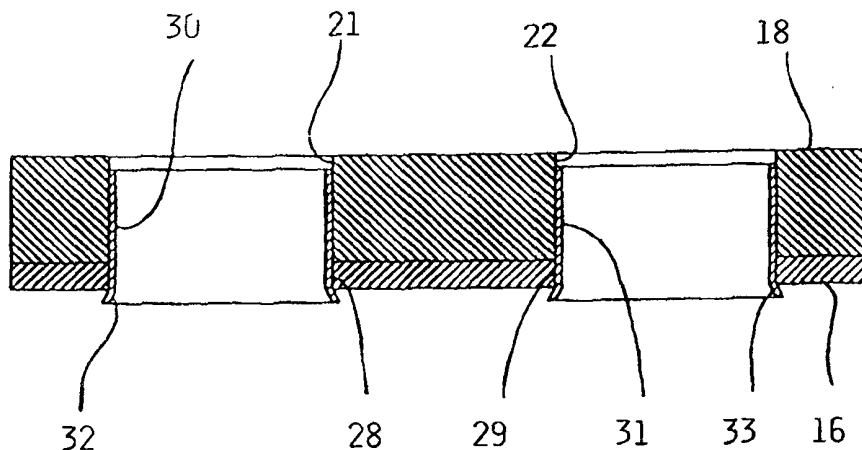




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(54) Title: A METHOD OF PRODUCING A PLATE HEAT EXCHANGER; AND A PLATE HEAT EXCHANGER



## (57) Abstract

The plate heat exchanger according to the invention comprises heat transfer plates, which are provided with so called port holes and are permanently joined through brazing to a plate package, the port holes forming port channels through the plate package, an end plate (16), which is permanently connected with an outer heat transfer plate in the plate package and provided with at least one opening (28, 29) communicating with one of the said port channels, and a connection plate (18), which is permanently connected with the end plate (16) and adapted for connection of the plate heat exchanger to a conduit constituting an inlet or outlet for a heat exchange fluid. The connection plate (18) is provided with a through hole (21, 22) and this hole and the opening (28, 29) in the end plate (16) form respective parts of a connection channel. A guiding member, preferably in the form of a sleeve (30, 31), extends in the said connection channel. The sleeve (30, 31) around its periphery is fluid-tightly connected with at least one of the end plate (16) and the connection plate (18). The invention also concerns a method of producing a plate heat exchanger, according to which the guiding member fixes the connection plate (18) in relation to the end plate (16) during the brazing of the plate heat exchanger.

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A method of producing a plate heat exchanger; and a plate heat exchanger

The present invention concerns a method of producing a plate heat exchanger for heat exchange between two heat exchange fluids, which comprises heat transfer plates provided with so called port holes, an end plate provided with at least one opening and a connection plate, which is adapted for connection of the plate heat exchanger to a conduit, constituting an inlet or outlet for one of the said heat exchange fluids, and which is provided with a through hole. The method comprises stacking of the heat transfer plates to a plate package, with brazing material arranged between the heat transfer plates, such that the port holes form port channels through the plate package. The end plate is placed against an outer heat transfer plate in the plate package, with a brazing material arranged between the end plate and the outer heat transfer plate, such that said opening in the end plate communicates with one of the port channels. Further, the connection plate is placed such that the through hole in the connection plate and the opening in the end plate form respective parts of a connection channel. The plate package, the end plate and the connection plate are brazed together by means of brazing material.

In plate heat exchangers of the kind described above, the heat transfer plates delimit between them at least two sets of heat transfer passages. Every second heat transfer passage is included in one of the sets and communicates with two of the port channels, the remaining passages being included in the second set of heat transfer passages and communicating with two other port channels. When the plate heat exchanger is in operation, each of the two heat exchange fluids flows into the plate heat exchanger through a first port channel, further through one set of heat transfer passages and out through a second port channel.

There are several different ways of connecting conduits to a plate heat exchanger, through which conduits heat exchange fluid is intended to flow to and from the plate heat exchanger, e.g. by welding of the conduits to connection devices formed as pipe sockets or by means of nuts arranged on threaded pipe sockets. In a plate heat exchanger produced by means of the method according to the invention, a conduit of the said kind is brought to abut against the said connection plate. Alternatively, the conduit is provided with an external thread and is screwed into a corresponding internal thread in the connection plate in the through hole, such that the conduit in both alternatives may communicate with the through hole in the connection plate.

Fixing of a connection plate in relation to an adjacent end plate during brazing together of a plate heat exchanger is associated with certain problems. The heat transfer plates are usually formed with bent edge portions acting to guide adjacent heat transfer plates in the plate package. Likewise, the end plate is provided with guiding members of one kind or another, which fix the end plate in relation to the outer heat transfer plate in the plate package. The connection plate, on the other hand, is not provided with any guiding member, which fixes the same in relation to the end plate. The connection plate is often considerably thicker than the end plate, which means that it is difficult both to bend the connection plate and to keep it plane. A plane connection plate is of great importance; partly, because the connection plate in many cases must be plane in order to seal against the conduits for the heat exchange fluids and, partly, because the brazing joint between the connection plate and the end plate has to be tight, so that heat exchange fluids cannot leak out of the plate heat exchanger between the connection plate and the end plate, or penetrate to between these two plates and give rise to damage on the plate heat exchanger.

So far the connection plate has been fixed in relation to the end plate before a brazing operation by being spot welded to the same. This mainly causes to two problems; the connection plate becomes less plane as a result of the spot welding, and it is difficult during the spot welding to keep  
5 the through hole in the connection plate exactly opposite to the opening in the end plate.

The object of the present invention is to present a solution to the problem discussed above, such that the production of plate heat exchangers of the  
10 kind here in question is simplified and such that the connection plate can be maintained plane.

According to the invention, this object can be obtained by means of a method, in which during the brazing together of the plate heat exchanger  
15 the said connection plate is fixed in relation to the end plate in a plane parallel with the end plate by means of a guiding member extending in the said connection channel. Hereby the connection plate is fixed in relation to the end plate without need for the connection plate to be subjected to machining or joining processes, which may lead to the connection plate  
20 becoming deformed.

In the method, the connection plate may be put against the end plate before the brazing operation with a brazing material arranged between the connection plate and the end plate.

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Advantageously, in the method according to the invention, a sleeve is used as said guiding member, the sleeve being arranged such that it extends in the said connection channel and abuts against the surface delimiting the connection channel. Preferably, the sleeve is brazed  
30 around its periphery together with at least one of the end plate and the

connection plate. the sleeve besides having a guiding function during the brazing together of the plate heat exchanger also getting a sealing function in the finished plate heat exchanger.

5 The connection plate has one side closest to the end plate, on which it may be provided with a ring-shaped recess in direct connection with its through hole, and the said sleeve at its one end may be provided with an outer flange. Advantageously, before the brazing operation, the sleeve is placed in the opening of the end plate such that the flange will rest  
10 against the end plate, after which the connection plate is positioned, the outer edge portion of the flange of the sleeve being used for guiding of the connection plate by matching or fitting into the recess of the connection plate. Thus, the connection plate hereby will be placed in the desired position in relation to the end plate.

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The sleeve may be formed in one piece with said end plate. This considerably facilitates the positioning of the connection plate on the end plate, since no separate sleeves have to be arranged in the connection channel.

20 The invention also concerns a plate heat exchanger for heat exchange between two heat exchange fluids. This plate heat exchanger comprises heat transfer plates, which are provided with so called port holes and are permanently joined to a plate package through brazing, the port holes forming port channels through the plate package, an end plate, which is  
25 permanently connected with an outer heat transfer plate in the plate package and provided with at least one opening communicating with one of the said port channels, and a connection plate, which is connected with the end plate by a permanent connection and which is intended for the connection of the plate heat exchanger to a conduit forming an inlet or  
30 outlet for one of the heat exchange fluids. The connection plate is

provided with a through hole and this hole and the opening in the end plate form respective parts of a connection channel. The plate heat exchanger according to the invention is characterized in that a sleeve extends in the said connection channel and around its periphery is fluid-tightly connected with at least one of the end plate and the connection plate. Advantageously, the sleeve extends through both parts of the connection channel. Further, the sleeve may be formed in one piece with the end plate around its said opening, the sleeve preferably being brazed together with the connection plate.

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In a preferred embodiment of the plate heat exchanger according to the invention, the end plate is provided with two openings, which communicate with a respective of the said port channels, and the connection plate is provided with two through holes, the openings and the through holes forming parts of two connection channels, in each of which there extends one sleeve, which is fluid-tightly connected with at least one of the end plate and the connection plate.

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According to one embodiment the aforementioned permanent connection is constituted by a brazing joint between the end plate and the connection plate.

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The heat transfer plates in a plate heat exchanger are thin and therefore sensitive to loads, to which they are subjected. Particularly dangerous are changing loads, which can give rise to fatigue failure. An end plate may have several different forms. It may either be of the same kind as the heat transfer plates or of a different kind. For example, it may be thicker than the heat transfer plates and cover the entire or only parts of the outermost heat transfer plate in the plate package. The connection plate is usually considerably thicker than the remaining plates of a plate heat exchanger.

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When the connection plate is brazed together with a relatively thick end plate, these plates form together a large body, the temperature movements of which will be much slower than the temperature movements of the thin heat transfer plates. A plate heat exchanger, which is used inter-  
5 mittedly, is subjected to different temperatures, and at least the outer heat transfer plate in the plate package will be subjected to changing loads, which can lead to fatigue failure. A similar problem arises when the end plate is of the same kind as the heat transfer plates. In this case the connection plate forms a large body, the temperature movements of  
10 which are considerably slower than those of the end plate, and the end plate will be subjected to changing loads with fatigue failure as a result.

In a particular embodiment of the invention a ring-shaped element, which extends around the connection channel, is permanently connected with  
15 the end plate and with the connection plate to form a considerable part of the permanent connection between the end plate and the connection plate. In this embodiment there is no widespread brazing joint between the end plate and the connection plate, since the connection is mainly accomplished via the ring-shaped element. As a result of this local  
20 connection the end plate and the connection plate constitute separate bodies, the different plates in the plate heat exchanger being able to move in relation to each other to much a larger extent than otherwise, without being subjected to large loads. In a preferred embodiment the ring-shaped element is formed in one piece with the sleeve.

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According to one embodiment of the invention the connection plate, on its one side closest to the end plate, may be provided with a ring-shaped recess around its through hole, in which the said ring-shaped element is arranged. Alternatively, the end plate on its one side closest to the  
30 connection plate may be provided with a ring-shaped recess around the

opening, in which recess the ring-shaped element is arranged. When the ring-shaped element is in one piece with the sleeve, the positioning of the end plate, the sleeve and the connection plate are facilitated in these embodiments, as is the fixation of the end plate before the brazing  
5 together of the plate heat exchanger. In cases where the ring-shaped element is a separate element, a good fixation of the element is achieved.

According to another preferred embodiment of the invention, the ring-shaped recess in the connection plate is made in direct connection with  
10 the through hole. Advantageously, in this embodiment a ring-shaped element is used, which is formed in one piece with the sleeve.

In a plate heat exchanger according to the invention, the connection plate may be arranged at a distance from the end plate. Alternatively, the con-  
15 nection plate may abut against the end plate, the connection plate on its side closest to the end plate being provided with a ring-shaped groove around and at a distance from the through hole. In the latter embodiment a brazing material has been placed between the connection plate and the end plate in connection with the ring-shaped element, before the brazing  
20 together. During the brazing operation the brazing material melts and spreads due to capillary effects between the abutting surfaces of the connection plate, the end plate, the ring-shaped element and the sleeve. At the ring-shaped groove the distance between the connection plate and the end plate is too great for giving rise to any capillary effects and,  
25 consequently, the brazing material does not spread further than to the ring-shaped groove. In the two latter embodiments the connection plate and the end plate form substantially separate thermal bodies, irrespective of the two plates abutting against each other or not.

In a further embodiment of the plate heat exchanger according to the invention, the sleeve extends axially through only a limited part of the through hole in the connection plate. Thereby, the connection plate may be provided with a thread in the through hole. Preferably, a sleeve is  
5 used, the ring-shaped element being formed in one piece with the sleeve at one end thereof. The sleeve is arranged in the plate heat exchanger such that it extends in the opening in the end plate, the ring-shaped element abutting with one side against the end plate and with an outer end portion against the connection plate in a ring-shaped recess as  
10 above. Accordingly, the diameter of the through hole in the connection plate may be chosen according to need without the sleeve and the opening in the end plate having to be changed.

In a further preferred embodiment the ring-shaped element is provided  
15 with a groove for receiving a brazing material. Before the brazing together of the plate heat exchanger a ring of brazing material is arranged in the groove. Accordingly, the brazing material will be arranged such that it can easily spread around the ring-shaped element during the brazing of the plate heat exchanger for connecting the ring-shaped element with adja-  
20 cent plates and creating fluid-tight joints between the sleeve and these plates.

The invention will now be described more closely with reference to the accompanying drawings, in which:

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fig. 1 shows a plate heat exchanger joined permanently through brazing and having connection devices in the shape of pipe sockets,

fig. 2 shows a section along the line II-II in fig. 1,

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fig. 3 shows a front view of a plate heat exchanger joined permanently through brazing and having connection devices in the form of two connection plates,

5 figs. 4 and 5 show sections along the lines IV-IV and V-V, respectively, in fig. 3, fig. 4 illustrating previously known technology and fig. 5 illustrating the present invention,

figs. 6 – 13 show sections through connection plates and end plates in  
10 special embodiments of a plate heat exchanger according to the invention.

Fig. 1 shows a known plate heat exchanger 1 comprising a stack of heat transfer plates 2 brazed together to a plate package. Onto the outer heat  
15 transfer plates of the plate package, end plates 3, 4 have been brazed, which are thicker than the heat transfer plates 2. One of the end plates 4 is provided with four holes, around which connection devices in the form of pipe sockets 5, 6, 7 and 8 are brazed.

20 Fig. 2 shows a section along the line II-II in fig. 1. Each heat transfer plate 2 is provided with four port holes, two of which are designated 9 and 10 in fig. 2. The heat transfer plates 2 abut against each other in pairs around the port holes such that four port channels are formed through the plate heat exchanger 1. Fig. 2 shows two port channels 11 and 12, respec-  
25 tively. The heat transfer plates 2 are further provided with a pressing pattern of depressions and elevations 13. Thereby, passages 14 for heat exchange fluids are formed between the heat transfer plates 2.

The present invention is applicable on plate heat exchangers comprising  
30 connection devices in the form of connection plates. One such plate heat

exchanger 15 is shown in fig. 3. The plate heat exchanger 15 comprises an end plate 16, onto which two connection plates 17, 18 have been brazed. Each of the connection plates 17, 18 is provided with two through holes 19, 20 and 21, 22, respectively, which are arranged opposite to openings in the end plate 16 and together with these form four connection channels. The connection plates 17, 18 are further provided with a number of holes 23, which suitably are provided with internal threads and which are intended for connecting the plate heat exchanger 15 with conduits, which conduct heat exchange fluids to and from the same.

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Fig. 4 illustrates previously known technology and shows a section along the line IV-IV in fig. 3 of the end plate 16 and the connection plate 17. Before brazing together of the plate heat exchanger 15, this connection plate 17 has been fixed in relation to the end plate 16 by spot welding, i.e. in a hitherto common manner. This form of fixing has caused an unevenness 24 in the connection plate 17, which may create sealing problems when conduits are to be connected to the finished plate heat exchanger. Further, fig. 4 reveals that it may be difficult to position the through holes 19, 20 in the connection plate 17 opposite to the openings 25, 26 in the end plate 16. Finally, with the known technology it can also be a problem to obtain a tight brazing joint 27 between the end plate 16 and the connection plate 17.

Hereinafter the same reference numbers will be used for corresponding details in the different embodiments. Fig. 5 illustrates the present invention and shows a section of the end plate 16 and the connection plate 18 along the line V-V in fig.3. In accordance with the invention, special guiding members are used for fixing the connection plate 18 in relation to the end plate 16 during the brazing together of the plate heat exchanger. Thus, into the respective connection channels, which are formed by the

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through holes 21, 22 in the connection plate 18 and the openings 28, 29 in the end plate 16, guiding members in the shape of sleeves 30, 31 have been inserted and by means of a tool been expanded or flared in their ends as shown in fig. 5, this having been made before assembling of the parts of the plate heat exchanger. At the expansion of the sleeves 30, 31 collars 32, 33 have been formed at one ends of the sleeves, and despite the collars 32, 33 protruding outside the end plate, they will not get into contact with the outermost heat transfer plate of the plate package.

10 The sleeves 30, 31 fix the connection plate 18 in relation to the end plate 16 during the brazing together of the plate heat exchanger 15 without the connection plate 18 having to be subjected to operations, causing it to deform. Further, the sleeves 30, 31 get a sealing function when they are brazed in the connection channels. Advantageously, a relatively thick ring-shaped piece of brazing material may be placed against each of the sleeves 30, 31 in their respective connection channels. This piece of brazing material is placed against the end surface of the sleeve and will melt and fill the space between the sleeve and both the connection plate 18 and the end plate 16 during the brazing process, which means that no leakage can arise between the connection plate 18 and the end plate 16 in the finished plate heat exchanger.

Fig. 6 shows a section corresponding to the section in fig. 5 through an end plate 16 and a connection plate 18 according to another embodiment of the invention. In this embodiment the guiding members are constituted by sleeves 30, 31 formed in one piece with the end plate 16 around the openings therein. In addition to the advantages mentioned above, this embodiment has the advantage that no separate sleeves have to be inserted into the connection channels.

Fig. 7 shows a section corresponding to the section in fig. 5 through an end plate 16 and a connection plate 18 according to a further embodiment of the invention. In this embodiment each sleeve 30, 31 at its one end is provided with a ring-shaped element in the form of an outer flange 34, 35, which is provided with a ring-shaped groove 36, 37 for receiving a brazing material. The connection plate 18 is provided with ring-shaped recesses 38, 39 in direct connection with the through holes 21, 22. The flanges 34, 35 of the sleeves abut against the end plate 16 and with their outer edge portions against the connection plate 18 in its recesses 38, 39 for fixation of the connection plate 18 in relation to the end plate 16 during brazing of the plate heat exchanger. During the brazing operation the brazing material in the groove 36, 37 of the flange 34, 35 of the sleeve melts and spreads between the sleeve 30, 31 and the connection plate 18, and between the sleeve 30, 31 and the end plate 16. A brazing material may also be arranged between the connection plate 18 and the end plate 16. Also this brazing material melts during the brazing operation and spreads between these two plates 16, 18.

In addition to the advantage of the sleeves 30, 31 being kept in place in an easy manner during brazing of the plate heat exchanger by abutting against the end plate 16, this embodiment also has a large flexibility concerning the forming of the through holes 21, 22 in the connection plate 18. Since the flanges 34, 35 of the sleeves abut against the connection plate in its recesses 38, 39, instead of the sleeves abutting against the connection plate in its through hole, a single kind of sleeves may be used and the openings of the end plates may have one and the same size for plate heat exchangers of a certain size, irrespective of which diameter is chosen for the through holes in the connection plate for a specific plate heat exchanger. Further, the connection plates may be provided with

threads in their through holes, since no sleeves extend in these through holes.

In the embodiment according to fig. 8, the flanges 34, 35 of the sleeves  
5 30, 31 are shaped such that they, besides constituting a guide for the  
connection plate 18 during the brazing together of the plate heat  
exchanger, also constitute spacing members between the connection  
plate 18 and the end plate 16. Before the brazing together of the plate  
heat exchanger a brazing material is placed in the groove 36, 37 in the  
10 flange 34, 35 of each sleeve and a ring of brazing material is placed  
between the respective flanges 34, 35 and the end plate 16 at 40 and 41.  
After each sleeve 30, 31 has been placed in the respective opening 28,  
29 in the end plate 16, the sleeve 30, 31 has been expanded or flared at  
its end having no flange, such that a collar 32, 33 has been formed. How-  
15 ever, the expansion of the flange free end of the sleeve 30, 31 is not  
necessary. After the brazing operation the connection plate 18 is perma-  
nently connected with the end plate 16 by means of the ring-shaped  
elements constituted by the sleeve flanges 34, 35.

20 In the embodiment in fig. 9 the connection plate 18 is formed with ring-  
shaped grooves 42, 43 around and at a distance from its through holes  
21, 22. Before the brazing together of the plate heat exchanger a ring of  
brazing material is placed between the connection plate 18 and the flange  
34, 35 of the respective sleeve 30, 31 at 44 and 45, and between the  
25 flange 34, 35 of the respective sleeve and the end plate 16 at 40 and 41.  
No brazing material is arranged in any other place between the connec-  
tion plate 18 and the end plate 16. During the brazing operation the rings  
of brazing material melt and this material spreads due to capillary effects  
between the end plate, the respective sleeves, the connection plate and  
30 the respective sleeve flanges. The brazing material will also spread

between the connection plate 18 and the end plate 16, no further though than to the grooves 42, 43 in the connection plate. At these grooves the distance between the connection plate 18 and end plate 16 is too great, namely for capillary effects to arise. Thus, a considerable part of the permanent joint between the connection plate 18 and the end plate 16 is created by the flanges 34, 35 of the sleeves.

In the embodiments according to figs. 8 and 9 the connection plate 18 and the end plate 16, respectively, constitute separate thermal bodies, which independent of each other may expand and contract as a result of temperature changes. An end plate is permanently joined with an outer heat transfer plate in the respective plate package. Since the end plate 16 constitutes a separate thermal body, the end plate 16 may change temperature much faster than if it formed a thermal body together with the connection plate 18. Accordingly, the loads on the outer heat transfer plate in the plate package will become smaller. To the extent that the temperature movements of the end plate 16 and the outer heat transfer plate differ, the end plate 16 will not create a resistance as big as if the end plate 16 would be brazed together with the connection plate 18. Also this reduces the loads on the outer heat transfer plate in the plate package. The outer heat transfer plates in plate heat exchangers having end plates and connection plates according to the embodiments in figs. 8 and 9 run a smaller risk of fatigue failure than the outer heat transfer plates in the embodiments according to figs. 5-7.

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Fig. 10 shows an embodiment of the invention, in which a separate ring-shaped element 46 is arranged between the connection plate 18 and the end plate 16. The ring-shaped element 46 extends around a sleeve 30, which extends in a connection channel 47, of which the through hole 21 in the connection plate 18 and the opening 28 in the end plate 16 form

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parts. The connection plate 18 and the end plate 16 are permanently connected with each other via the ring-shaped element 46. Exactly as in the earlier embodiments of the invention, the sleeve 30 has a fixing and a sealing function.

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The embodiment according to fig. 11 is similar to the embodiment according to fig. 6. The sleeve 30 is formed in one piece with the end plate 16. In the embodiment according to Fig. 11, the end plate 16 is permanently joined with the connection plate 18 via a separate ring-shaped element 46, which extends around the sleeve 30.

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In the embodiment according to fig. 12, besides a ring-shaped recess 38 in the connection plate 18, there also is a ring-shaped recess 48 in the end plate 16 around its opening 28. In this embodiment the recess 38 in the connection plate 18 could be left out.

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Fig. 13 shows an embodiment of the invention, in which the connection plate 18 is provided with a ring-shaped recess 49 around and at a distance from its through hole 21. The sleeve 30 has a flange 34, which is provided with an axially protruding ring-shaped projection 50. The projection 50 of the flange abuts against the connection plate 18 in its ring-shaped recess 49 for fixing of the connection plate 18 in relation to the end plate 16 during the brazing together of the plate heat exchanger. After the brazing operation the connection plate 18 is permanently connected with the end plate 16 via the flange 34 of the sleeve.

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Fig. 14 shows an embodiment of the invention, which is similar to the embodiment according to fig. 6. In this embodiment the connection plate 18 is provided with a groove 42 around and at a distance from its through hole 21. Before the brazing together of the plate heat exchanger a ring of

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brazing material is placed between the connection plate 18 and the end plate 16, only around the sleeve 30. During the brazing together of the plate heat exchanger the brazing material melts and spreads between the sleeve 30 and the connection plate 18, and between the connection plate  
5 18 and the end plate 16; however, no further than to the groove 42. Also in this embodiment the connection plate 18 and the end plate 16 constitute separate thermal bodies.

The invention is not limited to the embodiments described above and  
10 shown in the figures. A guiding member may for example be constituted by a number of pins distributed along the periphery of a connection channel. Further, in embodiments with sleeves formed in one piece with the end plate, such sleeves may abut against the connection plates in recesses around their through holes. A further possibility is to form the  
15 connection plate with sleeves, which fit into the openings in the end plate. Of course, a connection plate does not have to have exactly two through holes but may instead have only one hole or more than two through holes. Besides, not all of the connection plates have to be brazed together with one of two end plates of the plate heat exchanger. Some of  
20 the connection plates may instead be brazed together with the other one of the end plates. Also an end plate may be constituted by two separate parts, one part opposite to each pair of port channels. Alternatively, an end plate may be of the same kind as the heat transfer plates in the plate heat exchanger.

25

Brazing material, which is arranged between different parts of the plate heat exchanger before these are brazed together, is normally constituted by a thin foil. However, another possibility is that the parts included in the plate heat exchanger are plated with brazing material.

Claims

1. A method of producing a plate heat exchanger for heat exchange between two heat exchange fluids, which comprises
- 5       - heat transfer plates provided with so called port holes,  
      - an end plate (16) provided with at least one opening (28, 29) and  
      - a connection plate (18), which is adapted for connection of the plate heat exchanger to a conduit, constituting an inlet or outlet for one of said heat exchange fluids and which is provided with a through hole
- 10       (21, 22),  
      in which method
- said heat transfer plates are stacked to a plate package, with brazing material arranged between the heat transfer plates, such that the port holes form port channels through the plate package,
- 15       - said end plate (16) is placed against an outer heat transfer plate in the plate package, with a brazing material arranged between the end plate (16) and the outer heat transfer plate, such that said opening (28, 29) in the end plate (16) communicates with one of said port channels,
- 20       - said connection plate (18) is placed such that said through hole (21, 22) in the connection plate (18) and said opening (28, 29) in the end plate (16) form respective parts of a connection channel, and
- said plate package, end plate (16; 34) and connection plate (18; 35) are brazed together by means of brazing material,
- 25
- characterized in that during the brazing of the plate heat exchanger said connection plate (18) is fixed in relation to the end plate (16) in a plane parallel with the end plate (16) by means of a guiding member extending in the said connection channel.

2. A method of producing a plate heat exchanger according to claim 1, wherein before said brazing the connection plate is put against the end plate (16) with a brazing material arranged between the connection plate (18) and the end plate (16).  
5
3. A method of producing a plate heat exchanger according to claim 1 or 2, wherein a sleeve (30, 31) is used as said guiding member and arranged such that it extends in the said connection channel, the sleeve (30, 31) abutting against the surface delimiting the connection  
10 channel.
4. A method of producing a plate heat exchanger according to claim 3, wherein said sleeve (30, 31) around its periphery is brazed together with at least one of said end plate (16) and said connection plate (18).  
15
5. A method of producing a plate heat exchanger according to any one of the claims 3 and 4, in which plate heat exchanger said connection plate (18) has one side closest to said end plate (16), on which it is provided with a ring-shaped recess (38, 39) in direct connection with  
20 its said through hole (21, 22), and said sleeve (30, 31) at its one end is provided with an outer flange (34, 35), wherein before the brazing operation the sleeve (30, 31) is placed in said opening (28, 29) in the end plate (16) such that the flange (34, 35) rests against the end plate (16), after which the connection plate (18) is positioned and the outer  
25 edge portion of the sleeve flange (34, 35) is used for guiding of the connection plate (18) by fitting in said recess (38, 39) of the connection plate.

6. A method of producing a plate heat exchanger according to claim 3 or 4, wherein said sleeve (30, 31) is formed in one piece with the said end plate (16).
- 5 7. A plate heat exchanger for heat exchange between two heat exchange fluids, comprising
- heat transfer plates, which are provided with so-called port holes and are permanently joined to a plate package through brazing, the portholes forming port channels through the plate package,
  - 10 - an end plate (16), which is permanently connected with an outer heat transfer plate in said plate package and provided with at least one opening (28, 29) communicating with one of said port channels, and
  - a connection plate (18), which is connected with said end plate (16)
  - 15 by a permanent connection and adapted for connecting the plate heat exchanger to a conduit, constituting an inlet or outlet for one of said heat exchange fluids, the connection plate (18) being provided with a through hole (21, 22) and this hole (21, 22) and said opening (28, 29) in the end plate (16) forming respective parts of a
  - 20 connection channel,
- characterized in that a sleeve (30, 31) extends in the said connection channel and is fluid-tightly connected around its periphery with at least one of said end plate (16) and said connection plate (18).
- 25 8. A plate heat exchanger according to claim 7, wherein said sleeve (30, 31) extends through both of said parts of the connection channel.
9. A plate heat exchanger according to any one of the claims 7 and 8, wherein said sleeve (30, 31) is formed in one piece with said end
- 30 plate (16) around said opening (28, 29) of the latter.

10. A plate heat exchanger according to claim 9, wherein said sleeve (30, 31) is brazed together with said connection plate (16).
11. A plate heat exchanger according to any one of the claims 7-9,  
5 wherein said end plate (16) is provided with two openings (28, 29) communicating with a respective one of said port channels and said connection plate (18) is provided with two through holes (21, 22), the openings (28, 29) and the through holes (21, 22) forming parts of two  
10 connection channels, in each of which there extends one sleeve (30, 31) fluid-tightly connected with at least one of the end plate (16) and the connection plate (18).
12. A plate heat exchanger according to any one of the claims 7-11,  
15 wherein said permanent connection is constituted by a brazing joint between said end plate (16) and said connection plate (18).
13. A plate heat exchanger according to claim 7, wherein a ring-shaped element (34, 35; 46), which extends around the said connection  
20 channel, is permanently connected with said end plate (16) and with said connection plate (18) to form a considerable part of the permanent connection between the end plate (16) and the connection plate (18).
14. A plate heat exchanger according to claim 13, wherein said ring-  
25 shaped element (34, 35) is formed in one piece with said sleeve (30, 31).
15. A plate heat exchanger according to any one of the claims 13 and 14,  
30 wherein said connection plate (18) has one side closest to said end plate (16), the connection plate (18) on this side being provided with a

ring-shaped recess (38, 39; 49) around its said through hole (21, 22), wherein said ring-shaped element (34, 35; 46) is arranged.

- 5 16. A plate heat exchanger according to any one of the claims 13-15, wherein said end plate (16) has one side closest to said connection plate (18), the end plate (16) on this side being provided with a ring-shaped recess (48) around said opening, in which recess said ring-shaped element (34, 35; 46) is arranged.
- 10 17. A plate heat exchanger according to the claim 15, wherein said ring-shaped recess (38, 39) in said connection plate (18) is formed in direct connection with said through hole (30, 31).
- 15 18. A plate heat exchanger according to any one of the claims 13-17, wherein said connection plate (18) is arranged at a distance from said end plate (16).
- 20 19. A plate heat exchanger according to any one of the claims 13-17, wherein said connection plate (18) abuts against said end plate (16) and the connection plate (18) on its side closest to the end plate (16) is provided with a ring-shaped groove (42, 43) around and at a distance from said through hole (21, 22).
- 25 20. A plate heat exchanger according to claim 14, wherein said sleeve (30, 31) extends axially through only a limited part of the said through hole (21, 22) in the connection plate (18).
- 30 21. A plate heat exchanger according claim 14, wherein said ring-shaped element (34, 35; 46) is provided with a groove (36, 37) for receiving a brazing material.

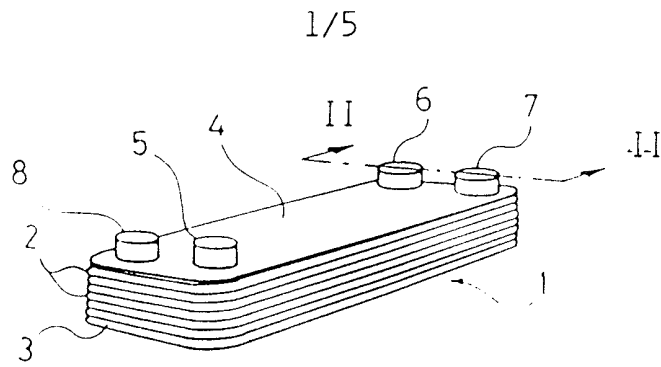


Fig. 1

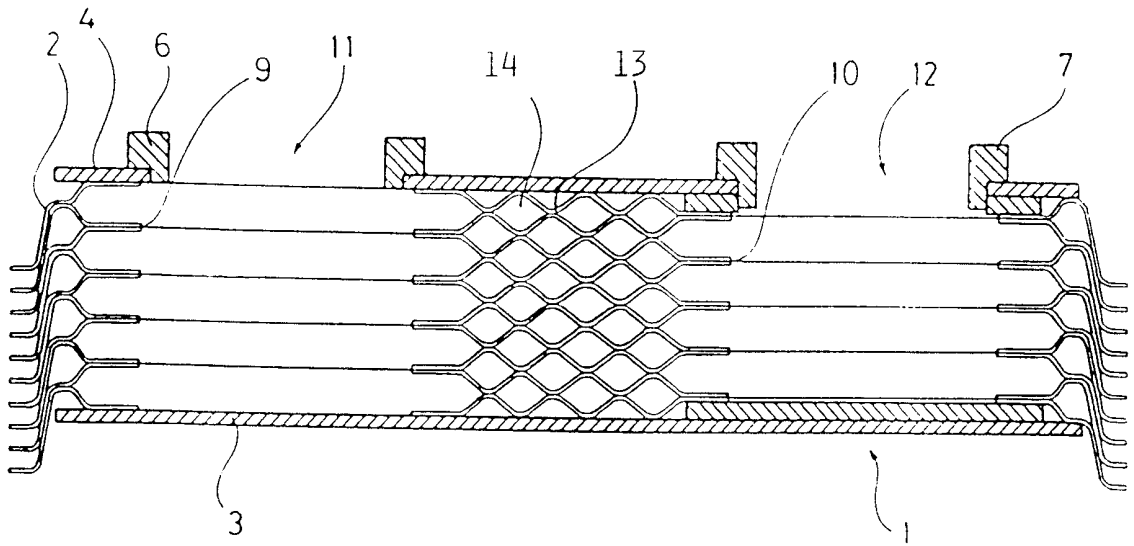


Fig. 2

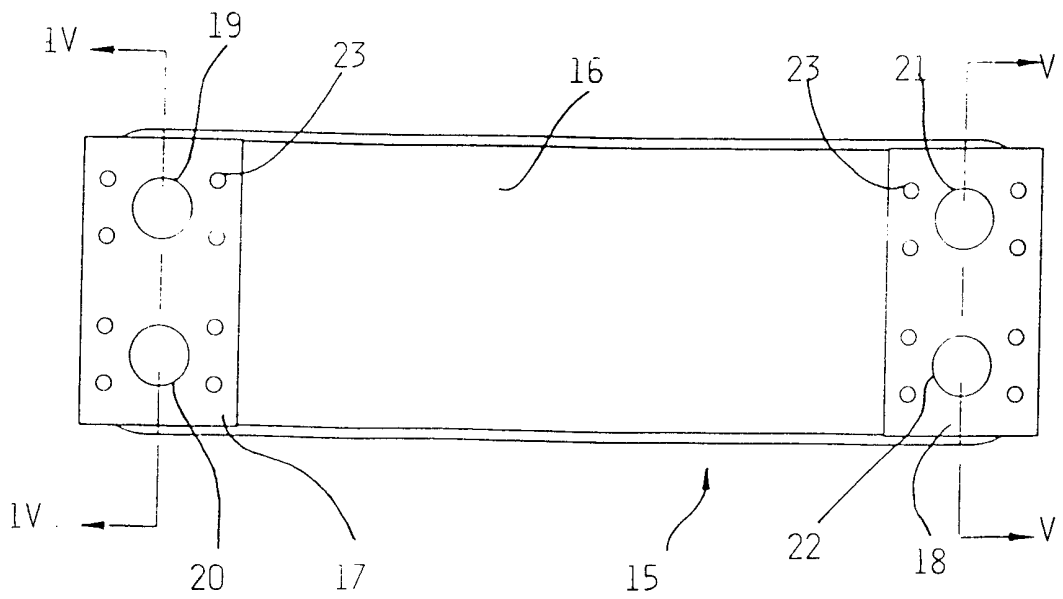


FIG. 3

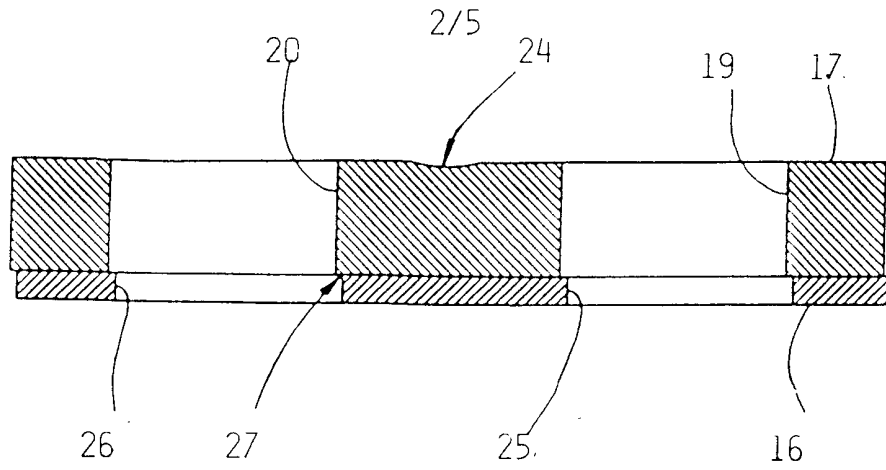


FIG. 4

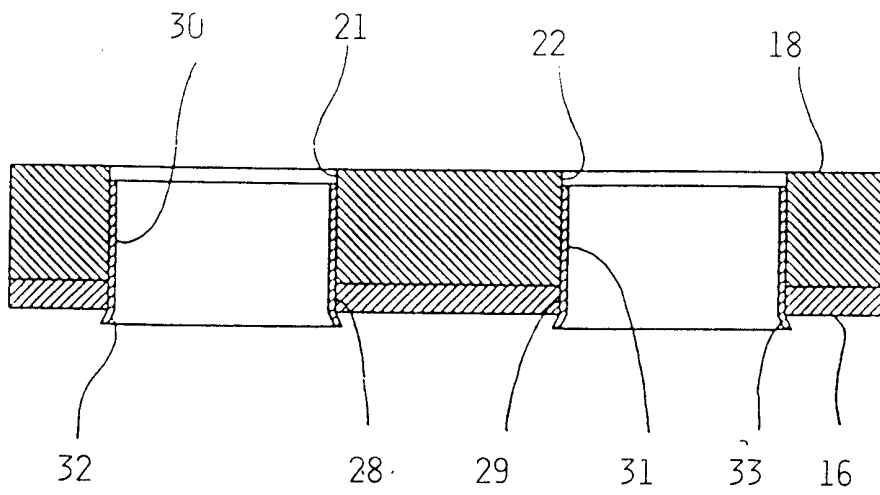


FIG. 5

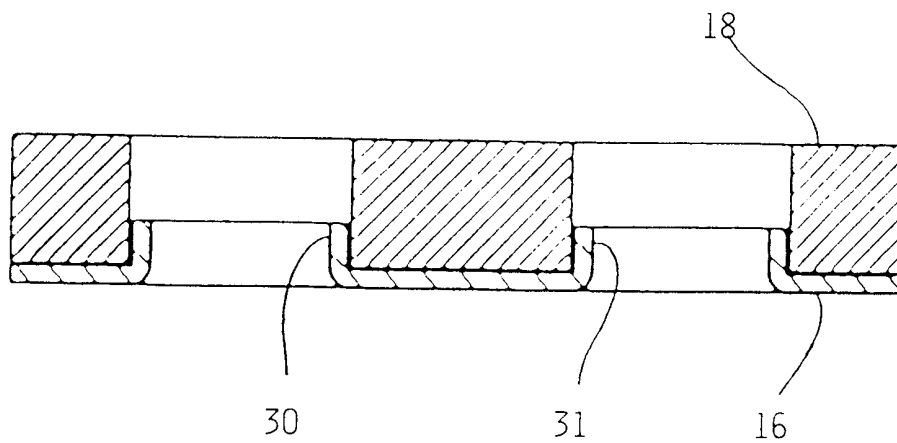


FIG. 6



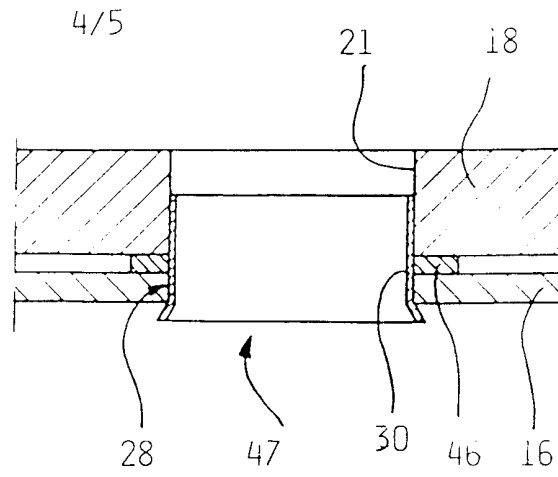


FIG. 10

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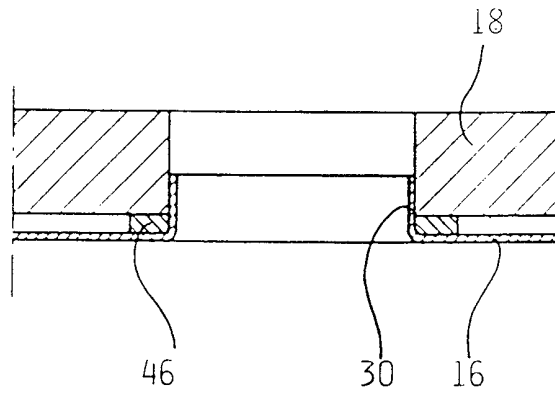


FIG. 11

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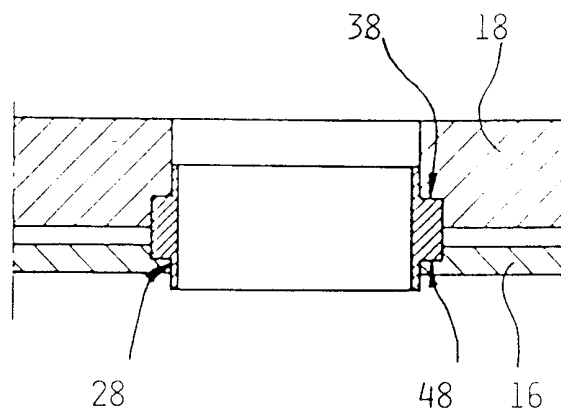


FIG. 12

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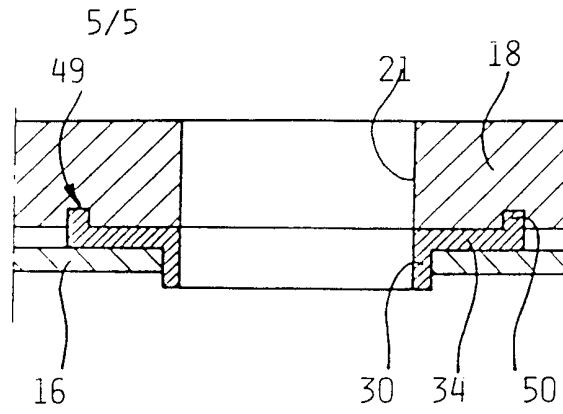


FIG. 13  
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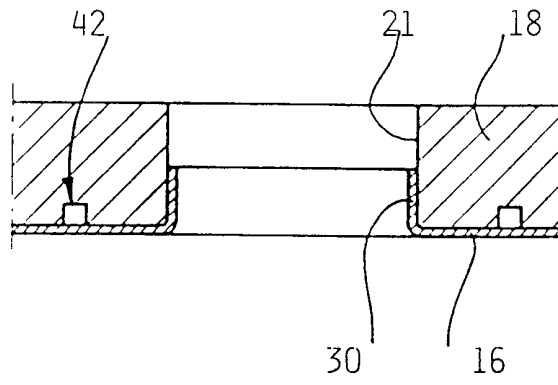


FIG. 14  
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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 99/00960

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B21D 53/04, F28D 9/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B21D, B23P, F28D, F28F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No. |
|-----------|--|-----------------------|
| X         | WO 8605866 A1 (TORELL AB), 9 October 1986<br>(09.10.86), page 1, line 4 - page 3, line 24,<br>figure 3, abstract   | 1,3,4,7,11            |
| Y         | --   | 13-17,21              |
| P,Y       | DE 19713883 A1 (KNECHT FILTERWERKE GMBH),<br>8 October 1998 (08.10.98), column 1,<br>line 39 - line 56; column 2, line 3 - line 42,<br>figures 1,3, claims 6,7 | 13-17,21              |
|           | --<br>-----  |                       |

 Further documents are listed in the continuation of Box C.
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"&amp;" document member of the same patent family

Date of the actual completion of the international search

31 August 1999

Date of mailing of the international search report

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**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

02/08/99

International application No.  
PCT/SE 99/00960

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
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| DE 19713883 A1                         | 08/10/98         | NONE                    |                  |
| -----                                  |                  |                         |                  |