(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 489 605 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
29.05.2019 Bulletin 2019/22

(51) Int Cl.:
F28D 9/00 *(2006.01)* ***F28F 3/10*** *(2006.01)*

(21) Application number: **18200291.5**

(22) Date of filing: **15.10.2018**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **22.11.2017 DK PA201700670**

(71) Applicant: **Danfoss A/S**
6430 Nordborg (DK)

(72) Inventor: **ANDERSEN, Benny**
6430 Nordborg (DK)

(74) Representative: **Petersen, Frank**
Danfoss A/S
Nordborgvej 81
6430 Nordborg (DK)

(54) **HEAT TRANSFER PLATE FOR PLATE HEAT EXCHANGER AND PLATE HEAT EXCHANGER WITH THE SAME**

(57) A heat transfer plate (10) for a plate heat exchanger (100) includes: a plate body (11) which has a gasket groove (12) with a groove wall (13, 14), the groove wall (13, 14) having a groove wall body (130, 140); and a ridge (20) disposed on the groove wall body (130, 140) of a segment (120) of the gasket groove (12) in a length direction of the gasket groove (12).

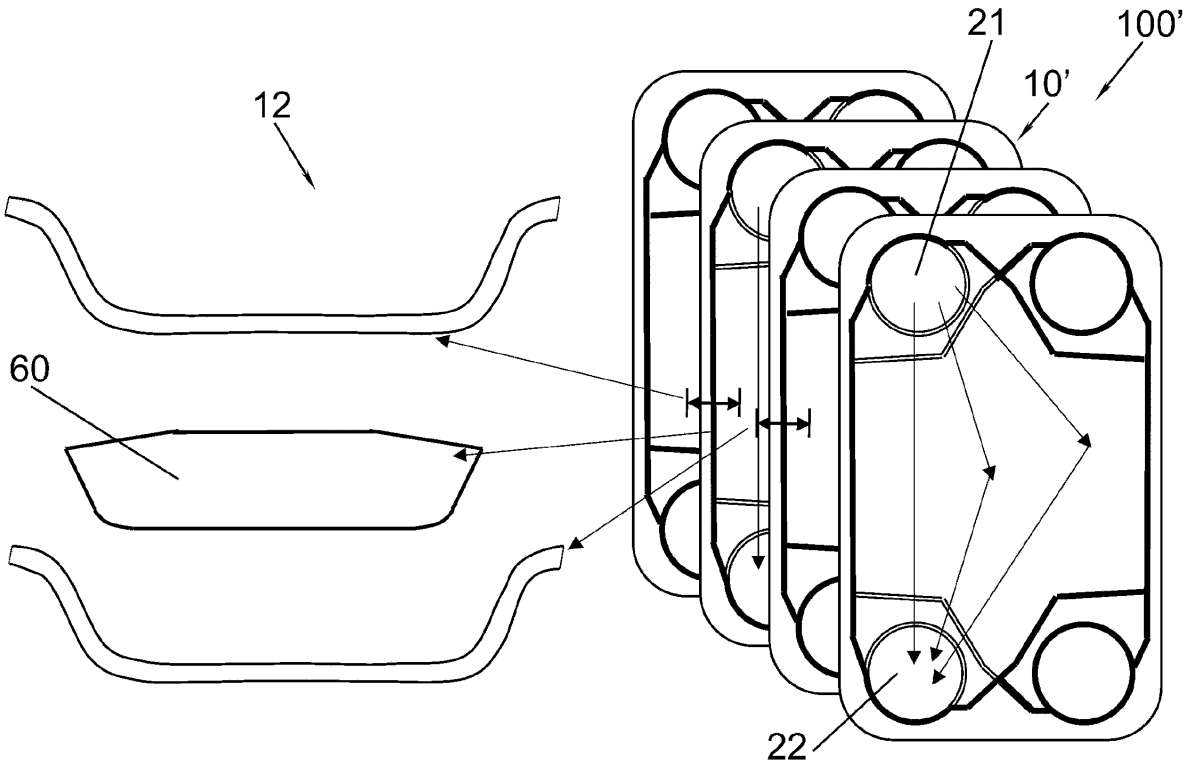

FIG. 1

EP 3 489 605 A1

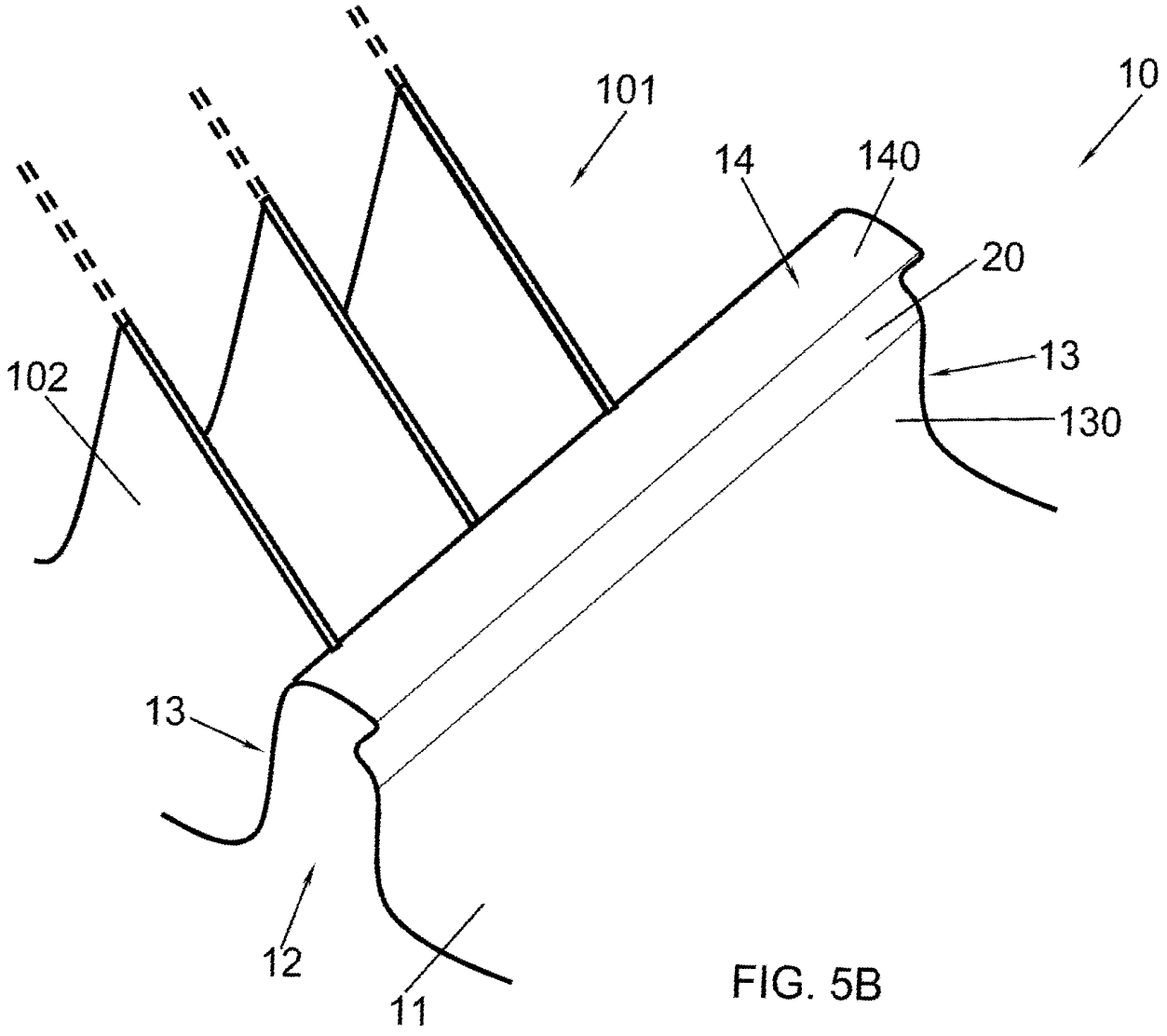

FIG. 5B

Description

TECHNICAL FIELD

[0001] Embodiments of the present disclosure relates to a heat transfer plate for a plate heat exchanger and a plate heat exchanger.

BACKGROUND

[0002] FIG. 1 shows a typical construction of a plate heat exchanger 100'. The plate heat exchanger 100' comprises a plurality of heat transfer plate 10' stacked on top of each other. The heat transfer plates 10' are formed with patterns such that flow paths are formed between each set of neighbouring heat transfer plates 10'. Openings 21 and 22 are formed in the heat transfer plates 10' to form inlets and outlets for fluids to these flow paths. Gaskets 60 are positioned between the heat transfer plates 10' in gasket grooves 12 formed in the heat transfer plates. The gasket is arranged at an edge portion of the heat transfer plate to seal the flow paths and at an area around the openings to seal pairs of the openings, such that only two of them have flow access to the flow path formed at one side of the heat transfer plate, while the other two is sealed therefrom.

[0003] FIG. 2 shows that the heat exchanger plates 10' are stacked and positioned between relatively thick and rigid top and bottom plates 51 and 52. Tension shown by arrows is then applied to the heat exchanger plates 10' to keep them close together and to squeeze the gaskets 60 slightly such that stable and fluid tight flow paths are formed. This tension typically is implemented through bolts (not shown) extending from the top plate 51 to the bottom plate 52.

[0004] The upper figure in FIG. 2 shows the state of the heat exchanger plates 10' before the tension is applied to them, while the lower figure in FIG. 2 shows a frequently experienced problem that this tension tends to prolong the heat exchanger plates 10', such as by several millimetres.

SUMMARY

[0005] The present disclosure provides a heat transfer plate for a plate heat exchanger and a plate heat exchanger that at least partly alleviate the prolongation of the heat transfer plates when tension is applied to the heat exchanger plates.

[0006] Embodiments of the present disclosure provide a heat transfer plate for a plate heat exchanger. The heat transfer plate comprises: a plate body which has a gasket groove with a groove wall, the groove wall having a groove wall body; and a ridge disposed on the groove wall body of a segment of the gasket groove in a length direction of the gasket groove.

[0007] According to embodiments of the present disclosure, the groove wall comprises two side walls and a bottom wall, each of the two side walls having a side wall body, the bottom wall having a bottom wall body, and the groove wall body comprising the side wall bodes and the bottom wall body; and the ridge is disposed on at least one of the bottom wall body and the side wall bodies of the segment of the gasket groove in the length direction of the gasket groove.

[0008] According to embodiments of the present disclosure, the ridge is projected from the groove wall body in a direction from an outside of the gasket groove toward an inside of the gasket groove.

[0009] According to embodiments of the present disclosure, the ridge is projected from the groove wall body in a direction from an inside of the gasket groove toward an outside of the gasket groove.

[0010] According to embodiments of the present disclosure, the ridge is projected from the at least one of the bottom wall body and the side wall bodies in a direction from an outside of the gasket groove toward an inside of the gasket groove.

[0011] According to embodiments of the present disclosure, the ridge is projected from the at least one of the bottom wall body and the side wall bodies in a direction from an inside of the gasket groove toward an outside of the gasket groove.

[0012] According to embodiments of the present disclosure, the heat transfer plate further comprises: a heat exchanging area surrounded by the gasket groove, and the ridge is disposed on one of the side wall bodies facing towards the heat exchanging area.

[0013] According to embodiments of the present disclosure, the heat transfer plate further comprises: a heat exchanging area surrounded by the gasket groove, and the ridge is disposed on one of the side wall bodies facing away from the heat exchanging area.

[0014] According to embodiments of the present disclosure, the ridge is disposed on at least one of the side wall bodies, and is closer to the bottom wall body than to the plate body.

[0015] According to embodiments of the present disclosure, the ridge is disposed on a middle portion of the bottom wall body in a width direction of the bottom wall body.

[0016] According to embodiments of the present disclosure, the heat transfer plate further comprises: a heat exchanging area surrounded by the gasket groove, and the ridge is disposed on a side of the bottom wall body facing towards the heat exchanging area in a width direction of the bottom wall body.

[0017] According to embodiments of the present disclosure, the heat transfer plate further comprises: a heat exchanging area surrounded by the gasket groove, and the ridge is disposed on a side of the bottom wall body facing away from the heat exchanging area in a width direction of the bottom wall body.

[0018] According to embodiments of the present disclosure, the segment of the gasket groove extends essentially parallel to an edge of the plate body.

[0019] According to embodiments of the present disclosure, the segment of the gasket groove extends essentially parallel to a length direction of the plate body.

[0020] Embodiments of the present disclosure also provide a plate heat exchanger. The plate heat exchanger comprises: a plurality of abovementioned heat transfer plates which are stacked on top of each other; and gaskets disposed in the gasket grooves of some of the plurality of heat transfer plates.

[0021] These and other objects, features and advantages of the present disclosure will become apparent in light of the detailed description of embodiments thereof, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

FIG. 1 is a schematic view of a prior art plate heat exchanger;

FIG. 2 is a schematic view showing states of heat transfer plates of the plate heat exchanger of FIG 1 before and after tension is applied to them;

FIG. 3 is a schematic view of a plate heat exchanger according to an embodiment of the present disclosure;

FIG. 4 is a schematic view of a heat transfer plate of the plate heat exchanger of FIG. 3.

FIG. 5A is a schematic partially enlarged sectional view of the heat transfer plate according to an embodiment of the present disclosure, taken along the line AA in FIG. 4;

FIG. 5B is a schematic partially enlarged perspective view of the heat transfer plate of FIG 5A;

FIG. 6A is a schematic partially enlarged sectional view of the heat transfer plate according to another embodiment of the present disclosure, taken along the line AA in FIG. 4;

FIG. 6B is a schematic partially enlarged perspective view of the heat transfer plate of FIG 6A;

FIG. 7 is a schematic partially enlarged sectional view of the heat transfer plate according to still another embodiment of the present disclosure, taken along the line AA in FIG. 4;

FIG. 8A is a schematic partially enlarged sectional view of the heat transfer plate according to yet another embodiment of the present disclosure, taken along the line AA in FIG. 4; and

FIG. 8B is a schematic partially enlarged perspective view of the heat transfer plate of FIG 8A.

DETAILED DESCRIPTION

[0023] Referring to FIGS. 3 and 4, a plate heat exchanger 100 according to an embodiment of the present disclosure is shown. The plate heat exchanger 100 comprises: a plurality of heat transfer plates 10 which are stacked on top of each other; and gaskets 60 (referring to FIG. 1) disposed in gasket grooves 12 of some of the plurality of heat transfer plates 10. The heat transfer plates 10 are formed with patterns such that flow paths are formed between each set of neighbouring heat transfer plates 10. Openings 21 and 22 are formed in the heat transfer plates 10 to form inlets and outlets for fluids to these flow paths.

[0024] Referring to FIGS. 3 to 8B, the heat transfer plate 10 comprises: a plate body 11 and a ridge 20. The plate body 11 has a gasket groove 12 with a groove wall 13, 14. The groove wall 13, 14 has a groove wall body 130, 140. The ridge 20 is disposed on the groove wall body 130, 140 of a segment 120 of the gasket groove 12 in a length direction of the gasket groove 12. The ridge 20 may be continuous. In addition, the ridge 20 may extend essentially parallel to an edge 121 of the plate body 11 or extends essentially parallel to a length direction of the plate body 11 (FIG. 4). The heat transfer plate 10 may be formed of a metal plate by pressing.

[0025] Referring to FIGS. 4 to 8B, the ridge 20 is projected from the groove wall body 130, 140 in a direction from an outside of the gasket groove 12 toward an inside of the gasket groove 12. Alternatively, the ridge 20 may also be projected from the groove wall body 130, 140 in a direction from an inside of the gasket groove 12 toward an outside of the gasket groove 12.

[0026] Referring to FIGS. 4 to 8B, in some embodiments, the groove wall 13, 14 comprises two side walls 13 and a bottom wall 14. Each of the two side walls 13 has a side wall body 130, the bottom wall 14 has a bottom wall body 140, and the groove wall body 130, 140 comprises the side wall bodes 130 and the bottom wall body 140. The ridge 20 is disposed on at least one of the bottom wall body 140 and the side wall bodies 130 of the segment 120 of the gasket groove 12 in the length direction of the gasket groove 12. As shown in FIGS. 4 to 8B, the ridge 20 is projected from the at least one of the bottom wall body 140 and the side wall bodies 130 in a direction from an outside of the gasket groove 12 toward an inside of the gasket groove 12. Alternatively, the ridge 20 may also be projected from the at least one of the bottom wall body 140 and the side wall bodies 130 in a direction from an inside of the gasket groove 12 toward an outside of the gasket groove 12.

[0027] Referring to FIGS. 4, 8A and 8B, FIG. 8A shows the cross section of a part of the gasket groove and its groove wall where the encircled part illustrates the ridge formed in the groove wall of the gasket groove. The heat transfer plate 10 further comprises: a heat exchanging area 101 surrounded by the gasket groove 12. In an embodiment, the ridge 20 is disposed on one of the side wall bodies 130 facing towards the heat exchanging area 101. In the present embodiment, corrugations 102 in the heat exchanging area 101 are integrated with the ridge 20, and accordingly are deformed slightly as indicated by the encircled part in FIG. 8B. Alternatively, referring to FIGS. 5A and 5B, the ridge 20 is disposed on one of the side wall bodies 130 facing away from the heat ex-

changing area 101. In some embodiments, referring to FIGS. 5A, 5B, 8A and 8B, the ridge 20 is disposed on at least one of the side wall bodies 130, and is closer to the bottom wall body 140 than to the plate body 11. Alternatively, the ridge 20 may be closer to the plate body 11 than to the bottom wall body 140, or the ridge 20 may also be disposed on a middle portion of at least one of the side wall bodies 130 in a width direction of the side wall body 130. The ridge 20 constitutes a barrier for protecting the heat exchanging area 101 as well as the groove wall 13, 14. Referring to FIGS. 5B, 6B, and 8B, in the heat exchanging area 101, the heat transfer plates 10 are formed with the chevron-shaped corrugations 102. However, the present invention is not limited to any structure formed in the heat exchanging area. For example, in the heat exchanging area 101, the heat transfer plates 10 may also be formed with other patterns such as bulges and hollows. The heat transfer plates 10 are reinforced by the ridge 20 to have sufficient rigidity, thereby preventing the elongation of the heat transfer plates 10 at least under the action of the tension. Although the figures show that the ridge 20 is disposed on one of the side wall bodies 130, the ridge may be formed in either or both of the side wall bodies 130.

[0028] Referring to FIGS. 6A and 6B, in another embodiment, the ridge 20 is disposed on a middle portion of the bottom wall body 140 in a width direction of the bottom wall body 140. Alternatively, referring to FIG. 7, the ridge 20 is disposed on a side of the bottom wall body 140 facing towards the heat exchanging area 101 in a width direction of the bottom wall body 140, or the ridge 20 may also be disposed on a side of the bottom wall body 140 facing away from the heat exchanging area 101 in the width direction of the bottom wall body 140.

[0029] Referring to FIG. 4, in some embodiments, the segment 120 of the gasket groove 12 provided with the ridge 20 extends essentially parallel to an edge 121 of the plate body 11 or extends essentially parallel to a length direction of the plate body 11. The segment 120 of the gasket groove 12 provided with the ridge 20 may have a length essentially equal to a length of an entire straight portion of the gasket groove 12. The straight portion of the gasket groove 12 is essentially parallel to the edge 121 of the plate body 11 or the length direction of the plate body 11.

[0030] Although in the embodiments, only one ridge 20 is formed on the groove wall body 130, 140, a plurality of ridge 20 may be formed on the groove wall body 130, 140. In addition, the figures shows that one of the bottom wall body 140 and the side wall bodies 130 is formed with the ridge 20, but all of the bottom wall body 140 and the side wall bodies 130, the bottom wall body 140 and one of the side wall bodies 130, or all of the side wall bodies 130 may be formed with the ridges 20.

[0031] While the figures shows that the gasket groove 12 has a U-shaped cross section, the cross section of the gasket groove 12 may have any other appropriate shapes, such as a V shape, and a semicircular shape.

[0032] With the heat transfer plate 10 and the plate heat exchanger 100 according to the embodiments of the present disclosure, the prolongation of the heat transfer plates 10 occurring when tension is applied to the heat exchanger plates can be at least partly alleviated.

[0033] While the principles of the present disclosure have been described herein, it is to be understood by those skilled in the art that this description is made only by way of example and not as a limitation as to the scope of the disclosure. Other embodiments are contemplated within the scope of the present disclosure in addition to the exemplary embodiments shown and described herein. Modifications and substitutions by one of ordinary skill in the art are considered to be within the scope of the present disclosure.

Claims

1. A heat transfer plate (10) for a plate heat exchanger (100), the heat transfer plate (10) comprising:

   a plate body (11) which has a gasket groove (12) with a groove wall (13, 14), the groove wall (13, 14) having a groove wall body (130, 140); and
   a ridge (20) disposed on the groove wall body (130, 140) of a segment (120) of the gasket groove (12) in a length direction of the gasket groove (12).

2. The heat transfer plate (10) of claim 1, wherein:

   the groove wall (13, 14) comprises two side walls (13) and a bottom wall (14), each of the two side walls (13) having a side wall body (130), the bottom wall (14) having a bottom wall body (140), and the groove wall body (130, 140) comprising the side wall bodes (130) and the bottom wall body (140); and
   the ridge (20) is disposed on at least one of the bottom wall body (140) and the side wall bodies (130) of the segment (120) of the gasket groove (12) in the length direction of the gasket groove (12).

3. The heat transfer plate (10) of claim 1, wherein:

   the ridge (20) is projected from the groove wall body (130, 140) in a direction from an outside of the gasket groove (12) toward an inside of the gasket groove (12).

4. The heat transfer plate (10) of claim 1, wherein:

   the ridge (20) is projected from the groove wall body (130, 140) in a direction from an inside of the gasket groove (12) toward an outside of the gasket groove (12).

5. The heat transfer plate (10) of claim 2, wherein:

the ridge (20) is projected from the at least one of the bottom wall body (140) and the side wall bodies (130) in a direction from an outside of the gasket groove (12) toward an inside of the gasket groove (12).

6. The heat transfer plate (10) of claim 2, wherein:

the ridge (20) is projected from the at least one of the bottom wall body (140) and the side wall bodies (130) in a direction from an inside of the gasket groove (12) toward an outside of the gasket groove (12).

7. The heat transfer plate (10) of any one of claims 2, 5 and 6, further comprising:

a heat exchanging area (101) surrounded by the gasket groove (12),
wherein the ridge (20) is disposed on one of the side wall bodies (130) facing towards the heat exchanging area (101).

8. The heat transfer plate (10) of any one of claims 2, 5 and 6, further comprising:

a heat exchanging area (101) surrounded by the gasket groove (12),
wherein the ridge (20) is disposed on one of the side wall bodies (130) facing away from the heat exchanging area (101).

9. The heat transfer plate (10) of any one of claims 2, 5 and 6, wherein:

the ridge (20) is disposed on at least one of the side wall bodies (130), and is closer to the bottom wall body (140) than to the plate body (11).

10. The heat transfer plate (10) of any one of claims 2, 5 and 6, wherein:

the ridge (20) is disposed on a middle portion of the bottom wall body (140) in a width direction of the bottom wall body (140).

11. The heat transfer plate (10) of any one of claims 2, 5 and 6, further comprising:

a heat exchanging area (101) surrounded by the gasket groove (12),
wherein the ridge (20) is disposed on a side of the bottom wall body (140) facing towards the heat exchanging area (101) in a width direction of the bottom wall body (140).

12. The heat transfer plate (10) of any one of claims 2, 5 and 6, further comprising:

a heat exchanging area (101) surrounded by the gasket groove (12),
wherein the ridge (20) is disposed on a side of the bottom wall body (140) facing away from the heat exchanging area (101) in a width direction of the bottom wall body (140).

13. The heat transfer plate (10) of claim 1, wherein:

the segment (120) of the gasket groove (12) extends essentially parallel to an edge (121) of the plate body (11).

14. The heat transfer plate (10) of claim 1, wherein:

the segment (120) of the gasket groove (12) extends essentially parallel to a length direction of the plate body (11).

15. A plate heat exchanger (100), comprising:

a plurality of heat transfer plates (10) of claim 1, which are stacked on top of each other; and
gaskets (60) disposed in the gasket grooves (12) of some of the plurality of heat transfer plates (10).

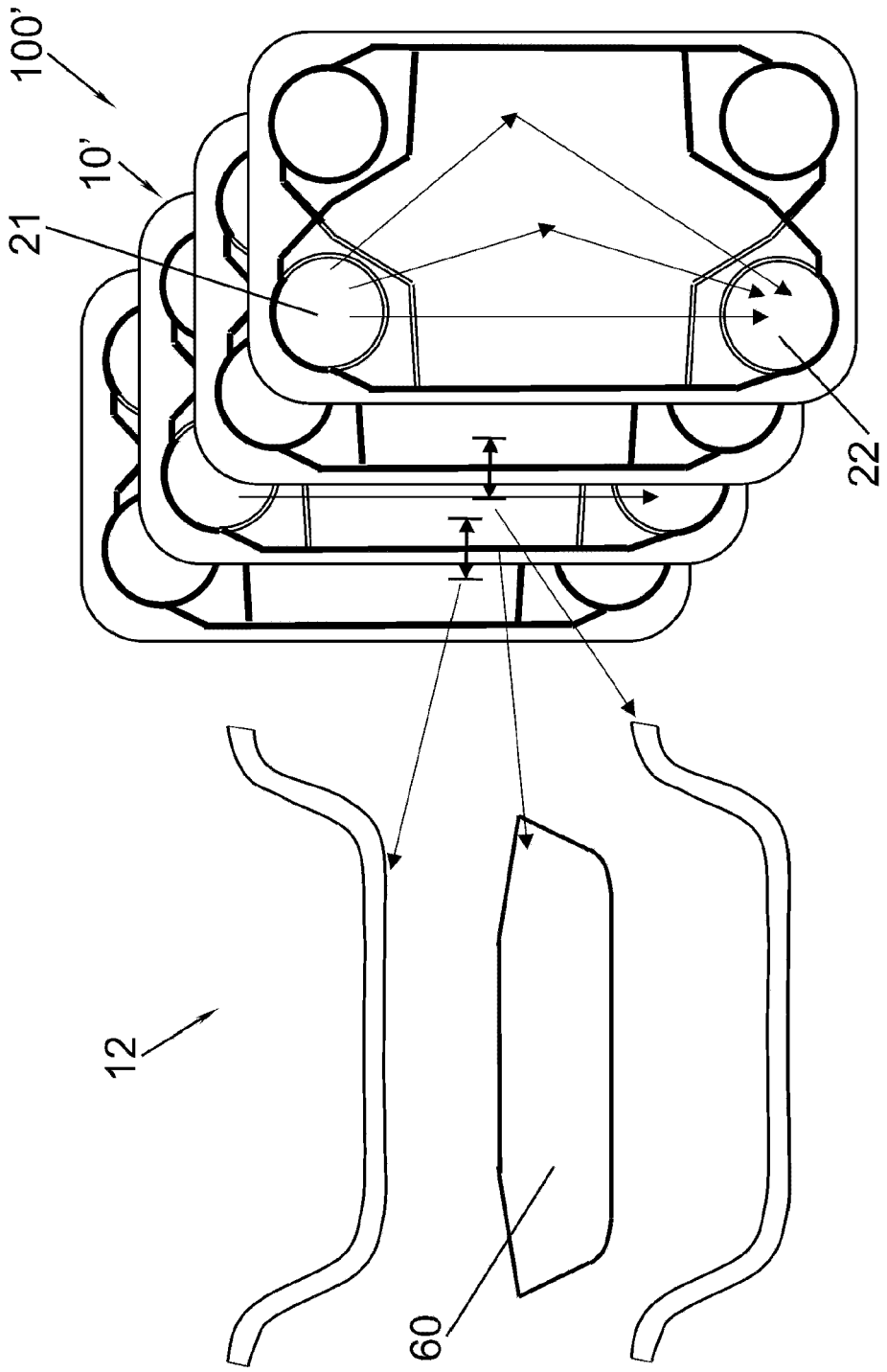

FIG. 1

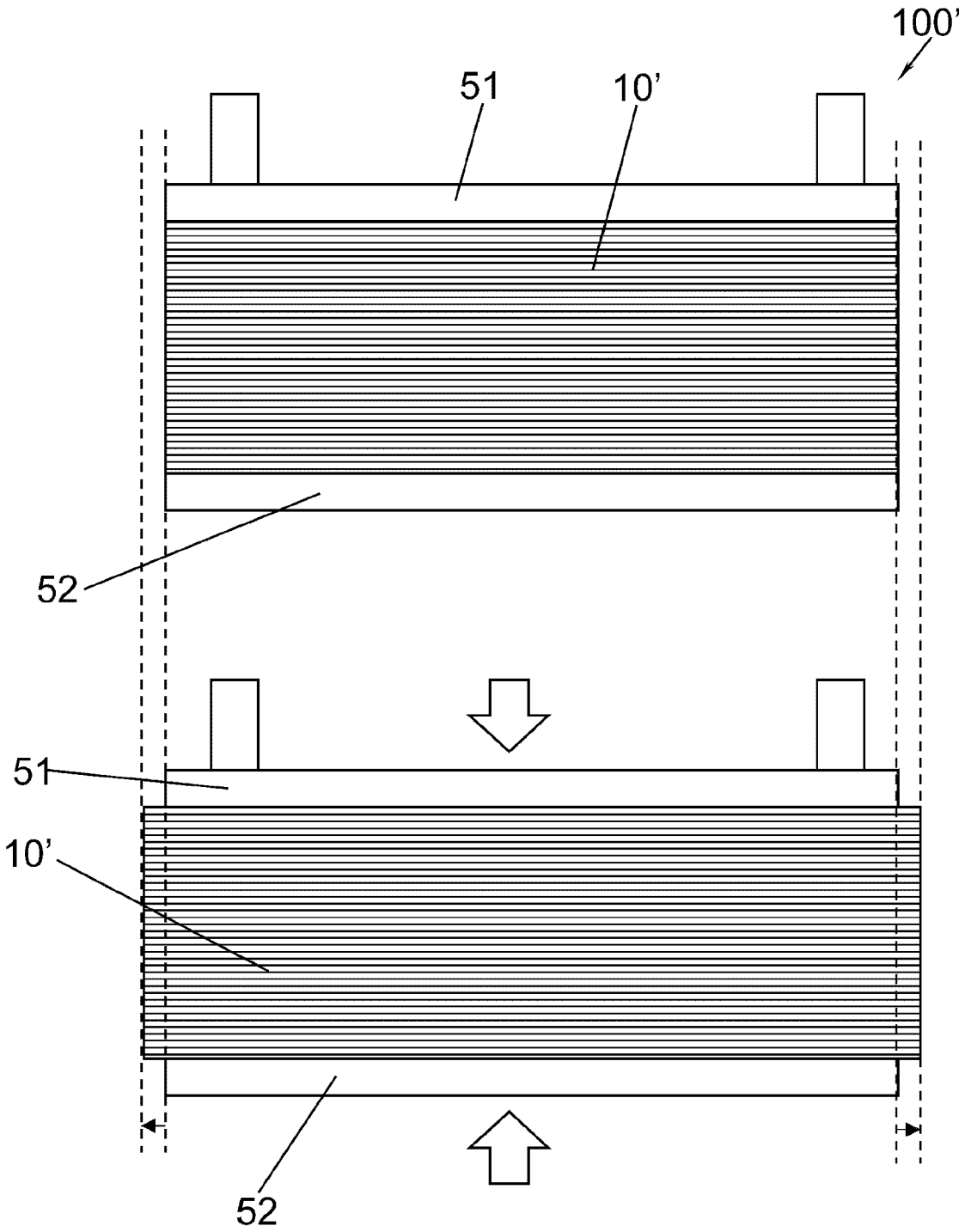

FIG. 2

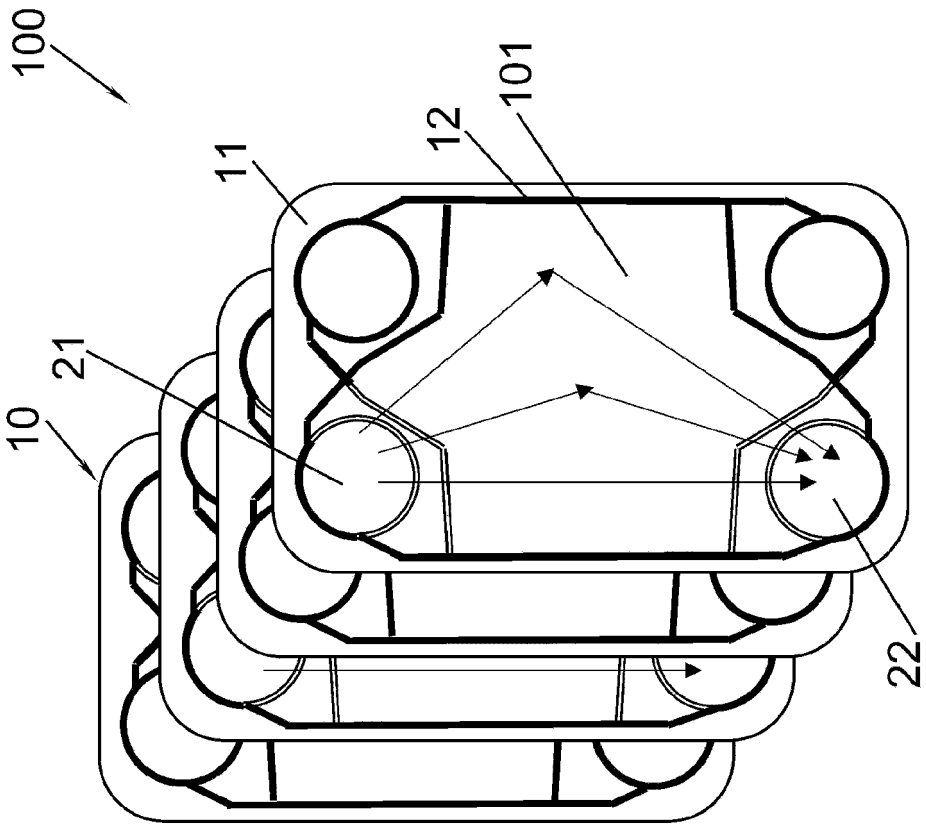

FIG. 3

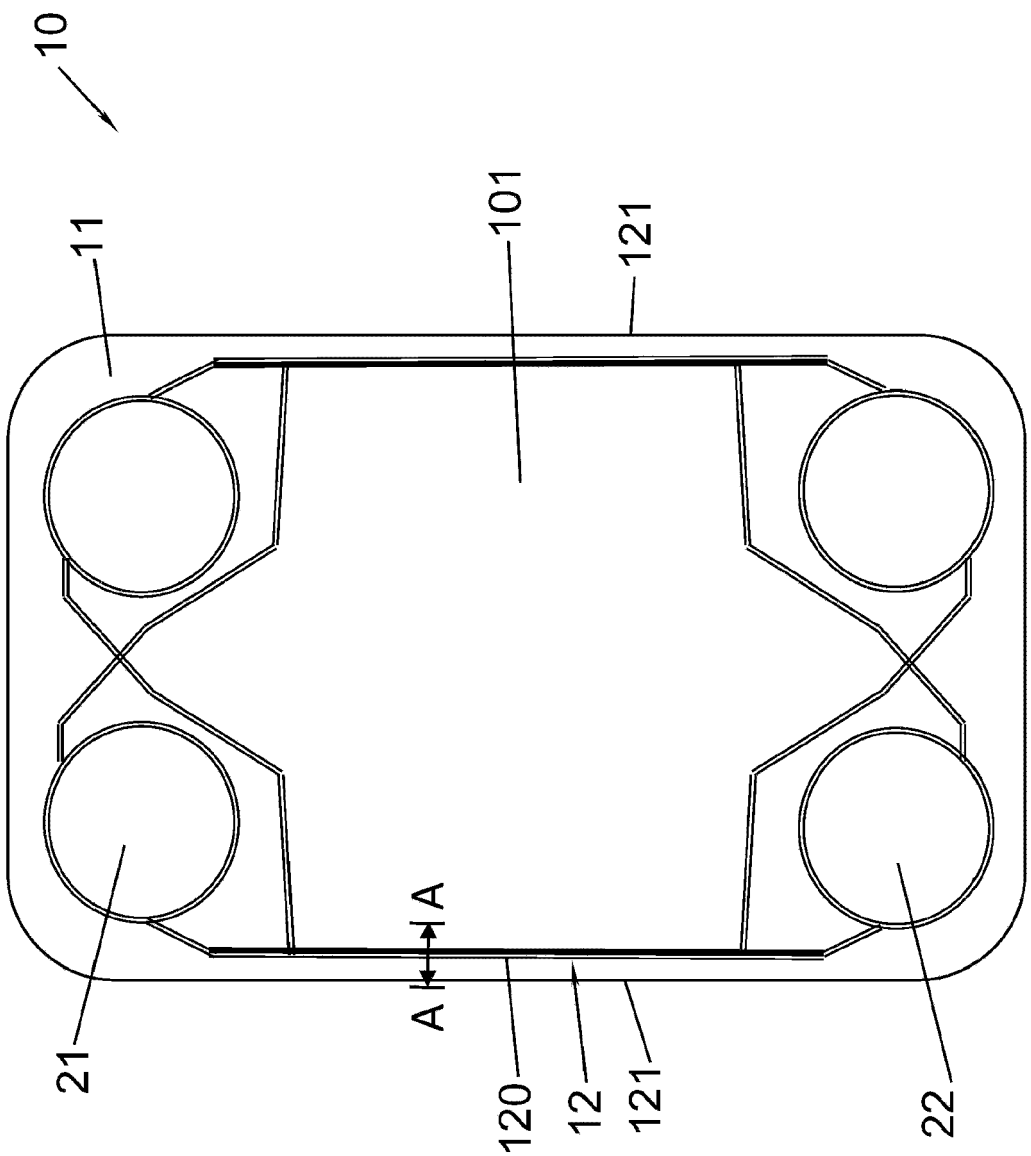

FIG. 4

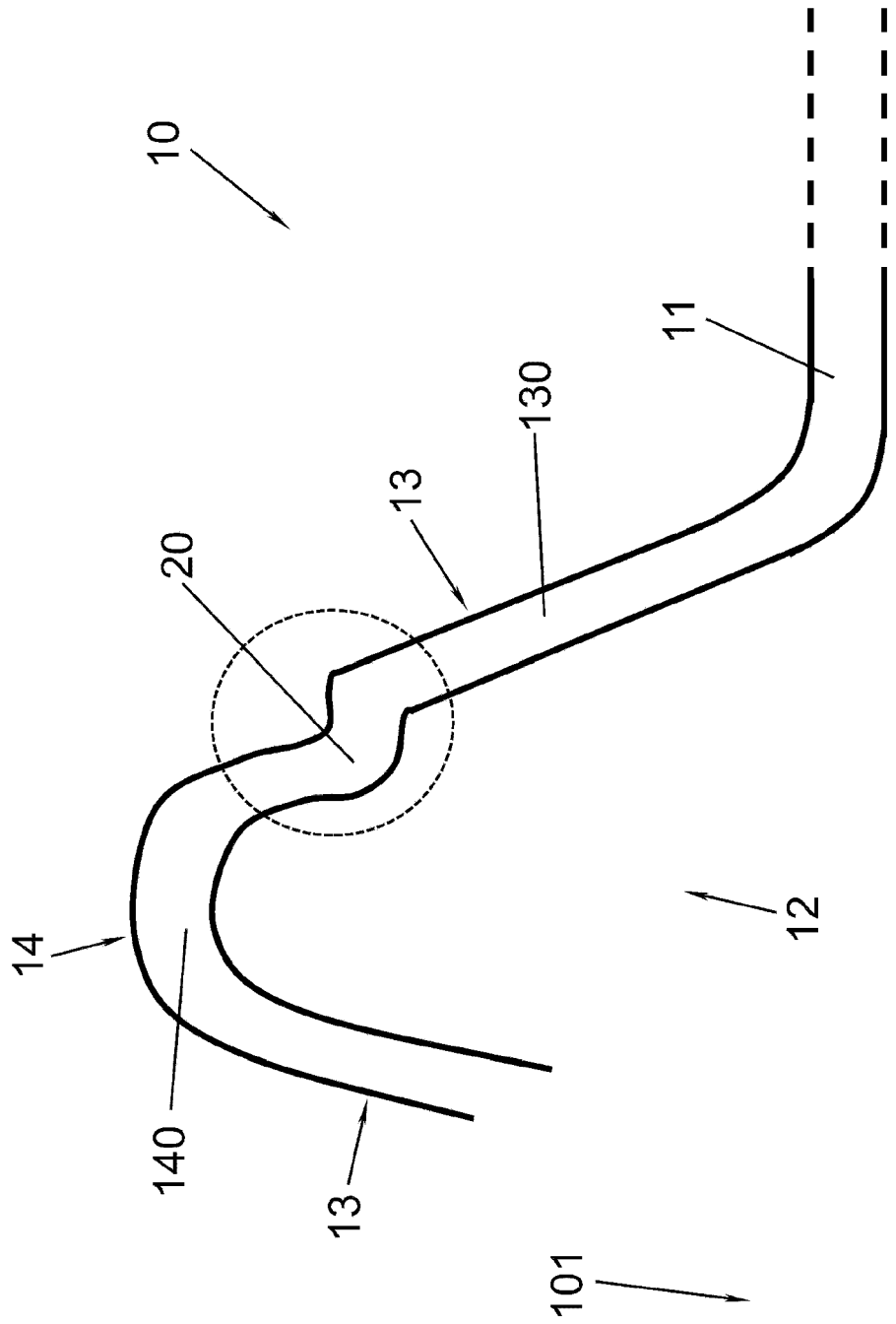

FIG. 5A

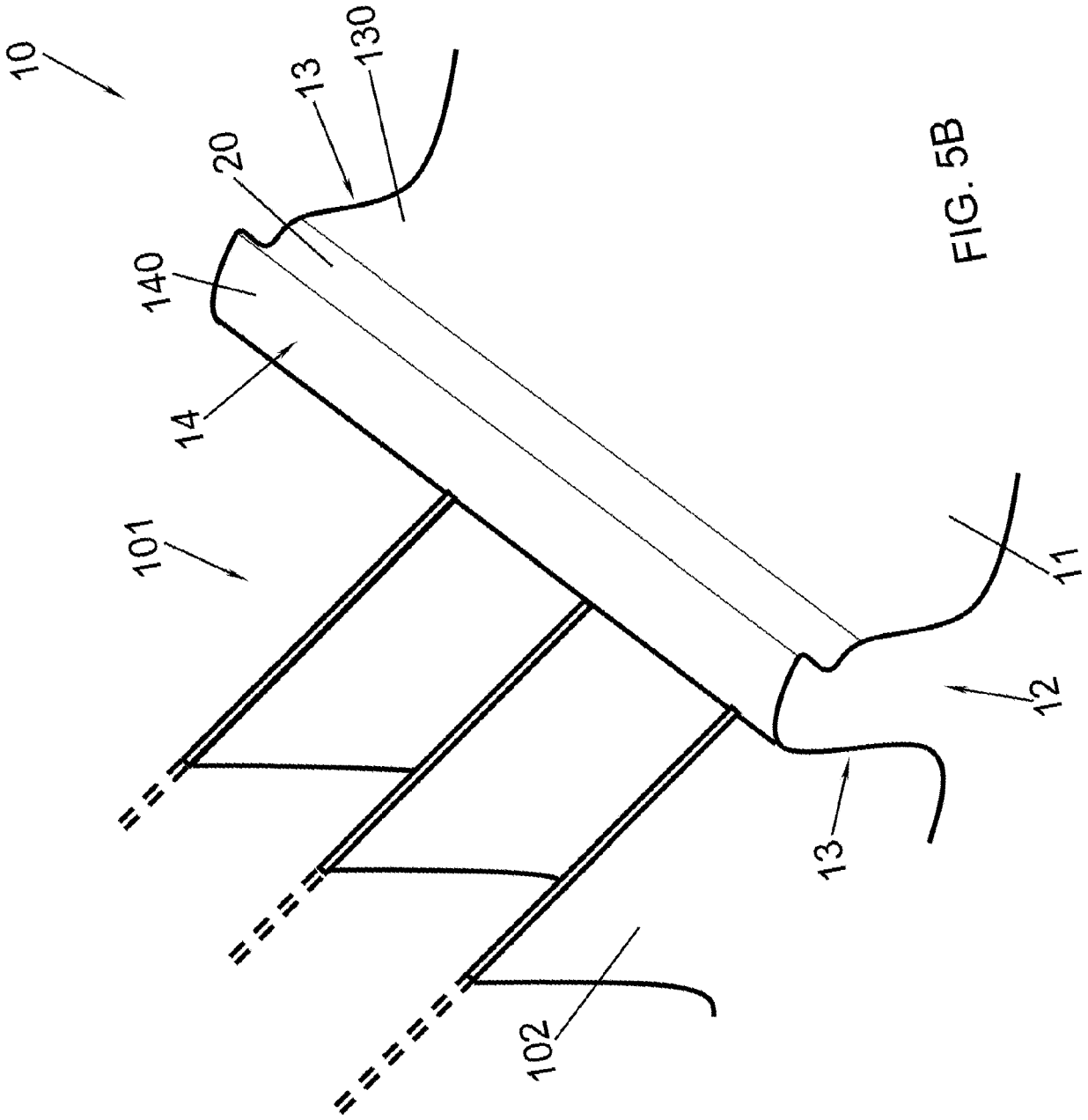

FIG. 5B

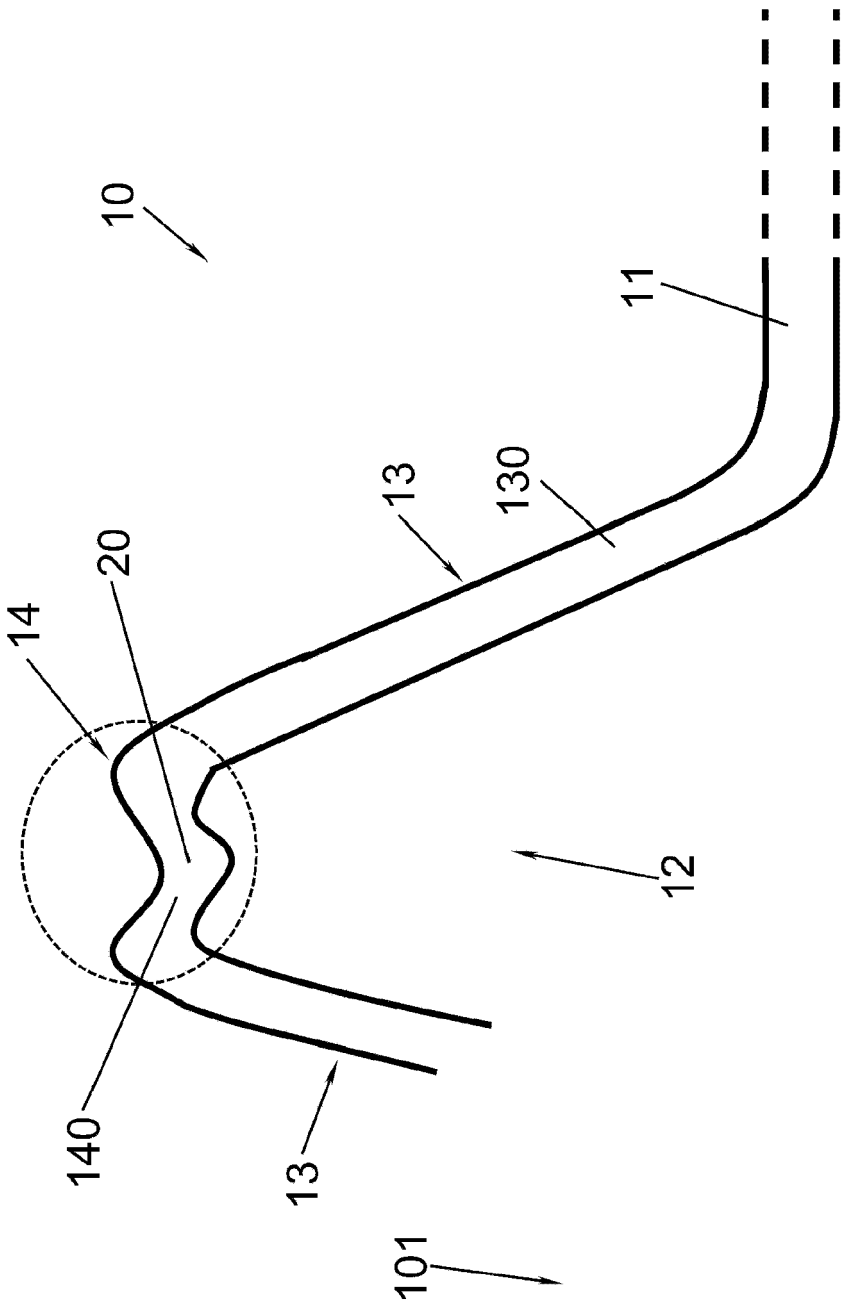

FIG. 6A

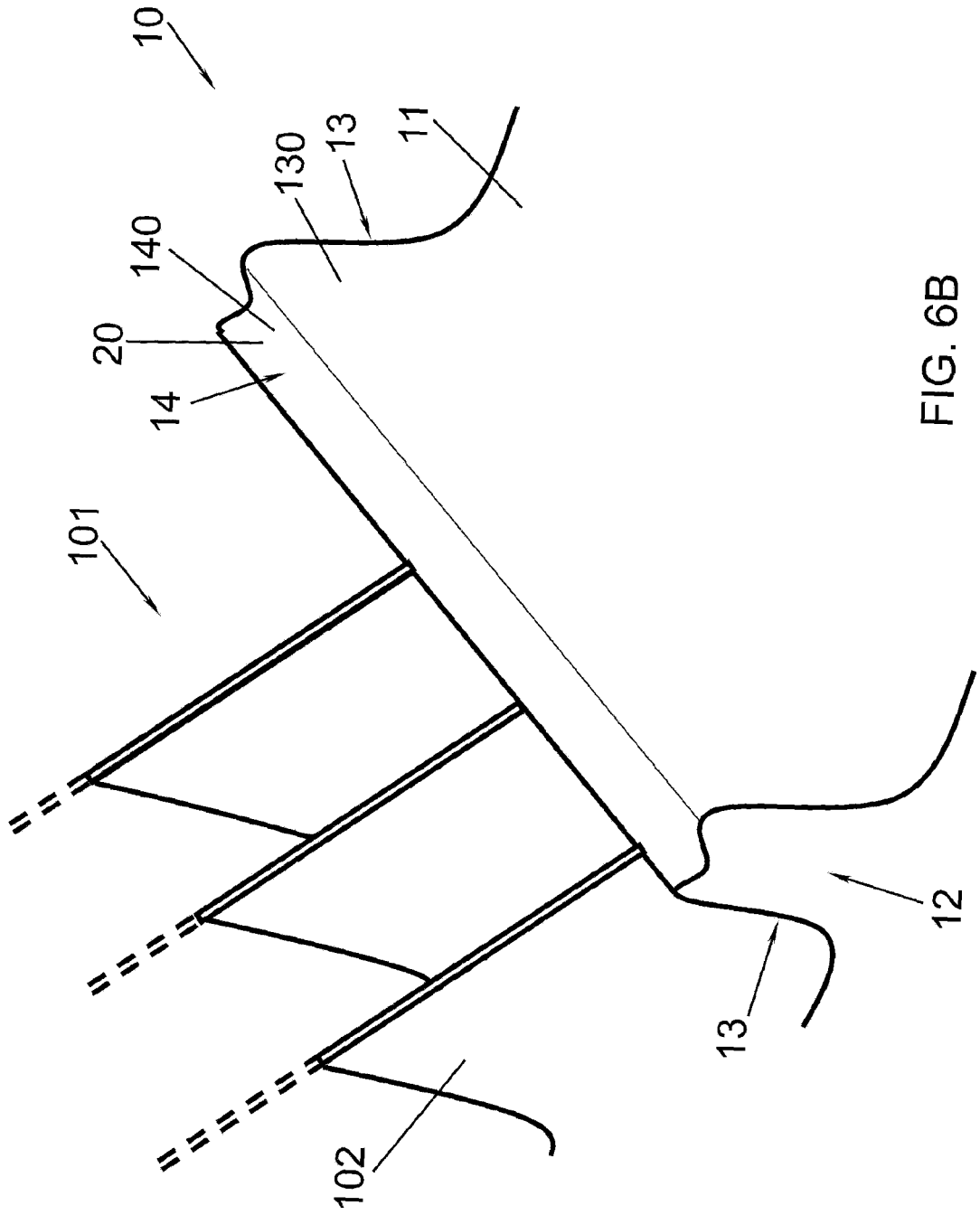

FIG. 6B

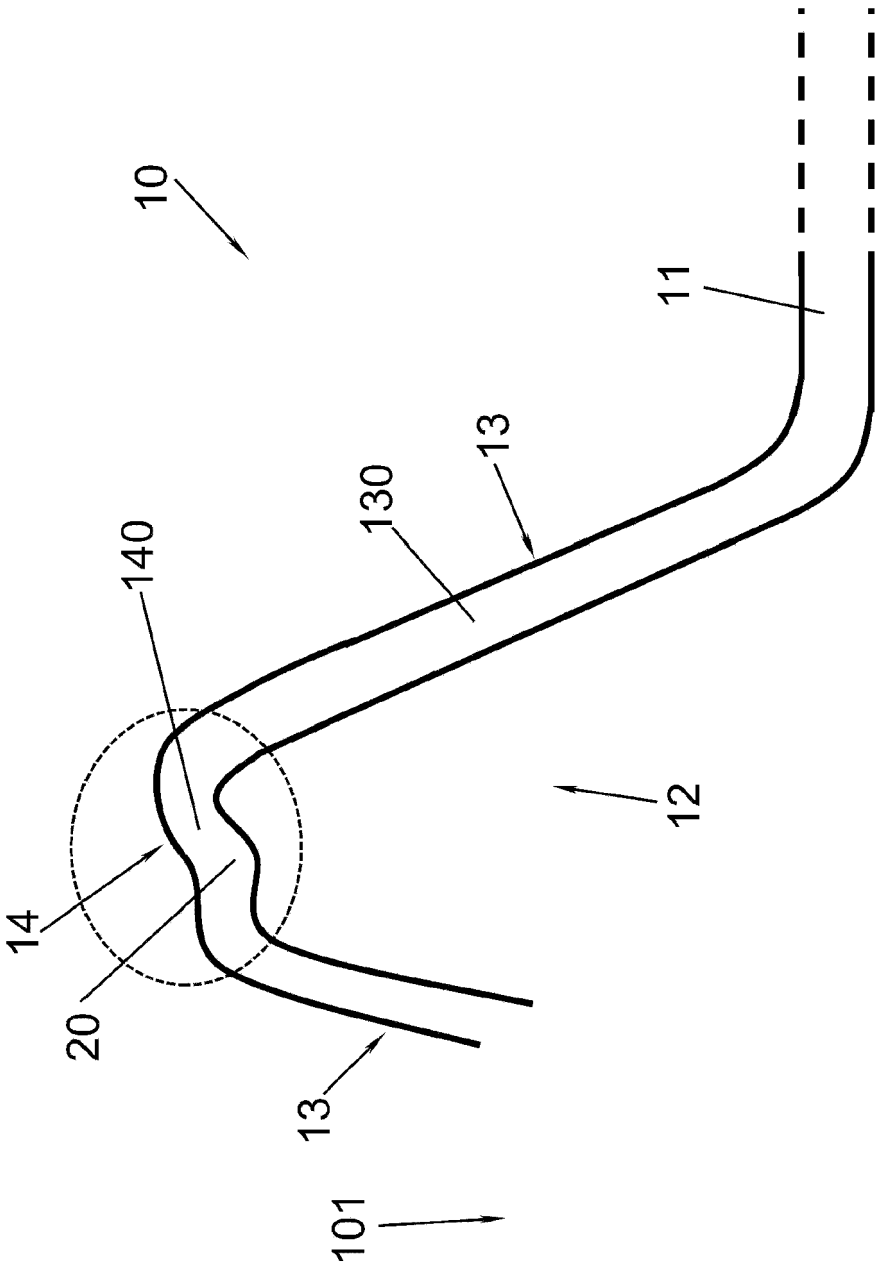

FIG. 7

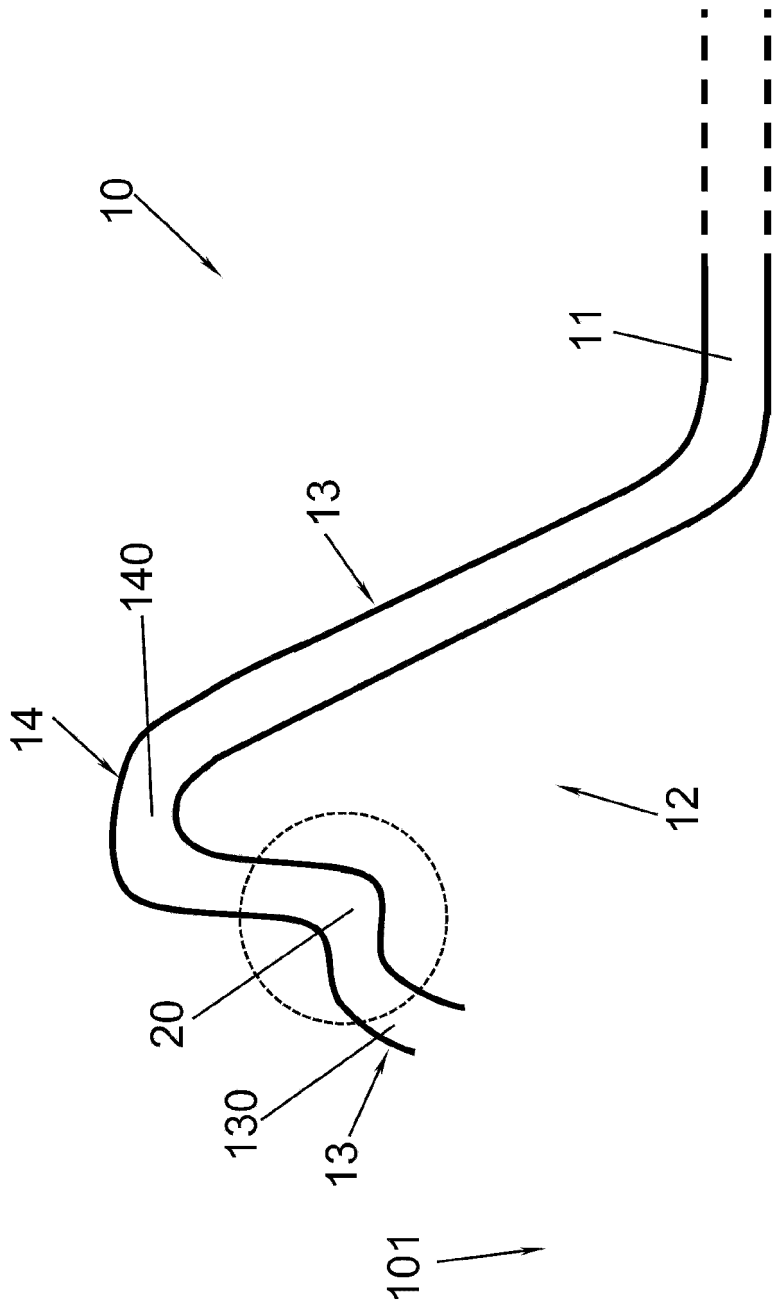

FIG. 8A

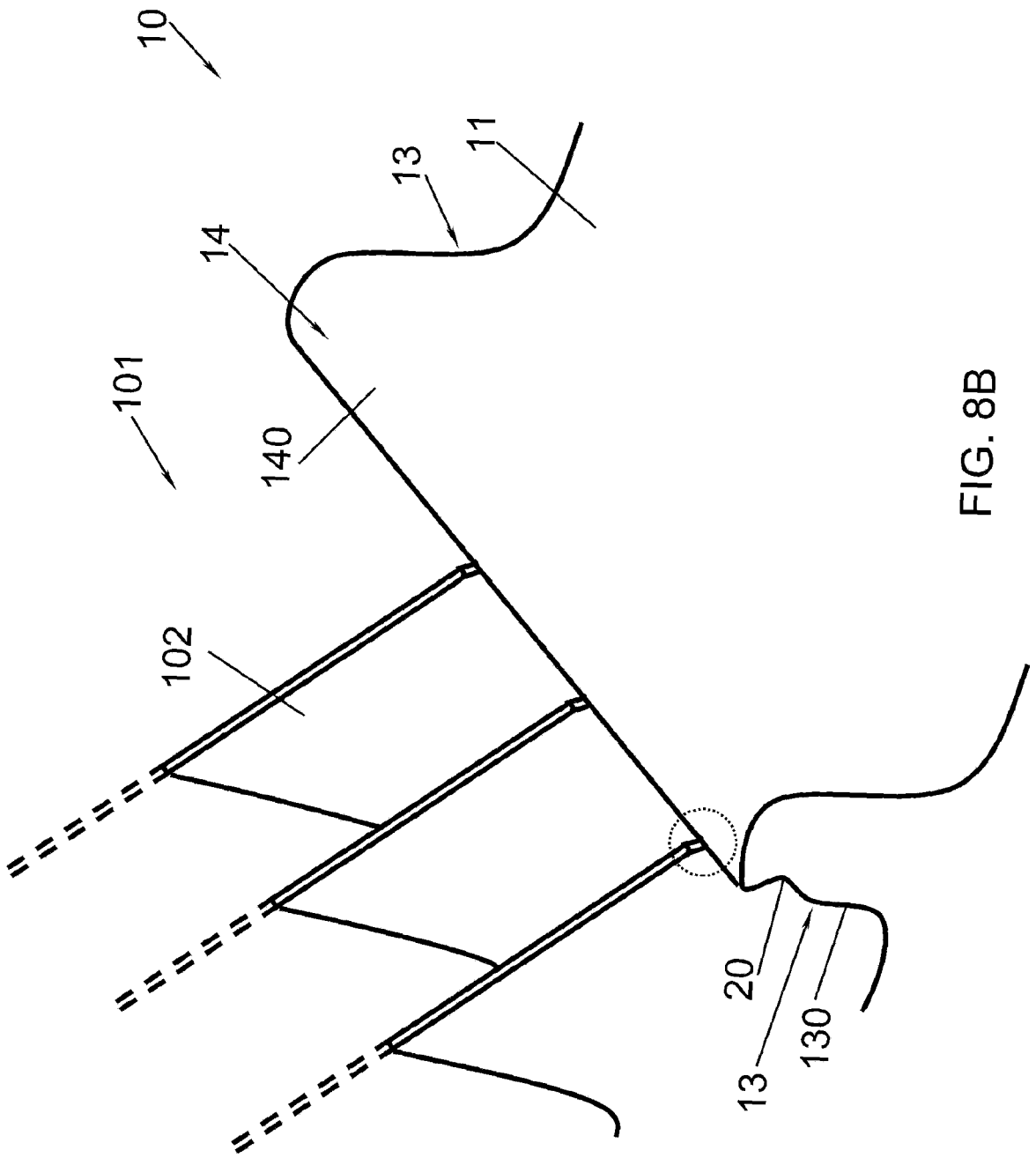

FIG. 8B

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 20 0291

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 809 156 A (ANDERSSON J) 7 May 1974 (1974-05-07) * figures 6-9 *	1,2,4, 6-8, 10-15	INV. F28D9/00 F28F3/10
X	US 4 359 087 A (JOHANSSON BOERJE) 16 November 1982 (1982-11-16) * figures 1-5 *	1,2,4, 6-8, 11-15	
X	WO 93/06426 A1 (APV CORP LTD [GB]) 1 April 1993 (1993-04-01) * figure 9 *	1,2,4, 6-8, 11-15	
X	WO 96/37746 A1 (CIPRIANI LUCA [IT]) 28 November 1996 (1996-11-28) * figures 1-3 *	1,2,4, 6-9, 11-15	
X	SE 116 638 C1 (E.D. HANSEN) 25 June 1946 (1946-06-25) * figure 2 *	1-3,5,7, 8,11-15	TECHNICAL FIELDS SEARCHED (IPC) F28D F28F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 March 2019	Delaitre, Maxime

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 20 0291

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-03-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3809156 A	07-05-1974	CA 964641 A	18-03-1975
		DE 2246031 A1	19-04-1973
		FR 2156131 A1	25-05-1973
		GB 1366018 A	04-09-1974
		JP S514706 B2	13-02-1976
		JP S4846943 A	04-07-1973
		SE 356123 B	14-05-1973
		SU 467527 A3	15-04-1975
		US 3809156 A	07-05-1974
US 4359087 A	16-11-1982	AU 525313 B2	28-10-1982
		BE 886405 A	01-06-1981
		BR 8007735 A	09-06-1981
		CA 1138423 A	28-12-1982
		DE 2948586 A1	25-06-1981
		ES 8200182 A1	16-10-1981
		FI 70471 B	27-03-1986
		FR 2471570 A1	19-06-1981
		GB 2064750 A	17-06-1981
		IT 1134490 B	13-08-1986
		JP H0126479 B2	24-05-1989
		JP S5687797 A	16-07-1981
		SE 445139 B	02-06-1986
		US 4359087 A	16-11-1982
		YU 304080 A	28-02-1983
		ZA 8007493 B	25-11-1981
WO 9306426 A1	01-04-1993	AT 173812 T	15-12-1998
		AU 2559592 A	27-04-1993
		DE 69227694 D1	07-01-1999
		DE 69227694 T2	22-04-1999
		DK 0604499 T3	09-08-1999
		EP 0604499 A1	06-07-1994
		GB 2275103 A	17-08-1994
		IN 186214 B	14-07-2001
		JP 3362849 B2	07-01-2003
		JP H06510848 A	01-12-1994
		KR 100232436 B1	01-12-1999
		US 5522462 A	04-06-1996
		WO 9306426 A1	01-04-1993
		ZA 9207036 B	29-03-1993
WO 9637746 A1	28-11-1996	EP 0830557 A1	25-03-1998
		IT VR950045 A1	25-11-1996
		US 6070658 A	06-06-2000
		WO 9637746 A1	28-11-1996

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 20 0291

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-03-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
SE 116638 C1	25-06-1946	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82