AUSTRALIA

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# NOTICE OF ENTITLEMENT

**BARRIQUAND ECHANGEURS** being the Nominated Person in respect of Application No. 63797/94 state the following :

The Nominated Person would, on the grant of a patent for the invention to the inventor, NICOLAS CRASSOUS be entitled to have the patent assigned to the Nominated Person.

The Nominated Person is entitled to claim priority from the basic application listed on the declaration under Article 8 of the PCT because the Nominated Person is the applicant in respect of the application listed in the declaration under Article 8 of the PCT, and because the application was the first application made in a Convention country in respect of the invention.

Dated this 31st day of July, 1997.

a member of the firm of
DAVIES COLLISON CAVE
for and on behalf of
the applicant(s).

AU9463797

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(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 683250

(54) Title
METHOD FOR MOUNTING FLANGES OR SIMILAR ATTACHMENT PARTS ON AN EXCHANGER PLATE AND EXCHANGER SO OBTAINED

International Patent Classification(s)
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(56) Prior Art Documents
JP 58077218
JP 56105874

(57) Claim

1/ ~~The~~ A method of assembling coupling members to a heat exchanger bundle of the type made up of a plurality of individual chambers, each formed by two conductive plates bonded along their "longitudinal" sides via oppositely-directed flanges, and welded together in pairs to define an internal circuit that opens out at said longitudinal sides via two lateral openings opening out into two respective tubes for coupling them to a supply of a heat exchange fluid, said chambers being disposed side by side and being united by welding the facing flanges together, thereby defining respective passages between adjacent chambers that define a second circuit independent of the first and opening out at "transverse" sides into two coupling members disposed in end-to-end correspondence with the bundle for connection to a network for circulating a fluid that is to be cooled or heated;

the method being characterized in that it consists in:

.../2

• for each chamber, welding together the portions of the two plates that correspond to the transverse sides;

• engaging a hoop or belt on each end;

• bonding each hoop or belt that is engaged on each transverse end by means of internal and external peripheral welding; and

• using the hoop or belt as a coupling member.

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A1

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(54) Title: METHOD FOR MOUNTING FLANGES OR SIMILAR ATTACHMENT PARTS ON AN EXCHANGER PLATE AND EXCHANGER SO OBTAINED

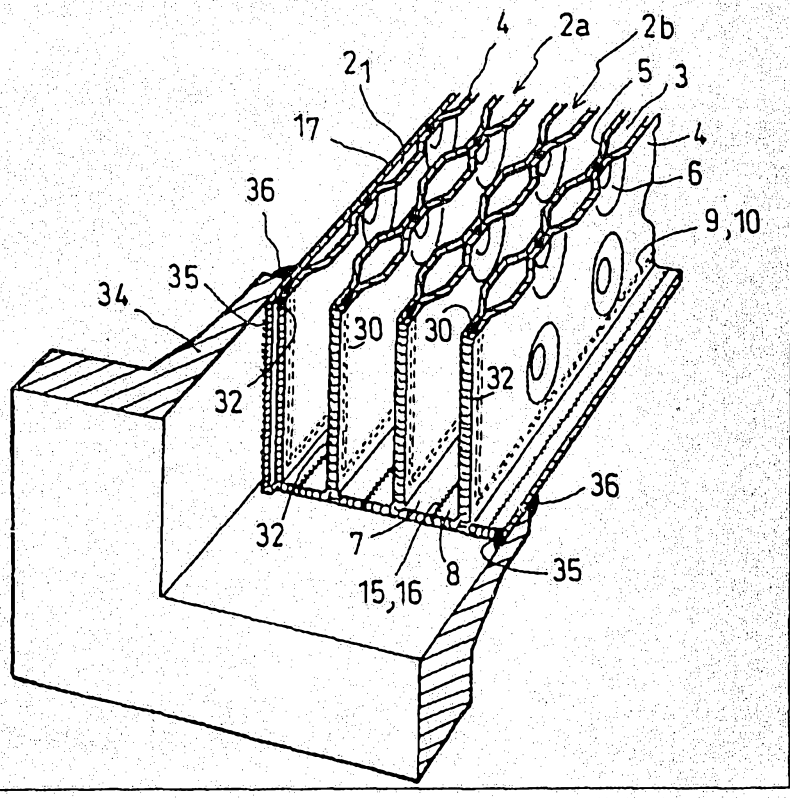
(54) Titre: PROCEDE D'ASSEMBLAGE DE BRIDES OU ANALOGUES DE RACCORDEMENT SUR UN FAISCEAU D'ECHANGEUR ET ECHANGEUR EN FAISANT APPLICATION

(57) Abstract

Heat exchanger characterized in that it involves welding, for each chamber (2), the parts of both plates (3, 4) corresponding to the transversal sides; fitting to each end a collar or binding (34); joining by means of internal (35) and external (36) peripheral welding each collar or binding (34) fitted to each transversal end, using the collar or binding (34) as a flange or similar attachment part. Application to plate-type exchangers.

(57) Abrégé

L'échangeur est caractérisé en ce qu'il consiste à: souder entre elles, pour chaque chambre (2), les parties des deux plaques (3, 4) correspondant aux côtés transversaux, emboîter sur chaque extrémité une frette ou ceinture (34), lier par soudure périphérique interne (35) et externe (36) chaque ceinture ou frette (34) emboîtée sur chaque extrémité transversale, utiliser la frette ou la ceinture (34) en tant que bride ou analogue de raccordement. Application aux échangeurs comportant un faisceau du type à plaques.



# A METHOD OF ASSEMBLING COUPLING MEMBERS TO A HEAT EXCHANGER BUNDLE, AND A HEAT EXCHANGER SO OBTAINED

## FIELD OF THE INVENTION

The present invention relates to the field of heat exchangers for various fluids, and more specifically, it concerns the field of "plate" heat exchangers.

## PRIOR ART

It can be taken that heat exchangers of the above type have been known for some time. Plate manufacturing technology may be considered as now being mature, even though improvements can still be made thereto.

However, heat exchangers of the above type sometimes suffer from structural defects in the connection between the plates and their coupling members, with such defects behaving like cracks that put the two fluid circulation circuits that a heat exchanger generally defines or includes into communication with each other.

For a better understanding of the problem posed by such heat exchangers, reference is made to Figures 1 to 3, which show a heat exchanger that is representative of the prior art.

Such a plate type heat exchanger comprises a bundle 1 mainly constituted by a plurality of unit chambers 2a, ..., 2n which are all made in identical manner.

Each chamber 2 is made up of two plates 3 and 4 of conductive material, which plates are stamped to include indentations 5 and 6 that are regularly distributed in any suitable type of geometrical pattern and equally well be in alignment or staggered.

The plates 3 and 4 are also stamped to include oppositely-directed flanges 7 and 8 running along two parallel "longitudinal" sides.

A chamber 2 is made up by placing two plates 3 and 4 face to face and uniting them by spot welds in the bottoms of the indentations 5 and 6, and also by weld fillets 9 and 10 established along the longitudinal sides, and set in from the flanges 7 and 8.

The plates 3 and 4 are also united along two opposite "transverse" sides by respective weld fillets 11 and 12 established directly between the edges of the sides, or else via a welded metal strip L.

Each pair of plates thus constitutes a chamber or a first circuit $C_1$ whose inside volume, as defined by the touching indentations 5 and 6, is in communication with the outside via two passages 13 and 14 opening out between the adjacent flanges 7 and 8 as the result of local shaping imparted to the plates 3 and 4 during stamping.

A bundle 1 is obtained by juxtaposing a plurality of identical chambers 2 which are united by weld fillets 15 and 16 running along the facing oppositely-directed flanges 7 and 8.

In this way, two consecutive chambers 2 define a passage $C_2$ between them, thus constituting a second circuit independent from the first and opening out in the transverse sides of the bundle 1 built up in this way.

Figure 2 shows that a bundle 1 is made up of a given number of chambers 2 associated in the manner described above and finished off by fitting two end plates respectively referenced 4 and 3 that are secured by weld fillets 15 and 16, and each of which has a thick, plane, side end plate 17 fitted thereto and secured by welding, and that co-operates with the corresponding plate 4 or 3 to define a respective end chamber 2.

Starting from the above-described bundle 1, the heat exchanger is finished off by fitting two tubes 18 and 19 on the aligned flanges 7, 8 of the various chambers 2, thereby enabling the various internal circuits of the chambers to be connected to a network for supplying a heat exchanger fluid of any suitable type, for the purpose of supplying or removing heat.

As can be seen in Figures 1 and 3, the transverse sides of the bundle 1 are also fitted to two coupling members, or more specifically, two coupling manifolds 21

and 22 enabling the second internal circuit constituted by the plurality of passages $C_2$ to be connected to a network for supplying a fluid whose temperature is to be controlled.

In the prior art, such coupling members or manifolds are placed in end-to-end relationship with the transverse sides of the heat exchanger 1, and each of them is connected thereto via two peripheral weld fillers 23, 24, one on the inside, and the other on the outside.

As can be seen clearly in Figure 1, each weld fillet for each coupling member or manifold engages only relatively thin thicknesses of metal with two bonds at each transverse side for each manifold, and more particularly, at each weld 11 and at the corners of the oppositely-directly flanges 7 and 8, and also at the strips L, if any.

At the above-mentioned locations, it turns out that bonding of that kind gives rise to cracks due to mechanical fatigue generated by temperature variations, and also by vibration in operation and by stresses due to assembly and fixing.

According to one aspect of the present invention there is provided a method of assembling coupling members to a heat exchanger bundle of the type made up of a plurality of individual chambers, each formed by two conductive plates bonded along their "longitudinal" sides via oppositely-directed flanges, and welded together in pairs to define an internal circuit that opens out at said longitudinal sides via two lateral openings opening out into two respective tubes for coupling them to a supply of a heat exchange fluid, said chambers being disposed side by side and being united by welding the facing flanges together, thereby defining respective passages between adjacent chambers that define a second circuit independent of the first and opening out at "transverse" sides into two coupling members disposed in end-to-end correspondence with the bundle for connection to a network for circulating a fluid that is to be cooled or heated; the method being characterised in that it consists in: for each chamber, welding together the portions of the two plates that correspond to the transverse sides; engaging a hoop or belt on each end; bonding each hoop or belt that is engaged on each transverse end by means of internal and external peripheral welding; and using the hoop or belt as a coupling member.

According to another aspect of the present invention there is provided a heat exchanger of the type comprising a bundle made up of a plurality of chambers, each formed by two

conductive plates bordered along their longitudinal sides by flanges and welded together to define an internal circuit opening out to said longitudinal sides via openings that open out into two tubes, said chambers being disposed side by side and being united via their facing flanges to define a passage constituting a second internal circuit, independent of the first and opening out at the transverse ends of the bundle, which ends are fitted with two coupling members, characterised in that the coupling members are fitted to the ends of the bundle by hoops or belts engaged on and welded to said ends via two peripheral welds, one internal and the other external.

Various other characteristics appear from the following description made with reference to the accompanying drawings that show implementations and embodiments of the invention as non-limiting examples.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a partially cutaway perspective view showing a prior art plate type heat exchanger.

Figure 2 is a fragmentary cross-section lying substantially in plane II-II of Figure 1.

Figure 3 is a section in elevation on a different scale showing a structural characteristic of a prior art heat exchanger.

Figure 4 is a partially cutaway perspective view on a larger scale showing the means of the invention.

Figure 5 is a partially cutaway perspective view showing the subject matter of the invention from a different angle.

Figure 6 is a fragmentary section in elevation showing up one of the characteristics of the method of the invention and the structural appearance of the heat exchanger obtained thereby.

Figures 7 and 8 are two partially cutaway perspective views showing two variant implementations of the method of the invention.

## BEST METHOD OF PERFORMING THE INVENTION

As described with reference to the prior art, in

Figures 4, 5, and 6, which relate to the invention, the method implemented consists in making up a bundle 1 of chambers 2, each of which is constituted by two plates 3 and 4 shaped as described above. Thus, the same references are used to designate the same component elements, portions, or members that are common to the prior art and to the present invention.

Figure 4 is a fragmentary perspective view showing a heat exchanger with only two of its chambers 2a and 2b being shown. It should naturally be understood that the bundle 1 could be made up of any number of chambers 2 associated together by bonding adjacent flanges 7 and 8 by weld fillets 15 and 16 running along their longitudinal sides.

However, according to the invention, provision is made for each chamber 2, $2_1$ to be implemented by using a transverse weld 30 that is established at each transverse side at a position that is set back from portions or edges 31 of the two plates 3 and 4 or 4 and 17. The transverse weld 30 is established over the entire length or height or width, i.e. the distance between the longitudinal sides themselves, as constituted by the flanges 7, 8 or by the welds 9 and 10 which unite the plates 3 and 4 or 4 and 17 along said longitudinal sides.

The extent to which the weld 30 is set back from the portions or edges 31 is not less than the width of the weld, but it is preferably greater than that. The essential point is to perform such welding 30 in such a manner that intimate bonding is established peripherally with connections to the welds 9 and 10. The weld 30 is preferably seam welded, although it may be considered that other appropriate means could equally well be implemented.

In another stage of the method of building up each chamber 2, provision is advantageously also made, additionally to unite the plates 3 and 4 and the plates 4 and 17 at the transverse sides thereof by means of a weld

fillet 32 that unites the edges 31 of the two plates. The weld fillet 32 is established conventionally and backs up the weld 30 so as to ensure sealing and genuine physical separation between the internal first circuit $C_1$ of the chamber 2 and the adjacent passages $C_2$ provided by associating two chambers together, such as the chambers 2a and 2b.

In another disposition of the invention, the fillet 32 is preferably also established to form or to connect with a filler weld 33 which is executed between the transverse edges 31 of the flanges 7 and 8, running all along said edges up to the openings 13 that are designed, on either side, to be placed in mutual relationship with a corresponding one of the tubes 18 or 19.

The filler weld 33 is thus established over a range P that extends between the transverse side of the bundle made up in this way and the beginnings of the openings 13.

In another manufacturing stage of the method, provision may be made for a stage in which the range P is rectified or trued so as to level the filler welds 33 and achieve a surface state of acceptable planeness, even if not accurately rectified at each longitudinal side of the bundle.

In another disposition of the invention, the bundle 1 is subsequently added to by fitting a hoop or belt 34 at each transverse end, the hoop or belt being designed to receive said end portion so as to surround it completely, as can be seen in Figure 5. The hoop or belt 34 is then bonded to the corresponding end portion of the bundle 1 via two weld fillets 35 and 36 established peripherally on the inside and on the outside, respectively, as can be seen in Figures 5 and 6.

Figure 7 shows that the hoop or belt 34 may constitute a part of a manifold 21 or 22 or of a coupling member 40 for fitting to a manifold by any appropriate means, as illustrated in Figure 8. In either case, the

method and the assembly take place as described above so as to procure the following advantages.

Firstly, given that the hoop or belt 34 is fitted over the outside of the transverse terminal portion or end of the bundle 1, it can be given considerably greater thickness of material than is possible in the conventional method. This gives rise to a stronger mechanical bond between the coupling member and the bundle, and also to deformation that is reduced or even substantially non-existent when the weld fillets 35 and 36 are established.

Thereafter, the weld fillet 35 is intended to achieve peripheral bonding but, unlike the prior art, it is not required also to ensure sealing between the two internal circuits making up the bundle. Sealing between the internal circuit $C_1$ of each chamber 2 and the passages $C_2$ provided between pairs of adjacent chambers is ensured in effective manner by the line 30 and the fillet 32 for each chamber, and also by the connection established between each fillet 32 and the filler weld 33. In this way, the internal peripheral weld 35 may be executed solely for the purpose of joining together the flanges 7 and 8 lying in common planes on each longitudinal side, and also for making connection with the side plates 17.

Also, the bonding of each hoop or belt 34 by means of two weld fillets 35 and 36 serves to establish a robust mechanical bond that is also established by the presence of the range P which makes it possible to use interfitting dispositions having clearance tolerances that are acceptable, given manufacturing conditions, while nevertheless always being advantageous for achieving a fit that is suitable for providing improved mechanical strength.

Another advantage of the technique of the invention lies in the possibility of using coupling members that are solid and of considerable thickness, and which are

subject to little or no deformation while the welds 35 and 36 are being made.

Provision may thus be made to install the coupling members or manifolds after establishing rectified support planes, but without any subsequent correction operation being expected after bonding by welding to the bundle.

## POSSIBILITY OF INDUSTRIAL IMPLEMENTATION

It is thus possible to envisage setting up, in a workshop or a factory, two manufacturing lines, one serving solely to machine coupling members in parallel with bundles being manufactured on or along the other line, after which it is possible to execute an assembly operation without that giving rise to significant amounts of correction.

The invention is not limited to the examples described and shown, since various modifications can be made thereto without going beyond the ambit thereof.

CLAIMS

1/ ~~The~~ A method of assembling coupling members to a heat exchanger bundle of the type made up of a plurality of individual chambers, each formed by two conductive plates bonded along their "longitudinal" sides via oppositely-directed flanges, and welded together in pairs to define an internal circuit that opens out at said longitudinal sides via two lateral openings opening out into two respective tubes for coupling them to a supply of a heat exchange fluid, said chambers being disposed side by side and being united by welding the facing flanges together, thereby defining respective passages between adjacent chambers that define a second circuit independent of the first and opening out at "transverse" sides into two coupling members disposed in end-to-end correspondence with the bundle for connection to a network for circulating a fluid that is to be cooled or heated;

the method being characterized in that it consists in:

- for each chamber, welding together the portions of the two plates that correspond to the transverse sides;
- engaging a hoop or belt on each end;
- bonding each hoop or belt that is engaged on each transverse end by means of internal and external peripheral welding; and
- using the hoop or belt as a coupling member.

2/ A method according to claim 1, characterized in that the transverse portions of the ends of each pair of chamber-forming plates are welded together by executing a seam weld parallel to the transverse portions and set back therefrom, and over the entire extent between the flanges.

3/ A method according to claim 2, characterized in that the transverse portions at the ends of each chamber-forming pair of plates are welded together by also

executing a direct bond between the transverse portions by means of a weld fillet.

4. A method according to claim 3, characterised in that the weld fillet directly bonding together the transverse portions is executed in such a manner as to connect with filler welds executed to bond together the longitudinal sides of the plates, and running from the transverse ends thereof over a range corresponding to the extent of the overlapping engagement of the hoops or belts.

5. A method according to any one of claims 1 to 4, characterised in that the bundle is dressed, levelled or flattened on its parts which are engaged by the flanges.

6. A heat exchanger of the type comprising a bundle made up of a plurality of chambers, each formed by two conductive plates bordered along their longitudinal sides by flanges and welded together to define an internal circuit opening out to said longitudinal sides via openings that open out into two tubes, said chambers being disposed side by side and being united via their facing flanges to define a passage constituting a second internal circuit, independent of the first and opening out at the transverse ends of the bundle, which ends are fitted with two coupling members,

characterised in that

the coupling members are fitted to the ends of the bundle by hoops or belts engaged on and welded to said ends via two peripheral welds, one internal and the other external.

7. A heat exchanger according to claim 6, characterised in that the hoops or belts constitute integral portions of the coupling members.

8. A heat exchanger according to claim 6 or 7, characterised in that the each ends of the bundle is dressed or levelled on given width or depth from the edge of the bundle in order to form the part which is engaged by the hoops or belts.

9. A heat exchanger according to claim 6, characterised in that the plates are united with

one another at their transverse sides by welds established so as to be set back from the transverse portions or edges of said sides, and extending over the entire length between the longitudinal sides of the plates.

10. A heat exchanger according to claim 9, characterised in that the plates are also united to one another at each transverse side by means of a respective weld fillet established along the edges.

11. A heat exchanger according to claim 10, characterised in that each weld fillet established along an edge connects with filler welds performed along or within the width or depth of the bundle that forms the range.

12. A method of assembly coupling members to a heat exchanger substantially as hereinbefore described with reference to Figures 4 to 8.

13. A heat exchanger substantially as hereinbefore described with reference to Figures 4 to 8.

Dated this 31st day of July, 1997

**BARRIQUAND ECHANGEURS**

By Their Patent Attorneys

DAVIES COLLISON CAVE

## A B S T R A C T

A heat exchanger characterized in that it consists in:

- for each chamber, welding together the portions of the two plates that correspond to the transverse sides;
- engaging a hoop or belt on each end;
- bonding each hoop or belt that is engaged on each transverse end by means of internal and external peripheral welding; and
- using the hoop or belt as a coupling member.

The invention is applicable to heat exchangers including a plate type bundle.

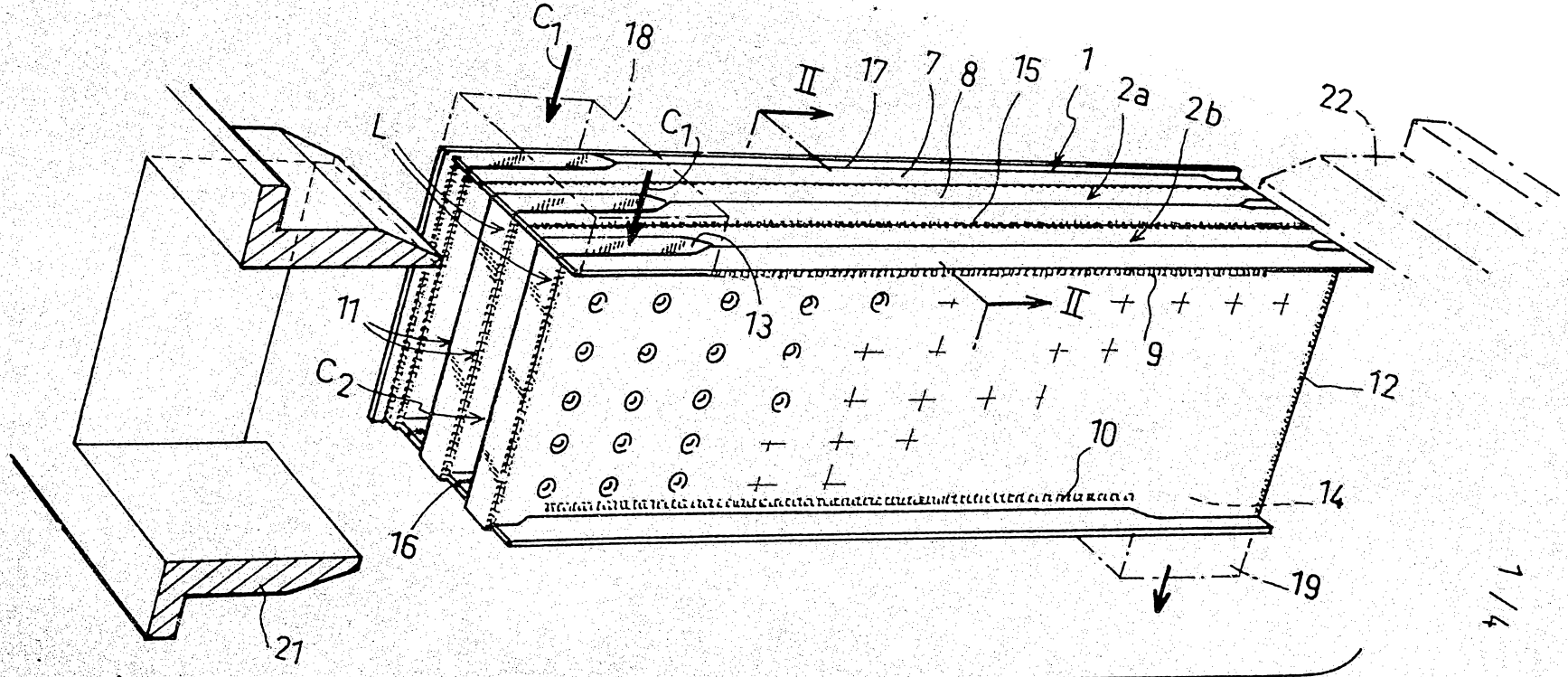



FIG_1

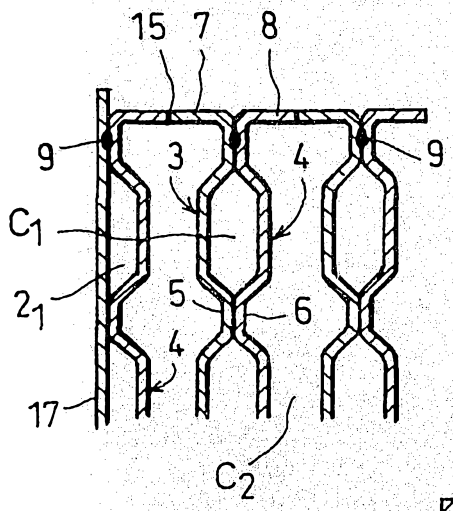



FIG_2

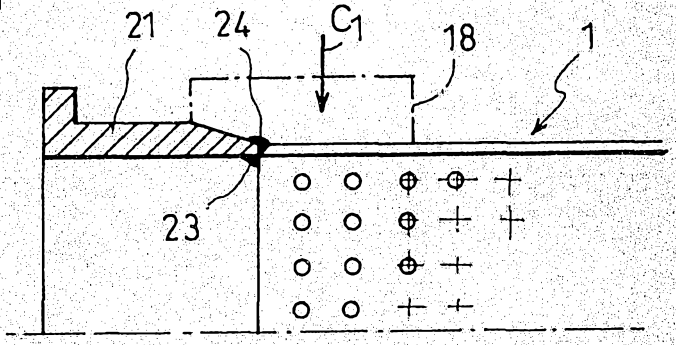



FIG_3

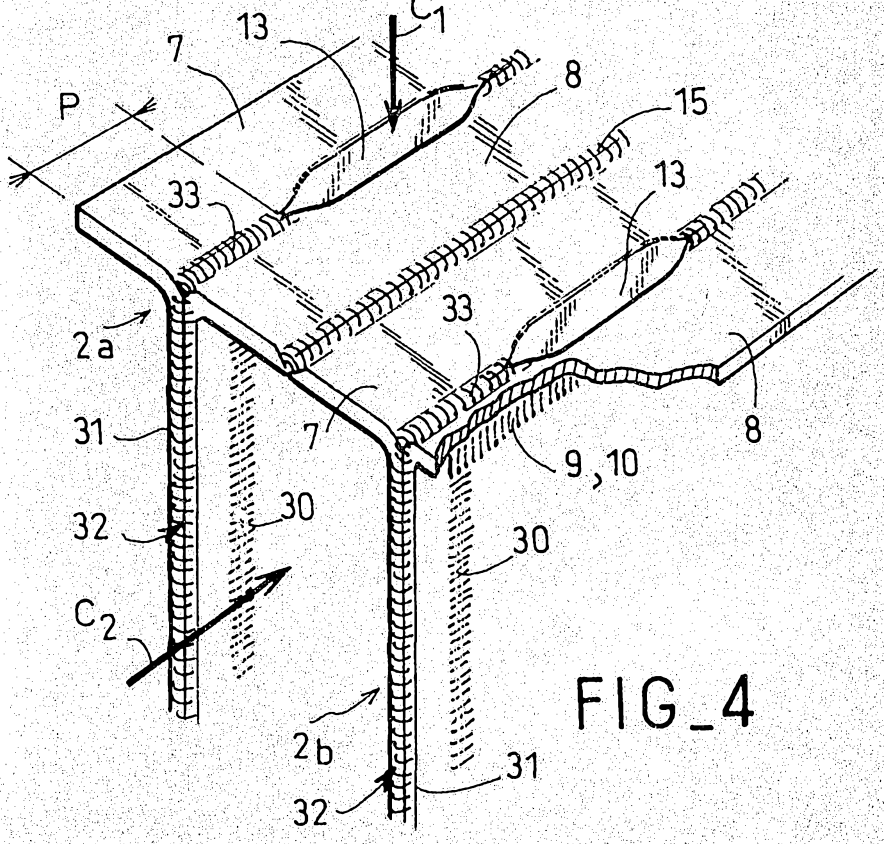



FIG_4

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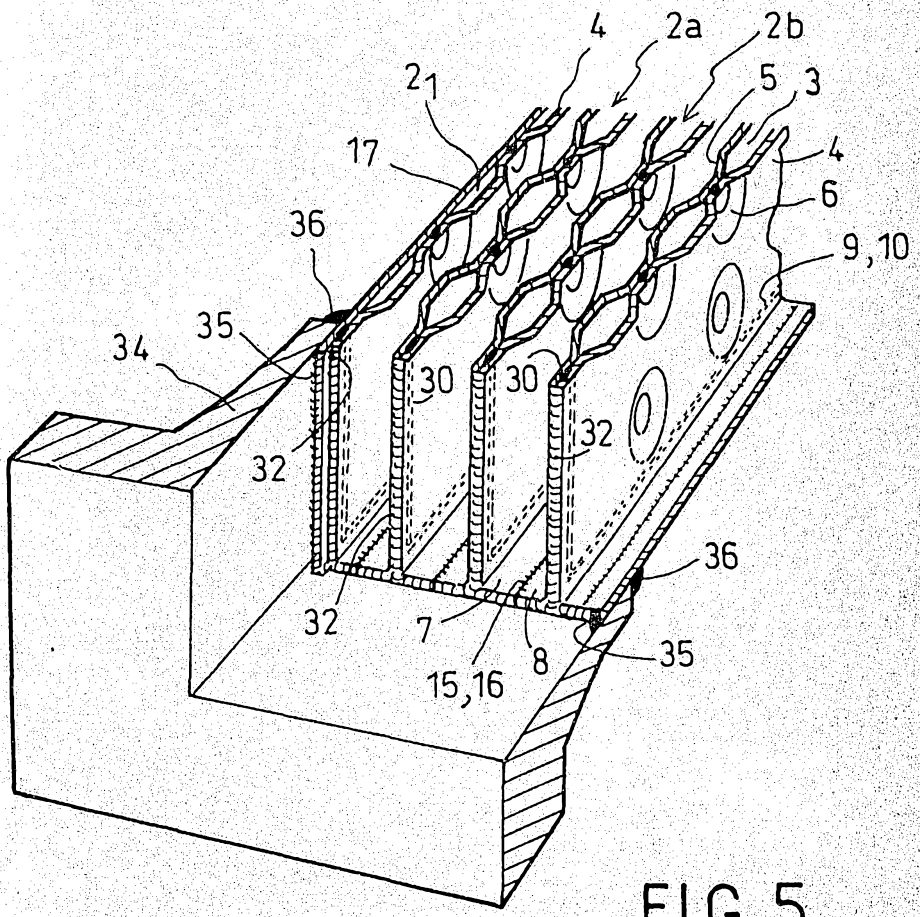


FIG_5

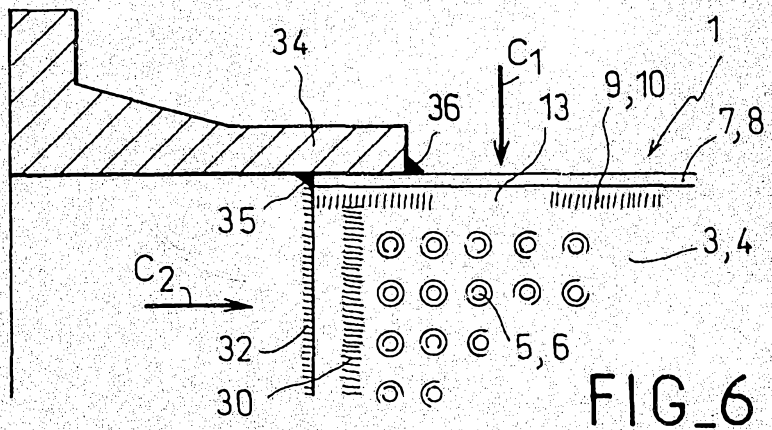


FIG_6

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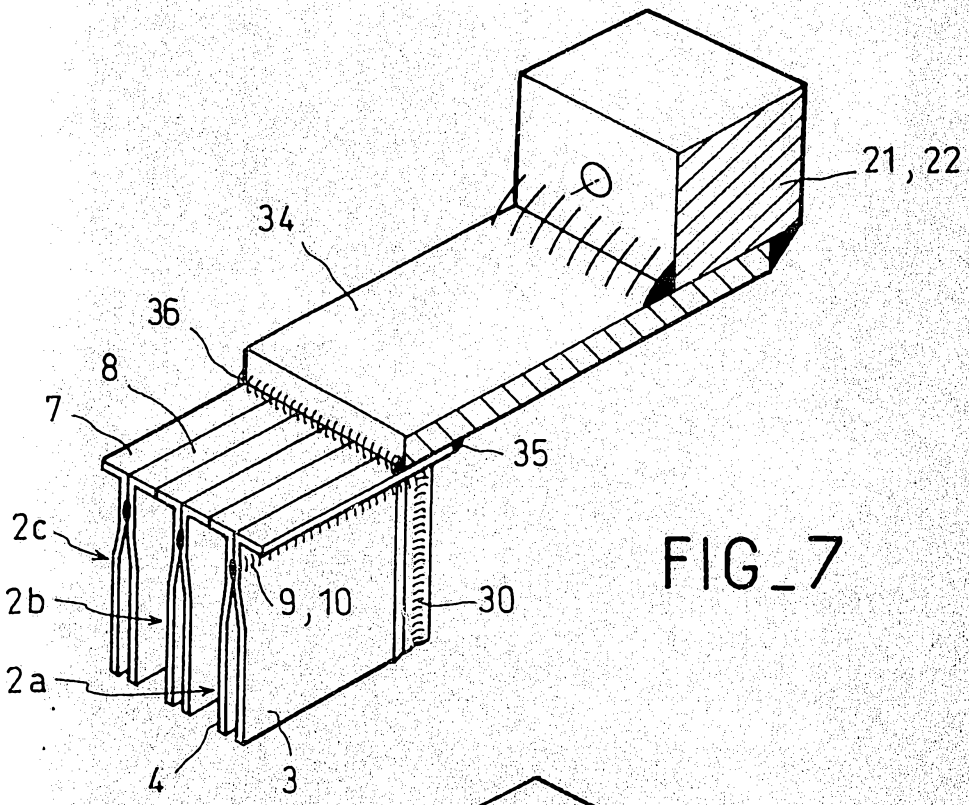


FIG_7

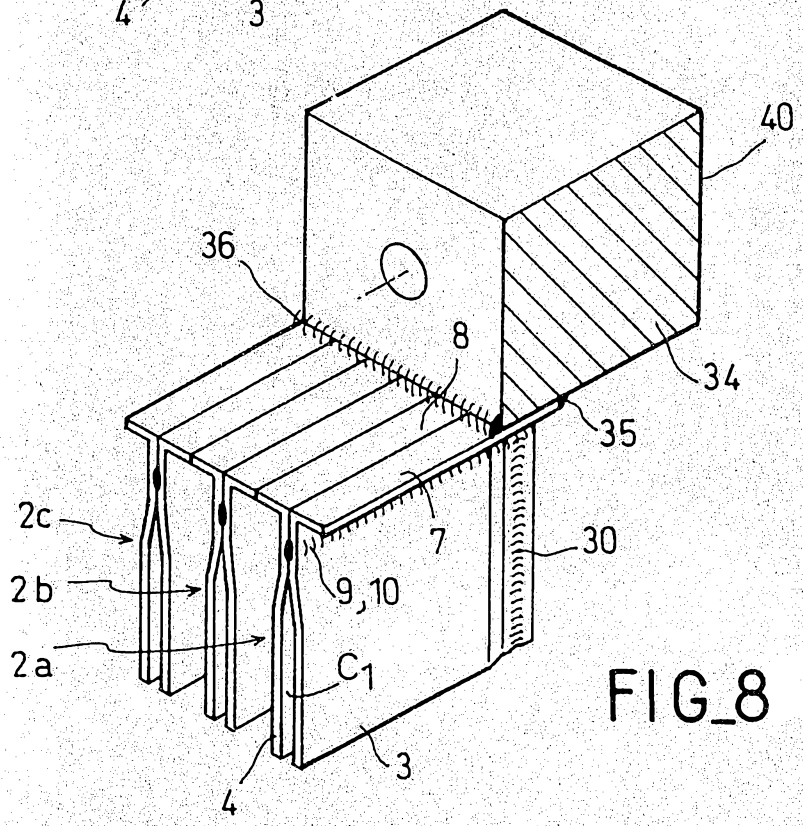


FIG_8

# INTERNATIONAL SEARCH REPORT

Interna al Application No
PCT/FR 94/00337

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 B23K11/06 F28F3/12

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)
IPC 5 B23K F28F

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | PATENT ABSTRACTS OF JAPAN vol. 007, no. 170 (E-189) 27 July 1983 & JP,A,58 077 218 (TOKYO SHIBAURA DENKI KK) 10 May 1983 see abstract | 1-7 |
| Y | PATENT ABSTRACTS OF JAPAN vol. 005, no. 187 (M-098) 26 November 1981 & JP,A,56 105 874 (NIPPON STAINLESS STEEL CO LTD) 22 August 1981 see abstract | 1-3 |
| Y | DE,U,16 53 900 (R. FLENDER) 16 April 1953 see claims 1,2; figures 1-3 | 4-7 |

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 6 June 1994 | 03.08.94 |
| Name and mailing address of the ISA<br>European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,<br>Fax (+31-70) 340-3016 | Authorized officer<br>Wunderlich, J |

Form PCT/ISA/210 (second sheet) (July 1992)

# INTERNATIONAL SEARCH REPORT

information on patent family members

Intern. al Application No
PCT/FR 94/00337

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| DE-U-1653900 | | NONE | |

# RAPPORT DE RECHERCHE INTERNATIONALE

Demande Internationale No
PCT/FR 94/00337

A. CLASSEMENT DE L'OBJET DE LA DEMANDE
CIB 5 B23K11/06 F28F3/12

Selon la classification internationale des brevets (CIB) ou à la fois selon la classification nationale et la CIB

B. DOMAINES SUR LESQUELS LA RECHERCHE A PORTE

Documentation minimale consultée (système de classification suivi des symboles de classement)
CIB 5 B23K F28F

Documentation consultée autre que la documentation minimale dans la mesure où ces documents relèvent des domaines sur lesquels a porté la recherche

Base de données électronique consultée au cours de la recherche internationale (nom de la base de données, et si cela est réalisable, termes de recherche utilisés)

C. DOCUMENTS CONSIDERES COMME PERTINENTS

| Catégorie * | Identification des documents cités, avec, le cas échéant, l'indication des passages pertinents | no. des revendications visées |
|---|---|---|
| Y | PATENT ABSTRACTS OF JAPAN<br>vol. 007, no. 170 (E-189) 27 Juillet 1983<br>& JP,A,58 077 218 (TOKYO SHIBAURA DENKI KK) 10 Mai 1983<br>voir abrégé | 1-7 |
| Y | PATENT ABSTRACTS OF JAPAN<br>vol. 005, no. 187 (M-098) 26 Novembre 1981<br>& JP,A,56 105 874 (NIPPON STAINLESS STEEL CO LTD) 22 Août 1981<br>voir abrégé | 1-3 |
| Y | DE,U,16 53 900 (R. FLENDER) 16 Avril 1953<br>voir revendications 1,2; figures 1-3 | 4-7 |

☐ Voir la suite du cadre C pour la fin de la liste des documents

☒ Les documents de familles de brevets sont indiqués en annexe

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| DE-U-1653900 | | AUCUN | |