heat exchanger and the other way leads to the realization of the above described supporting function for the plate heat exchanger.

[0023] Due to the described specific design of the plate heat exchanger in general and the pressure plate 1b, the feet 2, the sleeves 5b, the supporting device 9 and the nuts 6 especially, the pressure plate 1b may be utilized as a carrying device during normal operation of the plate heat exchanger while the supporting device 9 on the contrary functions as such for the whole plate heat exchanger - together with the frame plate 1a with the feet 2 - when mounting, opening for cleaning or demounting the plate heat exchanger. The frame plate 1a and the pressure plate 1b may be made identically alike which makes the manufacturing cheaper and due to the fact that the bolts 3 function both as carrying and guiding elements as well as as tie bars the dimensions of the frame plate 1a and the pressure plate 1b may be brought down in comparison with constructions which use separate bolts and/or beams for the above mentioned functions. Also the dimensions for the supporting device 9 may be brought down in comparison with constructions according to the prior art.

[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 comprising a frame plate

(1a), a pressure plate (1b) and a core of heat transferring plates placed between the frame plate (1a) and the pressure plate (1b), whereby a plurality of threaded tie bars (3) extend between the frame plate (1a) and the pressure plate (1b) and are arranged, with the aid of nuts (6) or the like, to hold these plates at a desired distance from each other in order to hold the core of heat transferring plates together,

characterized in

- **that** at least one of the threaded tie bars (3) constitutes a guiding element (3) for the pressure plate (1b) and the heat transferring plates, which guiding element (3) extends through a hole (4) in the pressure plate (1b) and further on to an area situated at a considerable distance from this,
- **that** the heat transferring plates have holes or notches (2a) in line with each other, through which the guiding element (3) extends,
- **that** the guiding element (3) is surrounded by a protecting sleeve (5a), extending from the frame plate (1a) to the pressure plate (1b) and protecting the threads of the guiding element (3) from engagement with the heat transferring plates,
- **that** the guiding element (3) in the area for the pressure plate (1b) is surrounded by a centering sleeve (7) which is movable along the guiding element (3) and is in releasable engagement with the pressure plate (1b) in such a way that it centers the guiding element (3) in the hole (4) in the pressure plate (1b) and
- **that** the guiding element (3) is arranged to be in connection with a supporting device (9) in the mentioned area situated at a considerable distance from the pressure plate (1b), which supporting device (9) is arranged to support together with the frame plate (1a) and the guiding element (3) both the core of heat transferring plates and the pressure plate (1b) when the pressure plate (1b) is to be released from the core of heat transferring plates and together with at least some of these be transferred along the guiding element (3).

2. A plate heat exchanger according to claim 1, at which the guiding element (3), at least when it is connected to the mentioned supporting device (9), is surrounded by a releasable further sleeve (5b) extending from the pressure plate (1b) to the supporting device (9) in order to protect the threads of the guiding element (3) from engagement with the

pressure plate (1b) and the heat transferring plates.

3. A plate heat exchanger according to claim 1 or 2, at which at least two of the threaded tie bars (3) constitute guiding elements (3) and are provided with sleeves (5a, 5b) of the mentioned kind, while each one of the remaining threaded tie bars extend between the frame plate (1a) and the pressure plate (1b) at a certain distance from the core of heat transferring plates.
4. A plate heat exchanger according to claim 3, at which both the guiding elements (3) are arranged to be connected with the mentioned supporting device (9) so that they are kept by this at a certain distance from each other.
5. A plate heat exchanger according to claim 4, at which one of the guiding elements (3) is situated substantially straight above the other one and the supporting device (9) consists of a bar (9) or the like releasably connected to the guiding element (3), whereby the lower end (9a) of the bar (9) is arranged, together with the frame plate (1a), to support the plate heat exchanger.
6. A plate heat exchanger according to claim 5, at which the mentioned bar (9) or the like is arranged for connection with the two guiding elements (3) in two different ways, of which one way makes support of the plate heat exchanger in the mentioned way possible, while the other one results in the supporting device (9) hanging in the guiding elements (3) when these are carried by the frame plate (1a) and the pressure plate (1b).
7. A plate heat exchanger according to any one of the preceding claims, at which the pressure plate (1b) is provided with a foot device (2) which is vertically adjustable or releasable.
8. A plate heat exchanger according to claim 7, at which the frame plate (1a) and the pressure plate (1b) are substantially identically designed and have releasable foot devices (2) of the same kind.
9. A plate heat exchanger according to claim 1, at which the centering sleeve (7) extends into the hole (4) of the pressure plate (1b) and has an annular flange arranged to abut against the pressure plate (1b) on the side on this which is turned away from the heat transferring plates.
10. A plate heat exchanger according to any one of claims 2-9, at which the mentioned protecting sleeve (5a) and the mentioned releasable further sleeve (5b) have substantially the same section, so that the later one, after the centering sleeve (7) has

been taken away, may be leaded to axially abutment against the first one via the hole (4) in the pressure plate (1b) and with this one create a substantially even guiding area for the pressure plate (1b) and the heat transferring plates.

Patentansprüche

1. Plattenwärmetauscher, umfassend eine Rahmenplatte (1a), eine Druckplatte (1b) und einen Kern von Wärmeübertragungsplatten, die zwischen der Rahmenplatte (1a) und der Druckplatte (1b) angeordnet sind, wobei sich eine Mehrzahl von mit Gewinde versehenen Verbindungsstangen zwischen der Rahmenplatte (1a) und der Druckplatte (1b) erstreckt und mit Hilfe von Muttern (6) oder ähnlichem so angeordnet ist, um diese Platten in einem gewünschten Abstand voneinander zu halten, damit der Kern der Wärmeübertragungsplatten gehalten wird,

dadurch gekennzeichnet,

- **daß** mindestens eine der mit Gewinde versehenen Verbindungsstangen (2) ein Führungselement (3) für die Druckplatte (1b) und die Wärmeübertragungsplatten bildet, wobei sich das Führungselement (3) durch ein Loch (4) in der Druckplatte (1b) und weiter zu einem Bereich hin erstreckt, der einen wesentlichen Abstand davon hat,
- **daß** die Wärmeübertragungsplatten Löcher oder Kerben (2a) haben, die miteinander ausgerichtet sind und durch die sich das Führungselement (3) erstreckt,
- **daß** das Führungselement (3) von einer Schutzhülse (5a) umgeben ist, die sich von der Rahmenplatte (1a) zur Druckplatte (1b) erstreckt und die Gewinde des Führungselementes (3) vor einer Berührung mit den Wärmeübertragungsplatten schützt,
- **daß** das Führungselement (3) im Bereich für die Druckplatte (1b) von einer Zentrierhülse (7) umgeben ist, die entlang des Führungselementes beweglich ist und auf eine solche Weise in einer lösbaren Verbindung mit der Druckplatte (1b) steht, daß sie das Führungselement (3) im Loch (4) in der Druckplatte (1b) zentriert, und
- **daß** das Führungselement (3) so angeordnet ist, daß es mit einer Haltevorrichtung (9) in dem erwähnten Bereich, der sich in einem wesentlichen Abstand von der Druckplatte (1b) befindet, steht, wobei die Haltevorrichtung (9) so angeordnet ist, daß sie zusammen mit der Rahmenplatte (1a) und dem Führungselement (3) sowohl den Kern der Wärmeübertragungsplatten als auch die Druckplatte (1b) trägt, wenn die Druckplatte (1b) vom Kern der Wärmeüber-

tragungsplatten gelöst und zusammen mit mindestens einer dieser entlang des Führungselementes (3) verschoben werden soll.

2. Plattenwärmetauscher nach Anspruch 1, wobei das Führungselement (3), mindestens wenn es mit der erwähnten Haltevorrichtung (9) verbunden ist, von einer entfernbaren weiteren Hülse (5b) umgeben ist, die sich von der Druckplatte (1b) zur Haltevorrichtung (9) erstreckt, um die Gewinde des Führungselementes (3) vor einer Berührung mit der Druckplatte (1b) und den Wärmeübertragungsplatten zu schützen.
3. Plattenwärmetauscher nach Anspruch 1 oder 2, wobei mindestens zwei der mit Gewinde versehenen Verbindungsstangen (3) Führungselemente (3) konstituieren und mit Hülsen (5a, 5b) der erwähnten Art versehen sind, während sich jede der verbleibenden mit Gewinde versehenen Führungsstangen zwischen der Rahmenplatte (1a) und der Druckplatte (1b) in einem bestimmten Abstand vom Kern der Wärmeübertragungsplatten erstreckt.
4. Plattenwärmetauscher nach Anspruch 3, wobei die beiden Führungselemente (3) so angeordnet sind, daß sie mit der erwähnten Haltevorrichtung (9) verbunden werden können, so daß sie durch diese in einem bestimmten Abstand voneinander gehalten werden.
5. Plattenwärmetauscher nach Anspruch 4, wobei eines der Führungselemente (3) im wesentlichen geradlinig oberhalb des anderen angeordnet ist und wobei die Haltevorrichtung (9) aus einer Stange (9) oder ähnlichem besteht, die lösbar mit dem Führungselement (3) verbunden ist, wobei das untere Ende (9a) der Stange (9) zusammen mit der Rahmenplatte (1) so angeordnet ist, um den Plattenwärmetauscher zu halten.
6. Plattenwärmetauscher nach Anspruch 5, wobei die erwähnte Stange (9) oder ähnliches so angeordnet ist, daß sie mit den beiden Führungselementen (3) auf zwei unterschiedliche Arten verbunden werden kann, von denen eine den Plattenwärmetauscher in der erwähnten möglichen Art trägt, während die andere daraus resultiert, daß die Haltevorrichtung (9) in den Führungselementen (3) hängt, wenn diese von der Rahmenplatte (1a) und der Druckplatte (1b) gehalten werden.
7. Plattenwärmetauscher nach einem der vorangehenden Ansprüche, wobei die Druckplatte (1b) mit einer Fußvorrichtung (2) versehen ist, die vertikal anpaßbar oder lösbar ist.
8. Plattenwärmetauscher nach Anspruch 7, wobei die

Rahmenplatte (1a) und die Druckplatte (1b) im wesentlichen identisch ausgestaltet sind und lösbare Fußvorrichtungen (2) der gleichen Art haben.

9. Plattenwärmetauscher nach Anspruch 1, wobei sich die Zentrierhülse (7) in das Loch (4) der Druckplatte (1b) erstreckt und einen ringförmigen Flansch hat, der so angeordnet ist, daß er an die Druckplatte (1b) auf der Seite anstößt, auf der sie von den Wärmeübertragungsplatten weg gerichtet ist. 5 10
10. Plattenwärmetauscher nach einem der Ansprüche 2-9, wobei die erwähnte Schutzhülse (5a) und die erwähnte lösbare weitere Hülse (5b) im wesentlichen den gleichen Querschnitt haben, so daß die letztere, nachdem die Zentrierhülse (7) weggenommen worden ist, so geführt werden kann, daß sie axial an die erste durch das Loch (4) in der Druckplatte (1b) anstößt und damit einen im wesentlichen ebenen Führungsbereich für die Druckplatte (1b) und die Wärmeübertragungsplatten bildet. 15 20

Revendications

1. Echangeur de chaleur à plaques comprenant une plaque de cadre (1a), une plaque d'appui (1b) et un noyau de plaques de transfert de chaleur placé entre la plaque de cadre (1a) et la plaque d'appui (1b), moyennant quoi une pluralité de traverses filetées (3) s'étendent entre la plaque de cadre (1a) et la plaque d'appui (1b) et sont disposées, à l'aide d'écrous (6) ou analogue, de façon à maintenir ces plaques à une distance souhaitée l'une de l'autre pour maintenir le noyau de plaques de transfert de chaleur ensemble, 25 30 35
- caractérisé en ce que**
- au moins l'une des traverses filetées (3) constitue un élément de guidage (3) pour la plaque d'appui (1b) et les plaques de transfert de chaleur, lequel élément de guidage (3) s'étend à travers un trou (4) dans la plaque d'appui (1b) et de plus sur une zone située à une distance considérable par rapport à celle-ci, 40 45
 - **en ce que** les plaques de transfert de chaleur présentent des trous ou des encoches (2a) alignées entre elles, à travers lesquelles s'étend l'élément de guidage (3),
 - **en ce que** l'élément de guidage (3) est entouré d'une gaine de protection (5a), s'étendant à partir de la plaque de cadre (1a) jusqu'à la plaque d'appui (1b) et protégeant les filets de l'élément de guidage (3) de l'engagement avec les plaques de transfert de chaleur, 50 55
 - **en ce que** l'élément de guidage (3) dans la zone pour la plaque d'appui (1b) est entouré d'une gaine de centrage (7) qui est mobile le long de

l'élément de guidage (3) et qui est en engagement libérable avec la plaque d'appui (1b) de telle manière qu'elle centre l'élément de guidage (3) dans le trou (4) dans la plaque d'appui (1b) et

- **en ce que** l'élément de guidage (3) est disposé de façon à être en liaison avec un dispositif de support (9) dans la zone mentionnée située à une distance considérable de la plaque d'appui (1b), lequel dispositif de support (9) est agencée de façon à supporter, conjointement avec la plaque de cadre (1a) et l'élément de guidage (3), aussi bien le noyau de plaques de transfert de chaleur que la plaque d'appui (1b) lorsque la plaque d'appui (1b) doit être libérée du noyau de plaques de transfert de chaleur et conjointement avec au moins certaines de celles-ci à transférer le long de l'élément de guidage (3).

2. Echangeur de chaleur à plaques selon la revendication 1, dans lequel l'élément de guidage (3), au moins lorsqu'il est relié au dispositif de support mentionné (9), est entouré par une autre gaine libérable (5b) s'étendant depuis la plaque d'appui (1b) jusqu'au dispositif de support (9) pour protéger les filets de l'élément de guidage (3) de l'engagement avec la plaque d'appui (1b) et les plaques de transfert de chaleur. 25 30

3. Echangeur de chaleur à plaques selon la revendication 1 ou 2, dans lequel au moins deux des traverses filetées (3) constituent des éléments de guidage (3) et sont dotées de gaines (5a, 5b) du type mentionné, tandis que chacune des traverses filetées restantes s'étend entre la plaque de cadre (1a) et la plaque d'appui (1b) à une certaine distance du noyau de plaques de transfert de chaleur. 35 40

4. Echangeur de chaleur à plaques selon la revendication 3, dans lequel à la fois les éléments de guidage (3) sont disposés de façon à être reliés au dispositif de support mentionné (9) de telle sorte qu'ils sont maintenus par celui-ci à une certaine distance entre eux. 45

5. Echangeur de chaleur à plaques selon la revendication 4, dans lequel l'un des éléments de guidage (3) est situé sensiblement juste au-dessus de l'autre et le dispositif de support (9) consiste en une barre (9) ou analogue raccordée de façon libérable à l'élément de guidage (3), moyennant quoi l'extrémité inférieure (9a) de la barre (9) est agencée pour, conjointement avec la plaque de cadre (1a), supporter l'échangeur de chaleur à plaques. 50 55

6. Echangeur de chaleur à plaques selon la revendication 5, dans lequel la barre mentionnée (9) ou analogue est agencée pour un raccordement avec

les deux éléments de guidage (3) de deux manières différentes, une manière permettant le support de l'échangeur de chaleur à plaques de la manière mentionnée, tandis que l'autre a pour effet que le dispositif de support (9) soit en suspension dans les éléments de guidage (3) lorsque ceux-ci sont portés par la plaque de cadre (1a) et la plaque d'appui (1b).

7. Echangeur de chaleur à plaques selon l'une quelconque des revendications précédentes, dans lequel la plaque d'appui (1b) est munie d'un dispositif de pied (2) qui est ajustable verticalement ou libérable.
8. Echangeur de chaleur à plaques selon la revendication 7, dans lequel la plaque de cadre (1a) et la plaque d'appui (1b) sont sensiblement conçues de façon identiques et présentent des dispositifs de pieds libérables (2) du même type.
9. Echangeur de chaleur à plaques selon la revendication 1, dans lequel la gaine de centrage (7) s'étend dans le trou (4) de la plaque d'appui (1b) et présente une bride annulaire agencée de façon à venir en butée contre la plaque d'appui (1b) sur le côté de celle-ci qui est détourné des plaques de transfert de chaleur.
10. Echangeur de chaleur à plaques selon l'une quelconque des revendications 2-9, dans lequel la gaine de protection mentionnée (5a) et l'autre gaine libérable mentionnée (5b) ont sensiblement la même section, de sorte que cette dernière, après enlèvement de la gaine de centrage (7), peut être mise en butée axialement contre la première par le biais du trou (4) dans la plaque d'appui (1b), et créent avec celle-ci une zone de guidage sensiblement plane pour la plaque d'appui (1b) et les plaques de transfert de chaleur.

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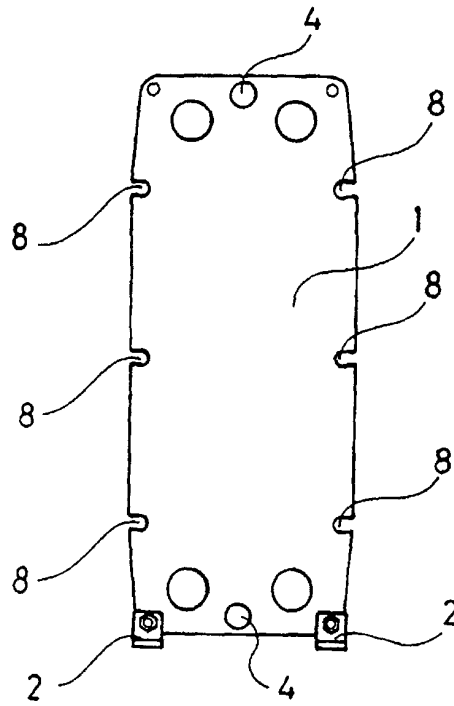


Fig. 1

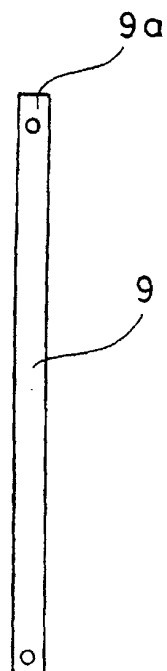


Fig. 2

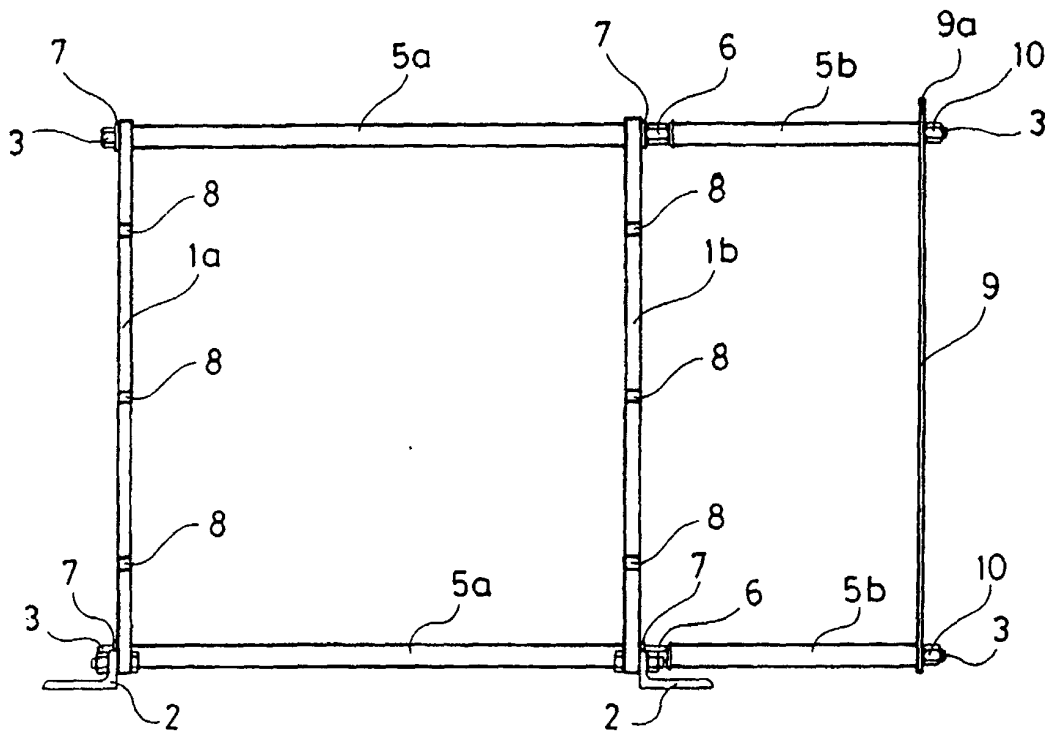


Fig.3

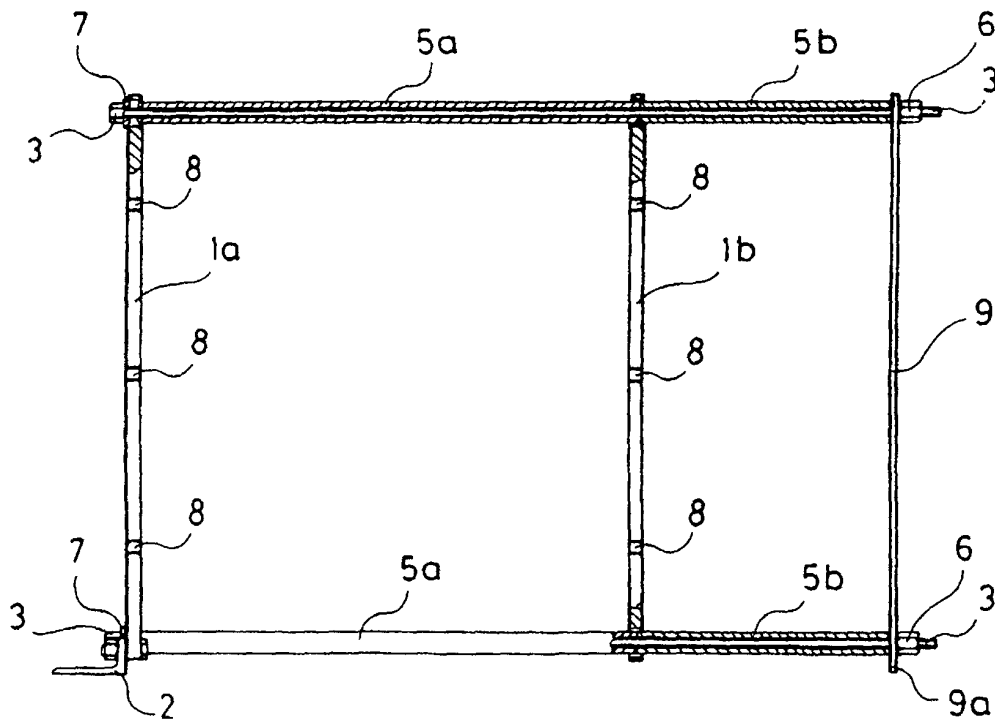


Fig.4

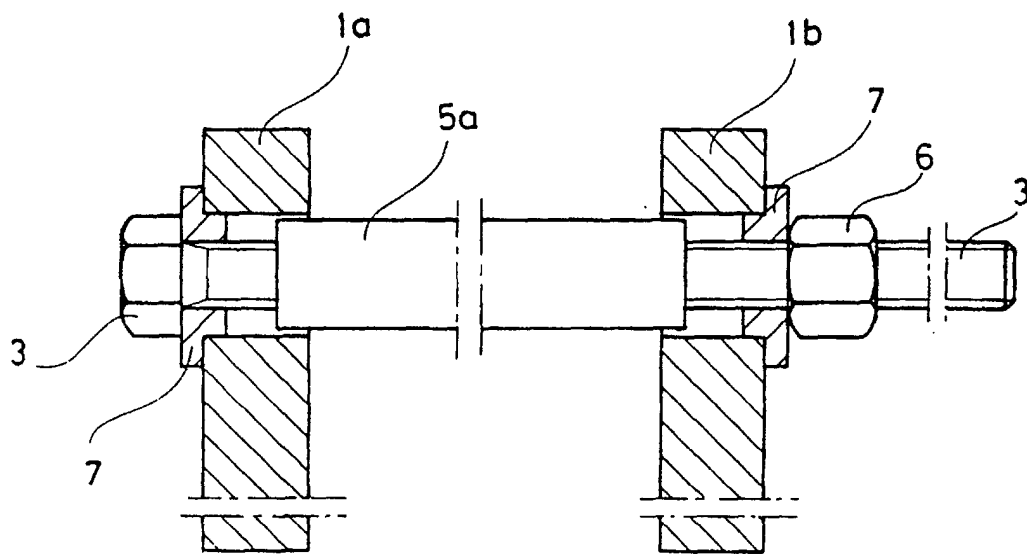


Fig. 5

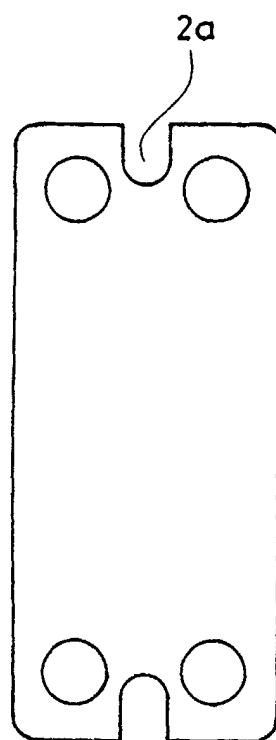


Fig. 6