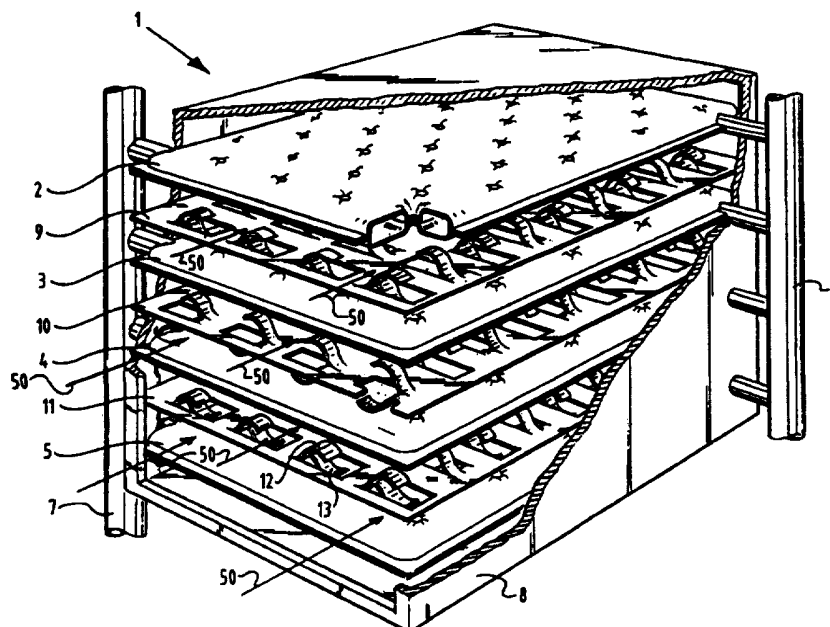




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(21) International Application Number: PCT/NL95/00438 (22) International Filing Date: 20 December 1995 (20.12.95) (30) Priority Data: 9402186 22 December 1994 (22.12.94) NL (71) Applicant (for all designated States except US): HELPMAN INTELLECTUAL PROPERTIES B.V. [NL/NL]; Huizerstraatweg 111, NL-1411 GM Naarden (NL). (72) Inventor; and (75) Inventor/Applicant (for US only): BERTELS, Augustinus, Wilhelmus, Maria [NL/NL]; Utrechtseweg 437, NL-6865 CL Doorwerth (NL). (74) Agent: SCHUMANN, Bernard, Herman, Johan; Arnold & Siedsma, Sweelinckplein 1, NL-2517 GK The Hague (NL).		(81) Designated States: AL, AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, LS, MW, SD, SZ, UG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> <i>In English translation (filed in Dutch).</i>

(54) Title: DEVICE FOR ENHANCING HEAT TRANSFER BETWEEN A PLATE AND A MEDIUM

**(57) Abstract**

The invention provides a device for enhancing heat transfer between a heat-conducting plate (2, 4, 5), for instance forming part of a heat exchanger (1), and a medium flowing therealong, for instance a gas or a liquid, which device comprises: a plate (9, 10, 11) for placing in the medium flow such that the flow direction (50) is parallel to the principal plane of the plate, which plate bears lips (12, 13) which each have a substantially prismatic form, the principal direction of which substantially coincides with the flow direction (50), which plate (9, 10, 11) is placed relative to the heat-conducting plate such that the lips (12, 13) extend at a short distance therefrom or are in contact therewith.

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**DEVICE FOR ENHANCING HEAT TRANSFER
BETWEEN A PLATE AND A MEDIUM**

For the strongest possible heat exchanging contact between a medium and a heat-conducting plate, which for instance forms part of a heat exchanger, it is desirable that the medium flowing along the plate, for instance a
5 gas or a liquid, displays a turbulent flow pattern on the surface. The thermal boundary layer is hereby effectively broken up and the coefficient of heat transfer can be increased considerably without this being accompanied by substantially increased pressure losses.

10 With a view to the above the invention provides a device for enhancing heat transfer between a heat-conducting plate, for instance forming part of a heat exchanger, and a medium flowing therealong, for instance a gas or a liquid, which device comprises:

15 a plate for placing in the medium flow such that the flow direction is parallel to the principal plane of the plate,

which plate bears lips which each have a substantially prismatic form, the principal direction of which
20 substantially coincides with the flow direction,

which plate is placed relative to the heat-conducting plate such that the lips extend at a short distance therefrom or are in contact therewith.

25 Surprisingly, it has been found that the described form of the lips can cause a very strong turbulent flow accompanied by a correspondingly low thermal resistance.

The device is preferably embodied such that the lips are placed in staggered manner.

30 A preferred embodiment has the special feature that the lips incline upward with a smooth transition out of the principal plane and have a bent back free end zone.

A simple and effective embodiment has the special feature that the lips have a rectangular form and are connected on a short side to the plate.

5 A surprisingly solid effectiveness is obtained with an embodiment in which the said short side connects onto two continuous holes in the plate, between which holes extends a corrugated lip portion. This structure ensures that the lips can be very easily pressed elastically.

10 Simple in terms of production technique is the embodiment in which the lips are pressed out of the principal plane of the plate. Use can be made for this purpose of a punching device which, while retaining one connecting edge, separates the lips from the rest of the plate and presses them out of the principal plane of the
15 plate.

An increase in the turbulent character of the medium flow is obtained with an embodiment in which the projections of the lips mutually intersect in the flow direction.

20 The plate according to the invention preferably has the special feature that the plate is adapted for positioning in adjoining relation to a plate which is in heat exchanging co-action with the medium. For instance for use in a heat exchanger with a plurality of heat exchanging
25 fins or flat hollow panels located at mutual distance, the plates according to the invention can be placed between these layers. It will be apparent that for the greatest possible effectiveness the plate according to the invention must be active over the greatest possible
30 part of the heat exchanging surface.

Attention is drawn to the fact that, for instance in the context of use in a heat exchanger of the described type, the lips can protrude from the plate on either side thereof.

35 A specific embodiment is that in which the plate consists substantially of steel, for instance stainless steel or spring steel.

For the sake of completeness attention is drawn to the fact that the lips can also be separate elements which are connected to a plate in suitable manner, for instance by glueing, soldering, (resistance) welding, with rivets etc.

The invention will now be elucidated with reference to the annexed drawing. Herein:

figure 1 shows a partly broken away perspective view of a heat exchanger with a device according to the invention;

figure 2 is a view corresponding with figure 1 of another heat exchanger;

figure 3 shows partially in front view, partially in cross section a heat exchanger in another embodiment;

figure 4 shows a partly broken away perspective view in the form of an exploded view of yet another heat exchanger with a device according to the invention;

figure 5 shows a cross section through a detail of a heat exchanger with devices according to the invention;

figure 6 is a perspective view on enlarged scale of a part of a device according to the invention; and

figure 7 is a perspective view corresponding with figure 6 of a preferred embodiment.

Figure 1 shows a heat exchanger 1 with four plates 2-5 through which medium can flow and which are connected to an inlet manifold 6 and an outlet manifold 7. The plates 2-5 are arranged in a housing 8 which via connections (not shown) is also incorporated in a second medium flow for heat exchanging contact with medium flowing through plates 2-5.

Between plates 2-5 are placed three plates 9,10,11 according to the invention. These are all embodied identically. They bear on either side of the plate lips 12,13 which protrude out of the principal plane of the plate and which each have a substantially prismatic form, the principal direction of which at least more or less coincides with the direction of flow of the medium flowing past. Each lip 12,13 inclines upward with a smooth tran-

sition out of the principal plane of the relevant plate and has a bent back free end zone. Each lip has a rectangular form and is connected to the associated plate with a short side. The lips are formed by punching and a
5 working wherein the lip is pressed out of the principal plane of the plate.

For the sake of clarity the respective plates in figure 1 (and also in figure 2) are drawn at some mutual distance. For the purpose of a good heat transfer it is
10 recommended however that each lip extends in the immediate vicinity of an adjoining heat-conducting plate or is in contact therewith.

Figure 2 shows a heat exchanger 14 wherein, at variance with the embodiment of figure 1, use is made of
15 a zigzag-folded hollow panel 15, between the layers of which extend the plates 9,10,11 according to the invention.

Figure 3 shows a heat exchanger 16 wherein the housing 17, at variance with the housings according to
20 figures 1 and 2, has a cylindrical form. This heat exchanger 16 also has a zigzag-formed hollow panel 18 through which medium can flow, between the layers of which extend plates according to the invention, which are designated respectively 19,20,21,22,23,24,25. This figure
25 clearly shows that the respective lips press against the adjoining surfaces of the panel 18. Attention is drawn to the fact that it can be seen more clearly in this figure 3 than in the preceding figures that the projections of the lips mutually intersect in the flow direction.

30 Figure 4 shows a heat exchanger 26. This comprises one spirally wound hollow plate 28 through which medium can flow via manifolds 26,27 and to which is connected a wound plate 29 according to the invention. For the sake of clarity in the drawing the plates 28 and 29 are drawn
35 in exploded view.

Figure 5 shows a part of a heat exchanger 30. This comprises a plurality of hollow panels 31 placed one above another through which medium can flow, plates 32

according to the invention placed between these panels 31 and plates 32 according to the invention placed inside these panels 31.

Figure 5 shows that the hollow plates, also those of the heat exchangers described in the foregoing, can be embodied as double-walled panel, the skin plates of which are locally connected by spot welds and which are deformed plastically to the shown form by supplying medium under pressure into the thus resulting interspace. The shown structure can be obtained by placing a plate 32 according to the invention beforehand between the skin plates 33,34.

Figure 6 shows schematically another embodiment in which each lip 36,37 is punched out individually.

Figure 7 shows a structure wherein each lip 38 has a rectangular form and is connected with a short side 39 to the associated plate 40. Connecting onto the ends of the short sides are two continuous holes 41,42 between which extends a corrugated lip part 43.

In all figures the flow direction is indicated with arrows 50. This direction coincides with the principal direction of the prismatic form of the lips.

CLAIMS

1. Device for enhancing heat transfer between a heat-conducting plate, for instance forming part of a heat exchanger, and a medium flowing therealong, for instance gas or a liquid, which device comprises:

5 a plate for placing in the medium flow such that the flow direction is parallel to the principal plane of the plate,

which plate bears lips which each have a substantially prismatic form, the principal direction of which
10 substantially coincides with the flow direction, and

which plate is placed relative to the heat-conducting plate such that the lips extend at a short distance therefrom or are in contact therewith.

2. Device as claimed in claim 1, wherein the lips
15 are placed in staggered manner.

3. Device as claimed in claim 1, wherein the lips incline upward with a smooth transition out of the principal plane and have a bent back free end zone.

4. Device as claimed in claim 1, wherein the lips
20 have a rectangular form and are connected on a short side to the plate.

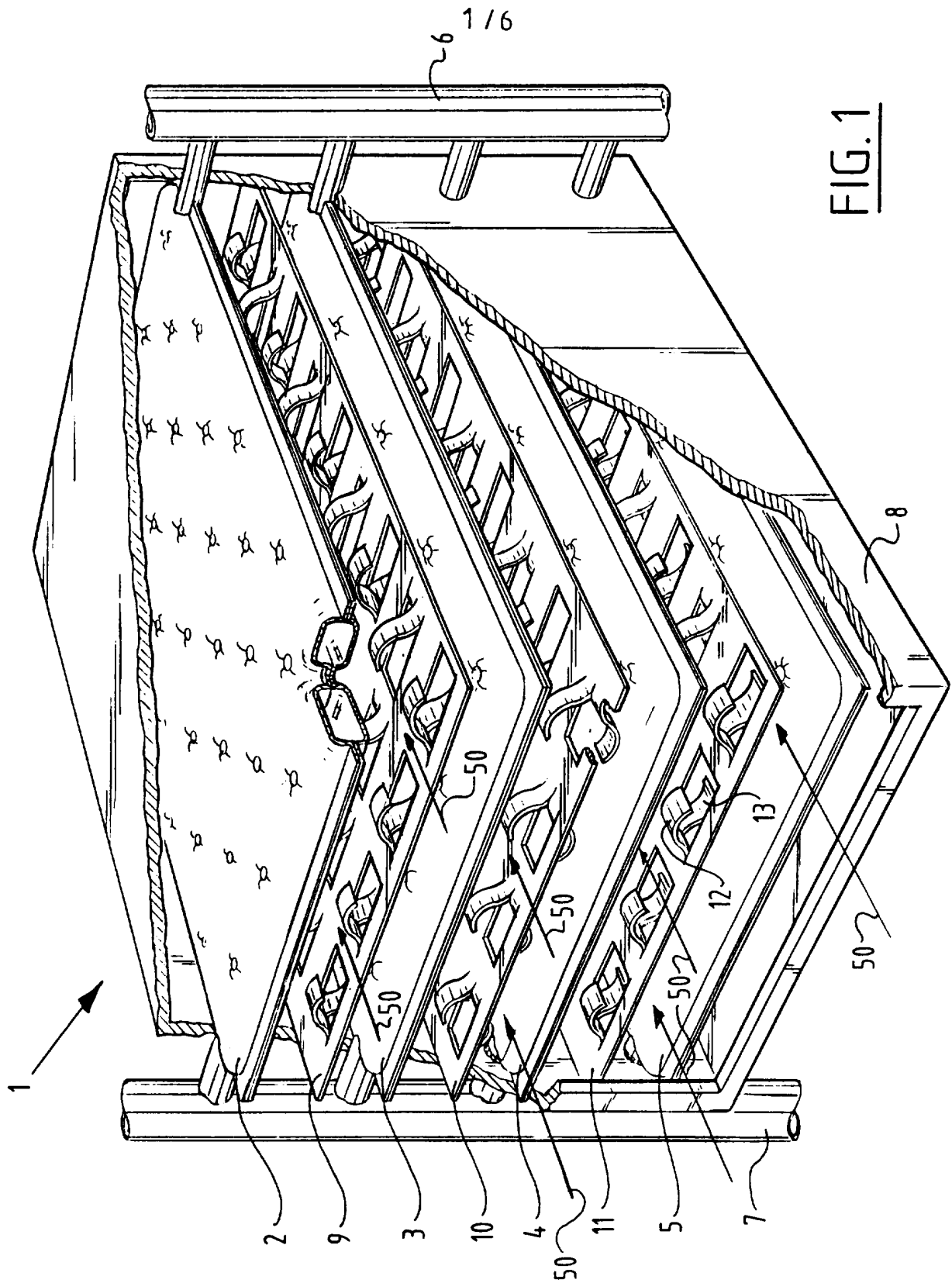
5. Device as claimed in claim 4, wherein the said short side connects onto two continuous holes in the plate, between which holes extends a corrugated lip
25 portion.

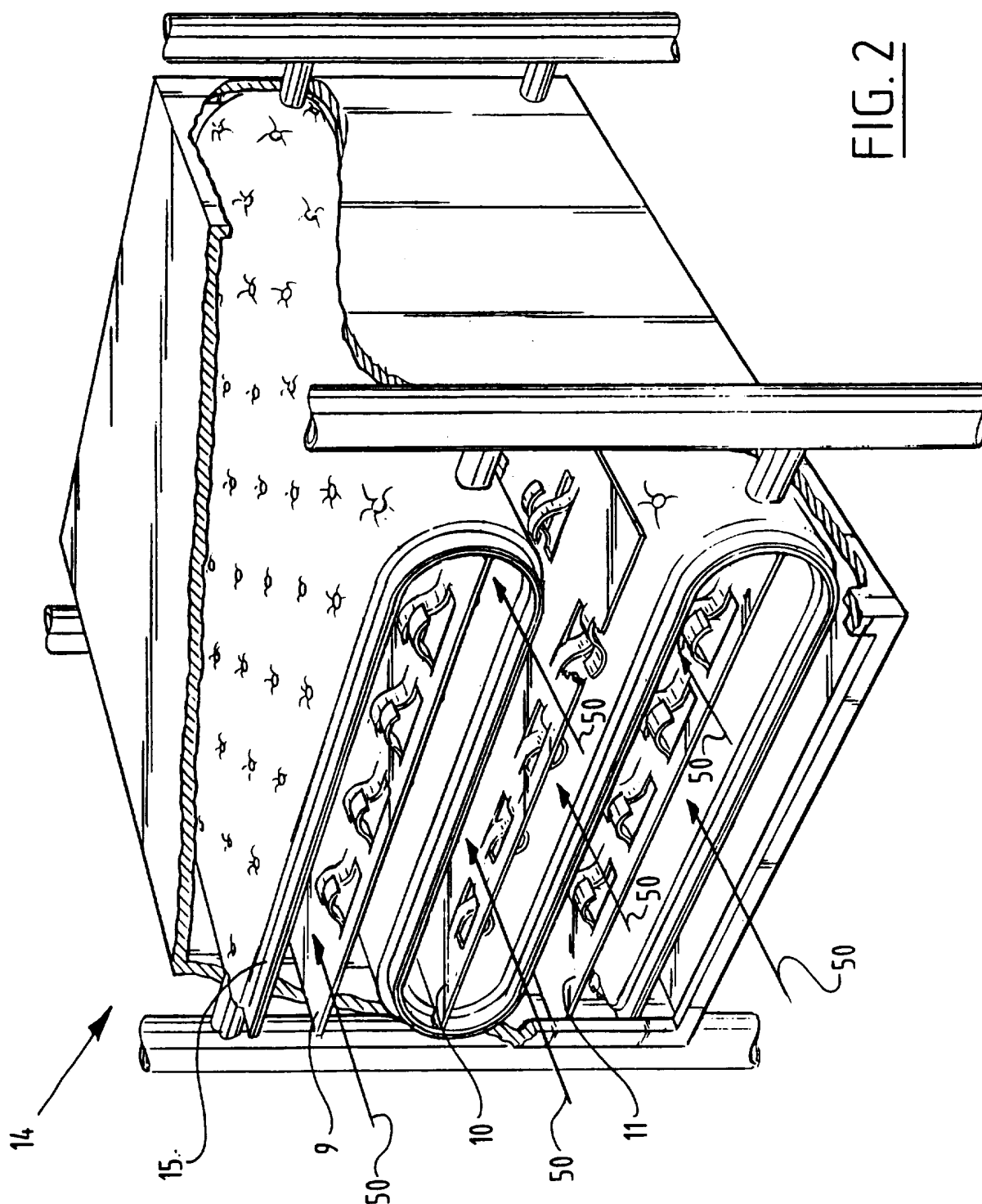
6. Device as claimed in claim 1, wherein the lips are pressed out of the principal plane of the plate.

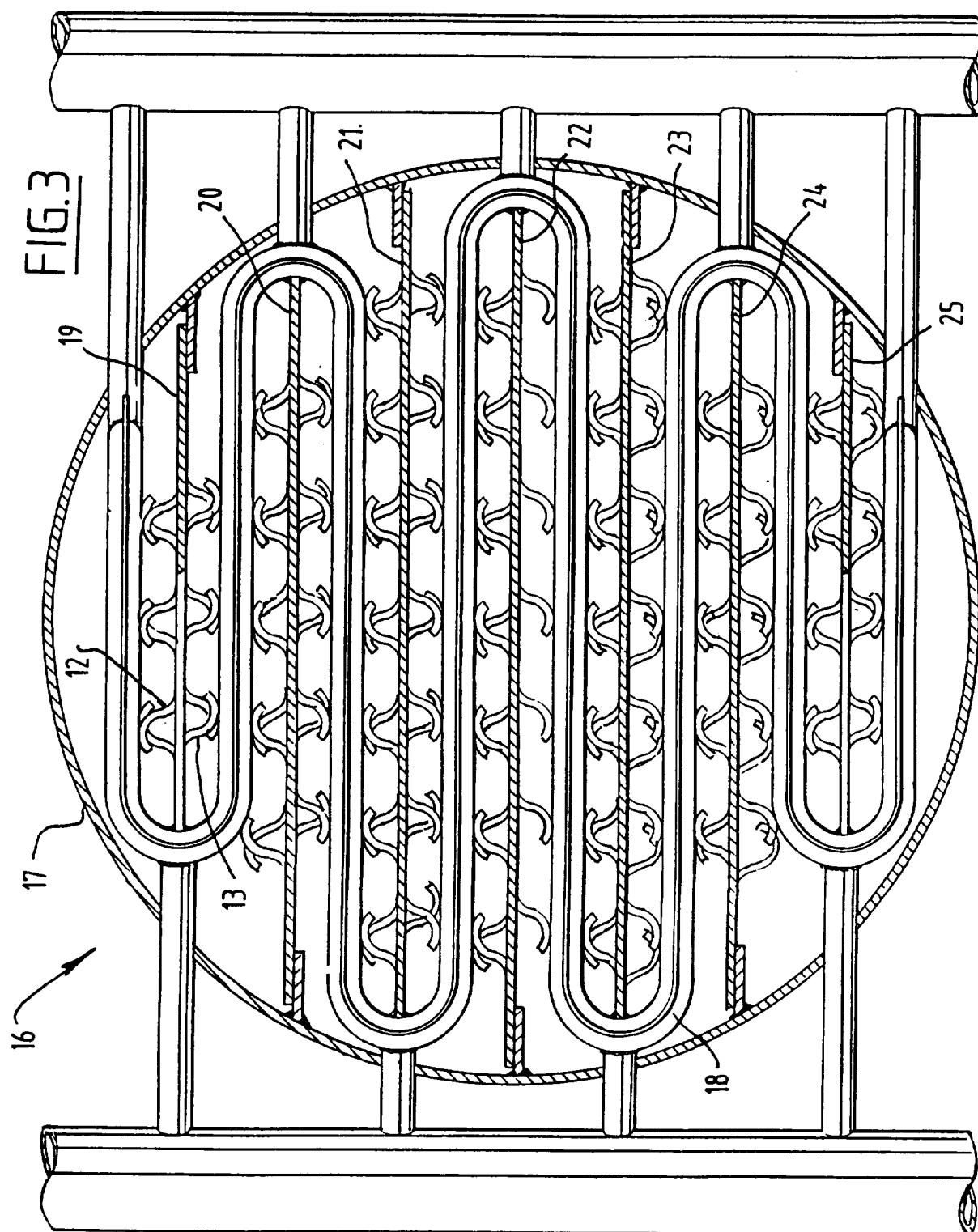
7. Device as claimed in claim 2, wherein the projections of the lips mutually intersect in the flow direction.
30 tion.

8. Device as claimed in claim 1, wherein the plate is adapted for positioning in adjoining relation to a plate which is in heat exchanging co-action with the medium.

9. Device as claimed in claim 1, wherein the plate consists substantially of steel, for instance stainless steel or spring steel.







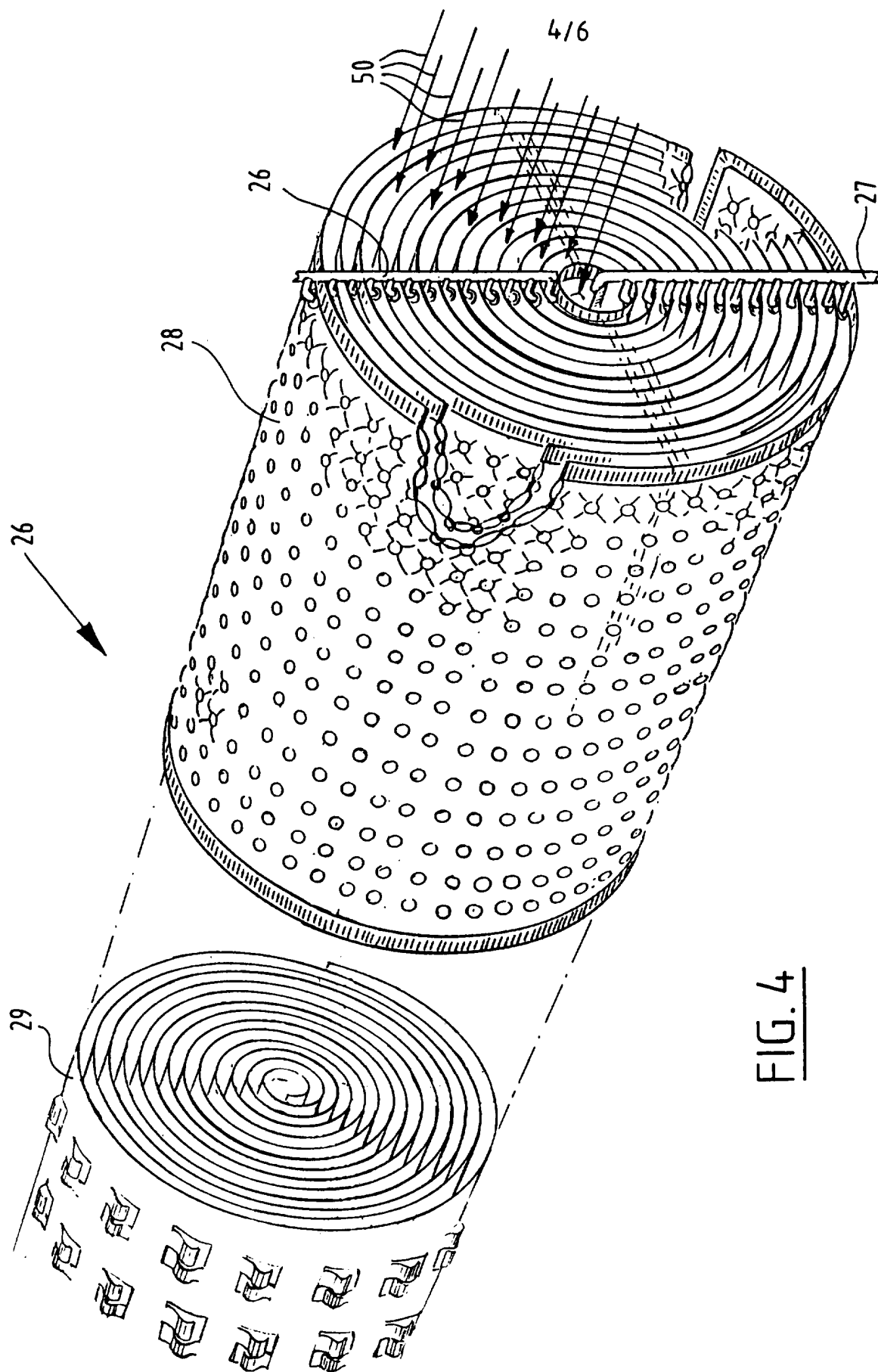


FIG. 4

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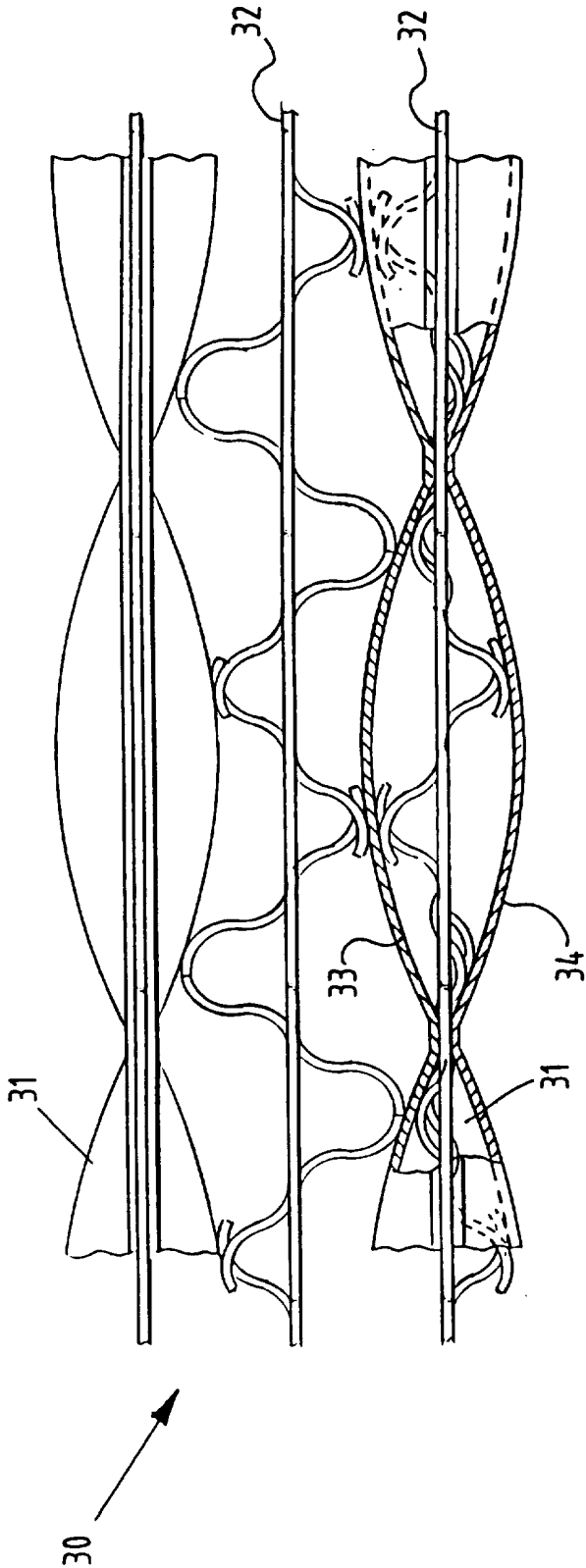
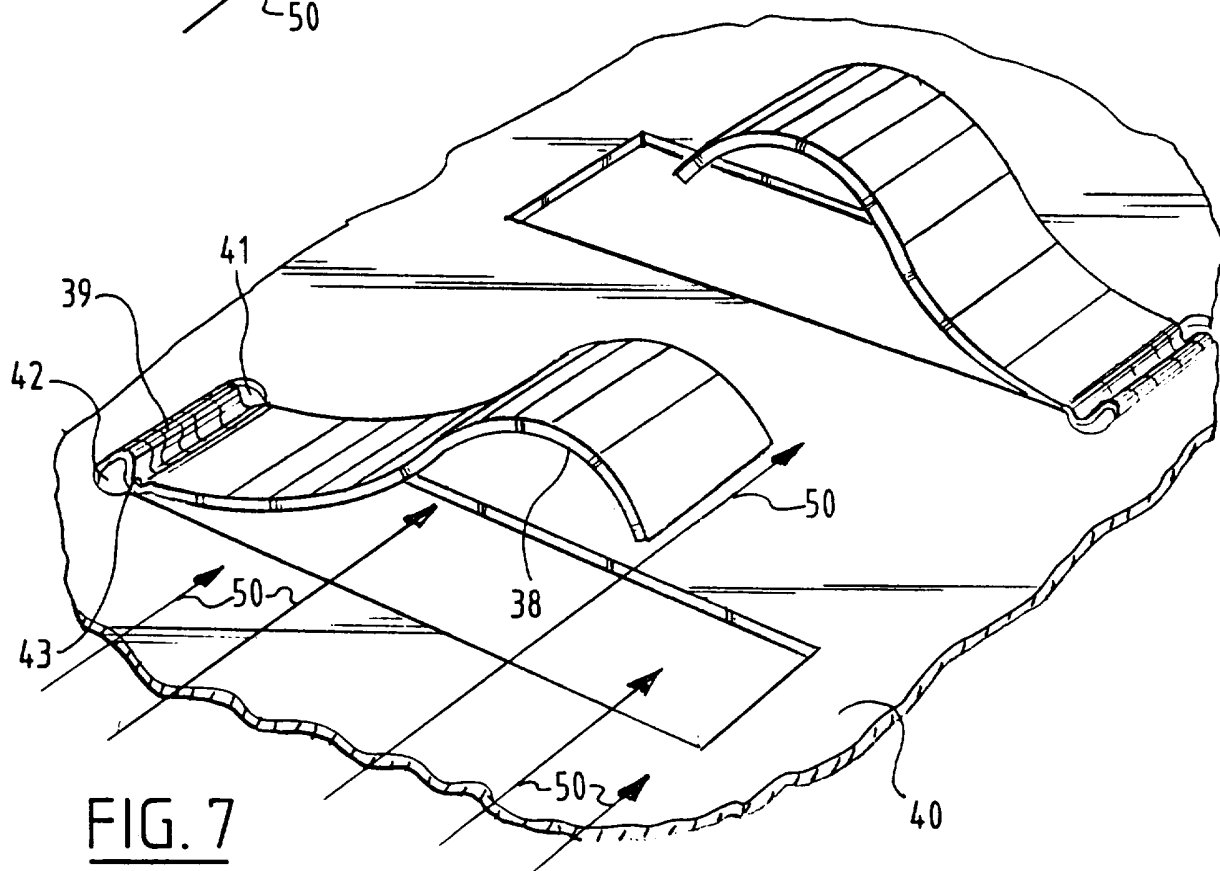
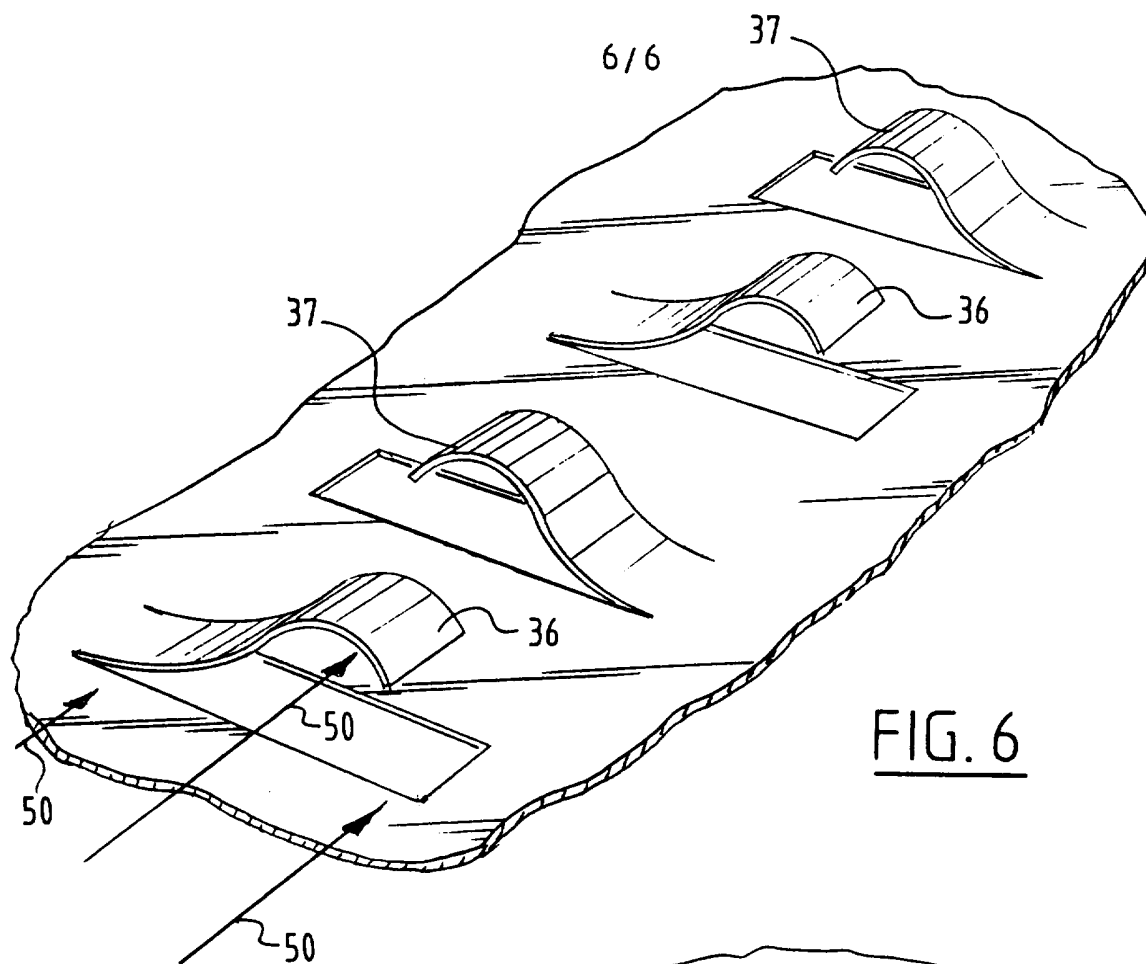


FIG. 5



INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 95/00438

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F28D9/04 F28F3/02

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 6 F28D 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.
X	DE,B,10 74 063 (GEA-LUFTKÜHLER) 28 January 1960 see column 4, line 16 - line 48; figure ---	1,8,9
A	US,A,4 899 812 (ALTOZ) 13 February 1990 see column 3, line 28 - line 60; figures 3A,3B,5A ---	1,3,8,9
A	EP,A,0 165 788 (MULOCK-BENTLEY) 27 December 1985 see page 3, line 8 - line 15 see page 5, line 14 - page 6, line 23; figures ---	1,2,7,8
A	GB,A,2 048 450 (COOKE) 10 December 1980 see page 1, line 35 - line 52 see page 1, line 109 - line 117; figure 1 --- -/--	1,6

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Date of the actual completion of the international search

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Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR,A,2 123 195 (CHAUSSON) 8 September 1972 see page 2, line 7 - line 34 see page 3, line 12 - line 35; figure 1 ---	1
A	FR,A,2 536 524 (NIBART) 25 May 1984 see page 6, line 1 - line 13; figure 3 ---	1
A	EP,A,0 122 667 (AWB) 24 October 1984 -----	

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US-A-4899812	13-02-90	NONE	
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GB-A-2048450	10-12-80	NONE	
FR-A-2123195	08-09-72	BE-A- 777179 BE-A- 778489 DE-A- 2163951 GB-A- 1360907 US-A- 3783938	17-04-72 16-05-72 17-08-72 24-07-74 08-01-74
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