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

(11) EP 1 099 915 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
16.05.2001 Bulletin 2001/20

(51) Int Cl.[7]: **F24H 3/10**

(21) Application number: **00203949.3**

(22) Date of filing: **09.11.2000**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **09.11.1999 NL 1013537**

(71) Applicant: **Holding J.H. Deckers N.V.**
Curacao (AN)

(72) Inventor: **Deckers, Jan Hubertus**
5912 TW Venlo (NL)

(74) Representative: **Prins, Adrianus Willem et al**
Vereenigde,
Nieuwe Parklaan 97
2587 BN Den Haag (NL)

(54) Heat exchanger with at least two juxtaposed sections

(57) A heat exchanger, comprising a burner chamber, a flue duct and connecting means for a flue gas discharge, wherein at least one passage is provided for passing through a medium to be heated, there being provided at least a first and a second section, which sections extend next to each other, the burner chamber linking up adjacent a first end of the first section, while a first part of the flue duct extends in the first section and a second part of the flue duct extends in the second section, while the first part of the flue duct is connected, adjacent the second end of the first section remote from the first end, with the second part of the flue duct, adjacent the second end of the second section, the at least one passage for the medium to be heated extending at least between the first and an adjacent second section, between the burner chamber and the second ends of the first and second section.

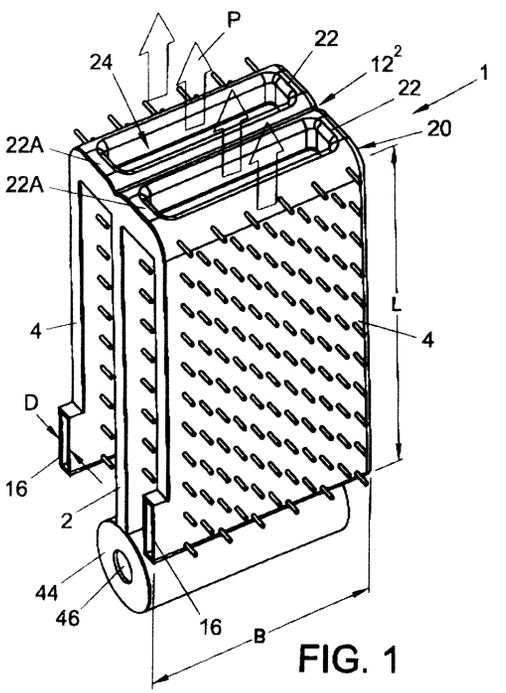

FIG. 1

EP 1 099 915 A1

Description

[0001] This invention relates to a heat exchanger. This invention relates in particular to a heat exchanger comprising a burner chamber, a flue duct and connecting means for a flue discharge, while at least one passage is provided for passing through a medium to be heated. Such a heat exchanger is known from practice.

[0002] Heat exchangers of this known type comprise a burner chamber which links up with a flue passage through which heated flue gases coming from a burner arranged in the burner chamber are passed to a flue discharge such as a chimney. Next to at least a portion of the flue passage extends a channel for passing through a medium to be heated, such as water. Only on one side of the channel is a flue passage provided, which may be disadvantageous for the heat transfer of such a heat exchanger and the efficiency to be attained therewith. Moreover, such a heat exchanger is relatively complicated in structure, difficult to clean, and moreover voluminous.

[0003] In NL1009901 an air heating apparatus is described in which, in an air channel, one or more heat exchangers are arranged which can be circumfused by air to be heated. Each heat exchanger comprises a substantially cylindrical body which extends in the air channel, with its longitudinal axis at right angles to the direction of flow of the air to be heated. On a first side, a burner with a fan is arranged, while on the opposite side the body is connected to a flue gas discharge duct. During use, heated flue gases from the burner are passed through the body and discharged through the flue gas discharge duct, while heat exchange takes place between the exterior of the body, heated by the flue gases, and the air flowing past.

[0004] Such a heating apparatus provides the advantage that such an apparatus, in particular a heat exchanger to be used therein, is relatively simple in structure. Moreover, in such an apparatus, the air channel can be dimensioned sufficiently amply to obtain a desired air flow, whereby a number of heat exchangers can be used, tailored to the desired air flow rates and temperature changes therein. However, such an apparatus has as a disadvantage that the flow resistance generated by the heat exchangers is undesirably high. A further disadvantage of these known heat exchangers is that, during use, the side of each heat exchanger located downstream in the direction of flow of the air to be heated is heated to an undesirably high degree, so that unduly great temperature differences arise in the wall of the heat exchanger, while moreover the efficiency is reduced because a portion of the heat supplied is removed unused. Further, as a result of the great temperature differences, heat stresses may arise in the heat exchanger.

[0005] The invention contemplates a heat exchanger of the type described in the opening paragraph hereof, whereby the above-mentioned disadvantages are obviated while maintaining the advantages thereof. More particularly, the invention contemplates a heat exchanger with a relatively large heat exchange surface and a low flow resistance, suitable for placement in a channel in order to be circumfused by a fluid to be heated. To that end, a heat exchanger according to the present invention is characterized by the features according to claim 1.

[0006] In a heat exchanger according to the present invention, the or each passage for the fluid to be heated, for instance air or water, is bounded on at least two sides by a heat transfer surface, so that a particularly large heat transfer surface with respect to the volume of the or each passage can be obtained. The overall volume of the heat exchanger can be relatively small, while the flow resistance during use can be chosen in a suitable manner. The sections can then be simply designed such that during use a uniform temperature distribution is obtained. An additional advantage thereby obtained is that medium to be heated flowing through the or each passage is heated relatively uniformly since a heat transfer surface is provided on opposite sides.

[0007] In a first advantageous embodiment, a heat exchanger according to the invention is further characterized by the features according to claim 2.

[0008] In such an embodiment, at least each second section, preferably each section, has a frontal surface upstream in the direction of flow, that is relatively small, while the or each passage has a relatively great width, so that the ratio between the contiguous heat transfer surface and the frontal surface can be particularly high. A further advantage thereby achieved is that the rear side, as viewed in the direction of flow, of the heat exchanger has a comparably small surface, at least projected surface, with respect to the overall heat transfer surface. 'Projected surface' is herein to be understood to mean the surface within the outer limiting lines of the respective section, viewed at right angles to the direction of flow of the medium to be heated adjacent the downstream end. The sections of a heat exchanger according to the present invention preferably have a substantially rectangular cross-section of a thickness which, measured at right angles to the heat transfer surface contiguous to a passage, which is considerably smaller than the width, measured along the plane of the respective heat transfer surface.

[0009] In an advantageous embodiment, on opposite sides of the first section at least one second section is provided having, in each case, an enclosed passage for the medium to be heated, while moreover, during use, the outside surfaces of the second sections remote from the first section at the same time form a heat transfer surface. As a result, in a particularly advantageous and economical manner, use can be made of the heated flue gases with a heat transfer surface which is particularly large with respect to the overall volume of the heat exchanger.

[0010] A heat exchanger according to the present in-

vention is suitable in particular for use in an air heating apparatus.

[0011] In a further advantageous embodiment, a heat exchanger according to the invention is further characterized by the features according to claim 8.

[0012] By connecting the first part of the flue duct, included in the first section, with the second part of the flue duct, included in the or each second section, by means of connecting elements displaced with respect to each other, the advantage is achieved that an opening is obtained which links up, on one side, with the passage between the sections mentioned and, on the other, with the environment, such that the medium to be heated, when flowing between the sections in a direction parallel to the main flow direction of the heated flue gases in the respective sections, can leave the passage through the opening mentioned. As a result, optimum use can be made of the complete heat transfer surface facing the respective passage.

[0013] A heat exchanger according to the present invention is preferably cast in one piece, in particular from a light-metal alloy. This enables particularly economical manufacture of such a heat exchanger, without necessitating assembly operations and the like.

[0014] The invention further relates to a heating apparatus characterized by the features according to claim 13.

[0015] Such a heating apparatus comprising a heat exchanger according to the present invention provides the advantage that a particularly high efficiency can be obtained with a heat exchanger of relatively simple and modular construction, which is economical in manufacture and use.

[0016] Further advantageous embodiments of a heat exchanger and heating apparatus according to the invention are set forth in the further dependent claims.

[0017] To clarify the invention, exemplary embodiments of a heat exchanger and heating apparatus according to the present invention will be further explained with reference to the drawing. In the drawing:

Fig. 1 shows in perspective view a heat exchanger according to the present invention;
Fig. 2 shows in sectional side elevation a heat exchanger along the line II-II in Fig. 3;
Fig. 3 shows a front view of a heat exchanger according to Fig. 1;
Fig. 4 shows a rear view of a heat exchanger according to Fig. 1;
Fig. 5 shows in partly sectional top plan view a heating apparatus comprising two heat exchangers according to the present invention;
Fig. 6 shows in partly sectional side elevation a heating apparatus according to Fig. 5; and
Fig. 7 shows an alternative embodiment of a heat exchanger according to the invention.

[0018] In this description, the same parts or corresponding parts have the same or corresponding reference numerals.

[0019] In this description, embodiments are shown of a heat exchanger and heating apparatus for air heating. It will be clear, however, that in a comparable manner, such a heat exchanger and heating apparatus can be employed for heating other media, such as water for use in a space or tap water heating circuit.

[0020] Fig. 1 shows in perspective view a heat exchanger 1 according to the invention, which, in the embodiment shown, is cast in one piece from light metal, in particular an aluminum alloy. The heat exchanger 1 comprises a first section 2 and, on opposite sides thereof, a second section 4. The first section 2 is connected at a first end 6 with a burner chamber 8, with a first flue duct part 10 extending within the first section 2 between an open fluid connection with the burner chamber 8 adjacent the first end 6 and a second end 12 of the first section 2. Each second section 4 comprises a second flue duct part 14 which constitutes a fluid connection between a flue gas discharge connection 16 adjacent the first end 18 of the respective second section 4, located near, at least at the location of, the first end 6 of the first section 2, and a second end 20 of the second section 4, located near, in particular next to, the second end 12 of the first section 2. Adjacent the second ends 12, 20 of the first section 2 and the second section 4, respectively, the first flue duct part 10 and the second flue duct part 14 are connected with each other through two connecting elements 22, which are spaced apart adjacent opposite longitudinal edges of the heat exchanger 1. Provided between two opposite connecting elements 22, 22A is an opening 24, which connects a passage 26 between the first section 2 and an adjacent second section 4 with the rear side 28 of the heat exchanger 1, remote from the burner chamber 8. As a consequence, air can flow along the burner chamber 8 between the first ends 6, 18 of the first section 2 and the second section 4, respectively, into a passage 26 located between the respective sections 2, 4 and leave the heat exchanger 1 through the respective opening 24. In the passages 26, heat transfer surface-enlarging elements 30 extend from the walls of the first section 2 and the second section 4 into the respective passage 26. The heat transfer surface-enlarging elements 30 will hereinafter be designated as projections 30. It will be clear, however, that these may also be differently shaped elements, for instance ridges, fins, grooves, and the like. In the exemplary embodiment shown, the free ends of the projections 30 are spaced apart to some extent, while the projections 30 are arranged at a relatively large distance from each other, in rows and columns staggered with respect to each other, so that paths following a slightly zigzag course are defined between the projections 30. The space of the passage 26 left clear between the projections 30 has been chosen such that a desired flow resistance is obtained while in an effective manner contact takes place between the air flowing through the pas-

sage 26 on the one hand and the walls 32 of the respective sections 2, 4 defining the passage 26 on the other. Air flows in the direction P from the burner chamber 8 to the opening 24. On the outer wall parts 34 of the second sections 4 that face towards the exterior of the heat exchanger 1, likewise projections 30 are provided, which, during use, extend in second passages 36 enclosed between the respective wall 34 and a wall 38 of an air channel 40 as shown in Fig. 5.

[0021] In the use for heating other media, the projections 30 can be shaped and arranged differently. Thus, in water heating, more projections 30 may be arranged closer to each other, with the free ends located next to or between each other. In air heating, too, of course, such an arrangement is an option, depending on the flow resistance, heat transfer capacity, contact time and the like.

[0022] In the embodiment shown, the first section 2 and the second sections 4 each have substantially a relatively flat box shape of a thickness D, measured in a direction at right angles to the direction of flow P, parallel to a plane at right angles to the sections 2, 4, which is considerably smaller than the width B, measured at right angles to the thickness D and the direction of flow P. Further, the thickness D is considerably smaller than the length L of the sections 2, 4, measured in the direction of flow P and also smaller than the width W of the passages 26, measured at right angles to the walls 32 of the sections 2, 4. As appears in particular from Fig. 3, as a result, each second section 4 has a forward end 42 with a relatively small frontal surface, while the sections 2, 4 have a particularly large heat transfer surface, which is increased still further by the projections 30. During use, the sections 2, 4 are substantially completely circumfused by air. As a result of the arrangement of the sections 2, 4 in at least substantially parallel planes, and of the openings 24, formed between the connecting parts 22, which are relatively large, the closed surface of the rearward end 28 is relatively small with respect to the projected surface that is defined by the outside dimensions W and Y (Fig. 4) of the rearward end 28, measured at right angles to the direction of flow P. As a result, the surface of the heat exchanger 1 which, during use, has no, at any rate a lesser intensive contact with the air flowing past, has been considerably reduced, so that large temperature differences in the heat exchanger are avoided in a particularly favorable manner.

[0023] The burner chamber 8, viewed in the direction of flow P, has a rounded forward end and in the embodiment shown is substantially cylindrical, so that it will generate little flow resistance. Other, preferably aerodynamically formed, burner chambers are possible, of course. As the first ends 18 of the second sections 4 are located at a sufficiently large distance from the burner chamber 8, air can be readily passed into the passages 26, without undesired flow resistance.

[0024] In the end walls 44 of the burner chamber 8, core holes 44 are provided, through which core material can be removed after manufacture of the heat exchanger. From one side, or optionally both sides, through such a core hole 46 a burner 48 can be inserted as shown in Fig. 6, while any unused core holes 46 can be simply closed off.

[0025] The flue gas discharge connections 16 have a direction of outflow at right angles to the direction of flow P of the air, parallel to the walls 32, 34. The first section 2 and the second sections 4 have a substantially equal width. The reason for this will be explained later.

[0026] During use, flue gases heated with the burner 48 in the burner chamber 8 are generated, which flue gases are passed through the first flue duct part 10 through the first section 2 and at the second end 12 are distributed over the four connecting elements 22, 22A and passed into the respective flue duct parts 14, in the direction of the flue gas discharge connections 16. Through these connections 16, the heated flue gases, which will have cooled off strongly during use as a result of heat exchange with air passing along the heat exchanger 1, can be discharged.

[0027] With a heat exchanger 1 according to the invention, for instance a heating apparatus 50 can be formed as shown in Figs. 5 and 6. This heating apparatus 50 comprises an air channel 40, for instance of a rectangular cross section and bounded on four sides by a wall 38. The air channel 40 comprises an air inlet 52 at a first end and an air outlet 54 on an opposite second end. During use, in the air channel 40 an air flow is generated in the direction of flow P, for instance with a fan 56. In the exemplary embodiment shown, in the air channel 40, two heat exchangers 1 are arranged, one behind the other as viewed in the direction of flow P, with the ends 28 facing the air outlet 54. The burner chamber 8 of the heat exchanger 1 located downstream (viewed in the direction of flow P) is spaced from the rear end 28 of the upstream heat exchanger 1, so as to enable a relatively unhindered air flow around the respective burner chambers 8. The width Y_1 of the air channel 40 is chosen such that with the heat exchangers 1 arranged centrally in the air channel 40, some space is left on opposite sides of them for forming the second passages 36. The height H of the air channel 40 is then chosen such that it substantially corresponds to the width B of the heat exchanger 1, so that the top and bottom wall 38 of the air channel 40 abut at least substantially against the sides of the sections 2, 4, thereby bounding the passages 26, 36 laterally. Air passing through the air channel 40 will therefore have to pass through the passages 26 or the second passages 36. As a result, intensive contact between the heat exchangers 1 and the air flowing past is obtained, whereby heat exchange between the heated flue gases and the air flowing past occurs in the manner described above.

[0028] In Fig. 5 the bottom wall of the air channel 40 has been omitted, so that the heat exchangers 1 are visible. As appears from Fig. 6, the somewhat projecting flue gas discharge connections 16 have been passed

through appropriate openings in the bottom wall 38 and terminate in a flue gas discharge chamber 58 formed under the air channel 40. Connected to the flue gas discharge chamber 58 is a siphon 60 for the discharge of condensation. Further provided is a flue gas discharge 62 in the form of a chimney for further discharging the flue gases used.

[0029] In the embodiment shown, a burner 48 has been inserted into each burner chamber 8 from above, that is, opposite the flue gas discharge chamber 58, this burner 48 being connected to a premix fan 64. The premix fans 64 are arranged in an air chamber 66 arranged outside the air channel 40. In the air chamber 66, ambient air can be supplied. Of course, the burners 48 are also connected, via the premix fans 64 and suitable gas control means, to a gas pipe or like fuel source. It will be clear, for that matter, that other kinds of burners can be used in an apparatus according to the invention, and further such burner may be inserted into the burner chamber from, for instance, the opposite side.

[0030] During use, the air inlet 52 of the air channel 40 is connected to a space, for instance an outside space, from which air to be heated can be drawn in, while the air outlet 54 is connected to a space in which the heated air is to be used, in particular for the purpose of space heating. Heating control means (not shown) such as thermostatic means are provided for controlling the burners 48 depending on an established heat demand and/or required refreshment degree, whereupon the fan 56 and the burners 48 are controlled and air forced through the air channel 40 is heated to a desired temperature and is passed via the outlet opening 54 into the space to be heated. The flue gases are discharged through the flue gas discharge 62 while condensation is discharged via the siphon 60.

[0031] Fig. 7 shows in a partly sectional view, comparable to Fig. 2, an alternative embodiment of a heat exchanger 1 according to the invention, in which a second section 4 is provided only on one side of the first section 2. Between the sections 2, 4, again a passage 26 is provided, which is in fluid communication with the opening 24 with the connecting elements 22. Projections 30 are again provided on opposite sides of the first section 2 and the second section 4 for enlarging the heat transfer surface. In this embodiment, the first end 6 of the first section 2 is of bent design, such that the burner chamber 8 is located entirely beside the first section 2, on the side remote from the second section 4. This means that the inflow opening of the passage 26 is exposed virtually completely. In the embodiment shown, the burner chamber 8 is placed on the side of a wall 38 remote from the air channel 40, that is, outside the air channel 40. In this embodiment, it is preferred that the burner chamber 8 is insulated particularly well on the outside, so as to prevent loss of heat. Between the wall 38 and the adjacent first section 2, again a second passage 36 is provided, which may also be provided on the opposite side of the second section 4.

[0032] The invention is not limited in any way to the exemplary embodiments represented in the description and the drawings. Many variations thereof are possible. Thus, in an air channel, different numbers of heat exchangers may be arranged, for instance only one, or a series of them. Also, heat exchangers may be arranged side by side in an air channel, for instance such that a matrix of heat exchangers is obtained with rows and/or columns which are straight or staggered with respect to each other. A suitable number of heat exchangers can be simply determined depending on the heat requirement. Also, heat exchangers can be designed with more sections, for instance one first section and more than two second sections, or two first sections each with one or more second sections. Also, a third section may be provided on the side of the or each second section remote from the first section. This third section may be connected with the second section in the same manner as or a comparable manner to that in which the second section is connected with the first section, which connection can be provided adjacent the first end or the second end of the respective second section. In such a manner, in principle any desired number of sections can be arranged side by side. Also, the different sections may include an angle with each other, for instance such that the or each passage 26 tapers between the sections, in the direction of flow or in the direction opposite to the direction of flow. As a result, the heat exchange during use can be simply optimized. A heat exchanger according to the present invention is preferably cast in one piece, but can also be manufactured in a different manner, for instance with sheet-metal working techniques known per se. The flue passage parts in the different sections can be connected in a different manner, for instance with only one connecting element or with more than two connecting elements, with consequently a different number of openings. The flue gas passages can be straight but can also have a meandering course. As indicated, a heat exchanger or a heating apparatus according to the invention can also be employed for use with other media to be heated, while moreover it can be provided that the temperature of medium flowing along the heat exchanger(s) can be influenced by passing a medium other than flue gases through the heat exchanger. Thus, for instance, air cooling can be obtained by passing a cold liquid through the heat exchangers. It will be clear that the configuration of the heat exchanger, in particular the shape of the sections and the burner chamber can be adapted at will. These and many comparable variations are understood to fall within the scope of the invention as outlined by the claims.

Claims

1. A heat exchanger (1), comprising a burner chamber (8), a flue duct (10, 14, 22, 22A) and connecting means (16) for a flue gas discharge, while at least

one passage (26) is provided for passing through a medium to be heated, there being provided at least a first (2) and a second section (4), which extend side by side, with the burner chamber linking up adjacent a first end of the first section, while a first part (10) of the flue duct extends in the first section (2) and a second part (14) of the flue duct extends in the second section (4), while the first part (10) of the flue duct is connected, adjacent the second end (12) of the first section (2) remote from the first end (6), with the second part (14) of the flue duct, adjacent the second end (20) of the second section (4), said at least one passage (26) for the medium to be heated extending at least between the first (2) and an adjacent second section (4), between the burner chamber (8) and the second ends (12, 20) of the first (2) and second section (4).

2. A heat exchanger according to claim 1, wherein at least the or each second section (4) has an upstream end (42) in the direction of flow (P) of the medium to be heated, which end (42) is substantially elongate and has a thickness (D) which is considerably smaller than the width (B), while the thickness (D) and width (B) extend approximately at right angles to said direction of flow (P).

3. A heat exchanger according to claim 1 or 2, wherein on opposite sides of the first section (2) at least one second section (4) is provided, as well as a passage (14) for the medium to be heated.

4. A heat exchanger according to any one of the preceding claims, wherein at the first end (18) of the second section (4) remote from the second end (20) thereof, a connecting means (16) for a flue gas discharge (62) is connected-to the respective second part (14) of the flue duct, located in the second section (4).

5. A heat exchanger according to any one of the preceding claims, wherein the at least one passage (26) for the medium to be heated is arranged for passing through air as the medium to be heated.

6. A heat exchanger according to any one of the preceding claims, wherein on the side of the or each second section (4) remote from the first section (2), a portion of the passage (36) is provided for the medium to be heated, in particular air.

7. A heat exchanger according to any one of the preceding claims, wherein heat exchange surface-enlarging elements (30) are provided on the outside of the first (2) and/or second (4) section, which elements (30) extend in an adjacent part of the passage (26, 36) for the medium to be heated.

8. A heat exchanger according to any one of the preceding claims, wherein the first part (10) of the flue duct is connected with the second flue duct part (14) through at least two connecting elements (22, 22A), spaced apart adjacent the second ends (12, 20) of the first (2) and second section (4), while an opening (24) is provided between the connecting elements (22, 22A) which links up with the passage (26) for the medium to be heated, located between the respective sections (2, 4).

9. A heat exchanger according to any one of the preceding claims, wherein the distance between two adjacent sections (2, 4) is approximately equal to or greater than the thickness (D) of each of the adjacent sections (2, 4).

10. A heat exchanger according to any one of the preceding claims, wherein the direction of flow (P) in the or each passage (26, 36) for the medium to be heated extends from the burner chamber (8) to the second ends (12, 20) of the sections (2, 4).

11. A heat exchanger according to any one of the preceding claims, wherein the heat exchanger (1) is cast in one piece, in particular from a light-metal alloy.

12. A heat exchanger according to any one of the preceding claims, wherein the approach side of the burner chamber (8) is rounded, the burner chamber (8) preferably being substantially cylindrical.

13. A heating apparatus comprising an air channel (40), wherein at least one heat exchanger (1) according to any one of the preceding claims extends in the air channel (40).

14. A heating apparatus according to claim 13, wherein the burner chamber (8) of the or each heat exchanger (1) is located upstream of the sections (2, 4) in the direction of flow.

15. A heating apparatus according to claim 13 or 14, wherein in the at least one burner chamber (8) a premix burner (48) is arranged, comprising a fan (64), while a connecting channel (66) is provided for supply of air to the fan (64) from outside of the air channel (66).

16. A heating apparatus according to claim 15, wherein at least a portion of the connecting channel (66) for each burner (48) extends at least partly in the air channel (40), such that during use some preheating of air flowing therethrough is obtained.

17. A heating apparatus according to any one of the preceding claims, wherein at least two heat ex-

changers (1) are included in the air channel (40).

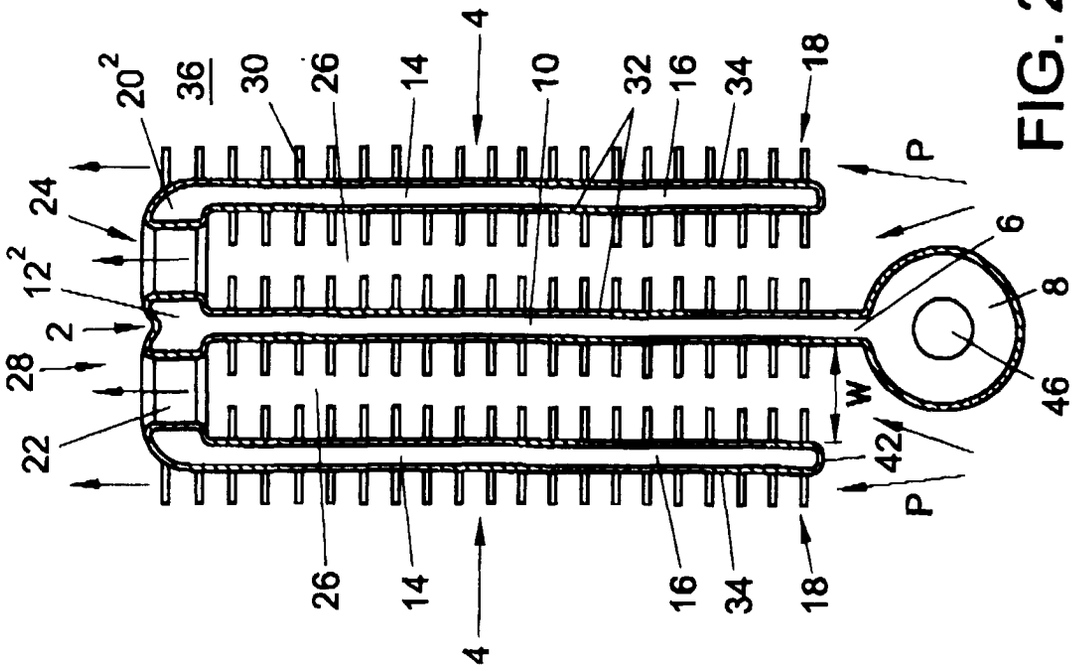
4
20²
36
30
26
14
10
32
16
34
18
P
24
12²
2
28
22
6
8
46
W
42
P
26
14
4
16
34
18

FIG. 2

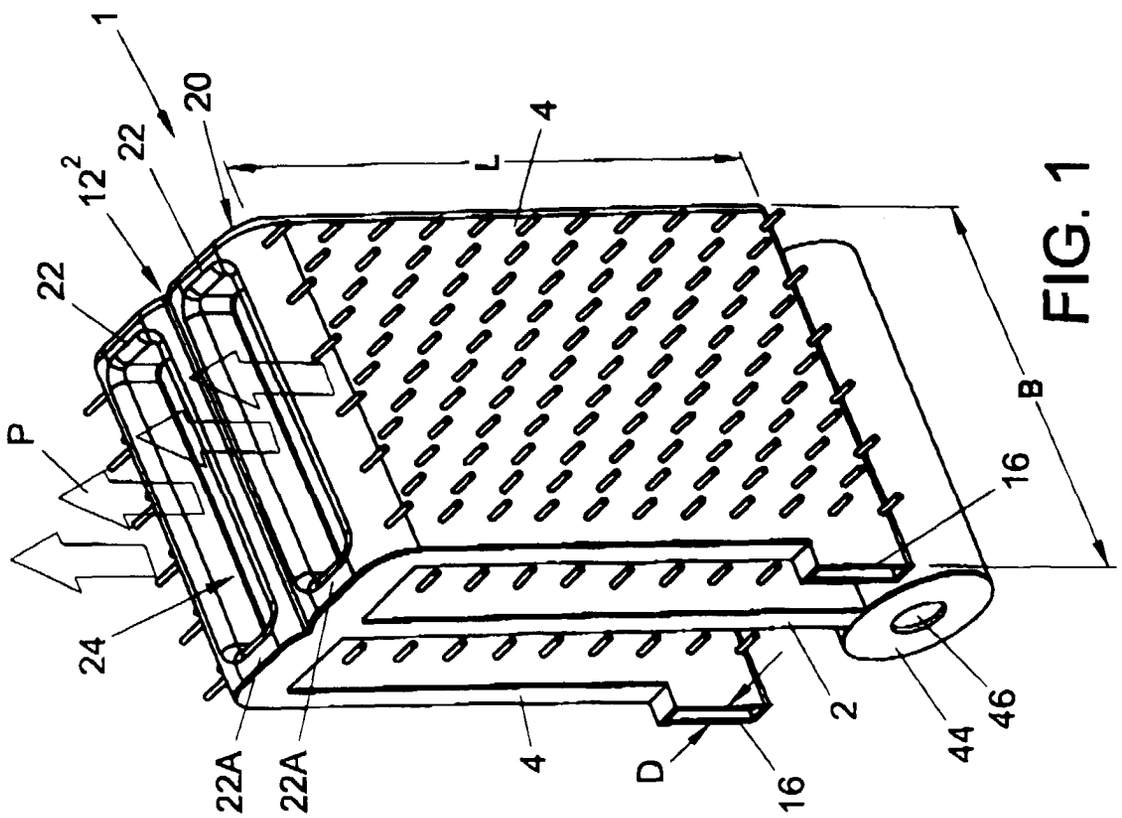
1
20
22
12²
22
4
L
P
24
22A
22A
4
D
16
2
44
46
16
B

FIG. 1

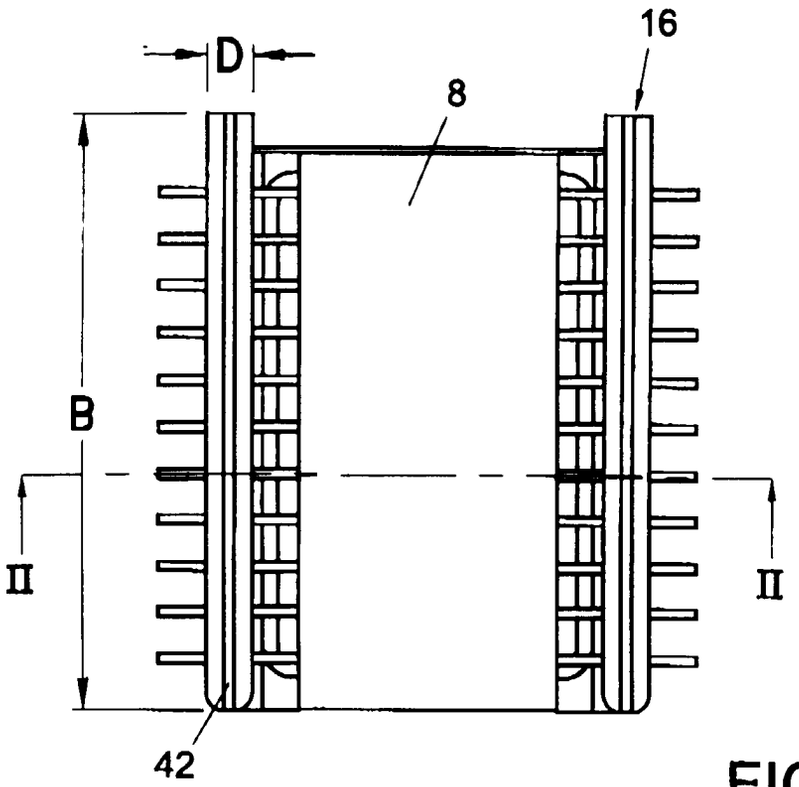

FIG. 3

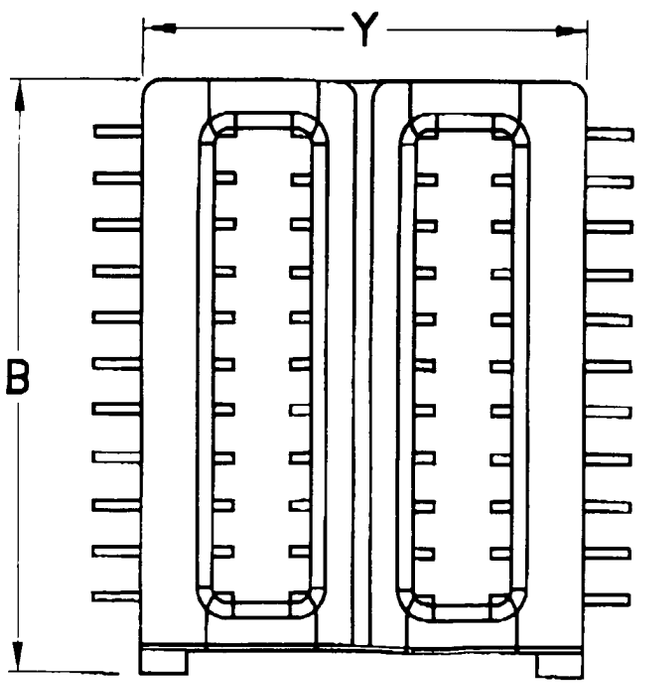

FIG. 4

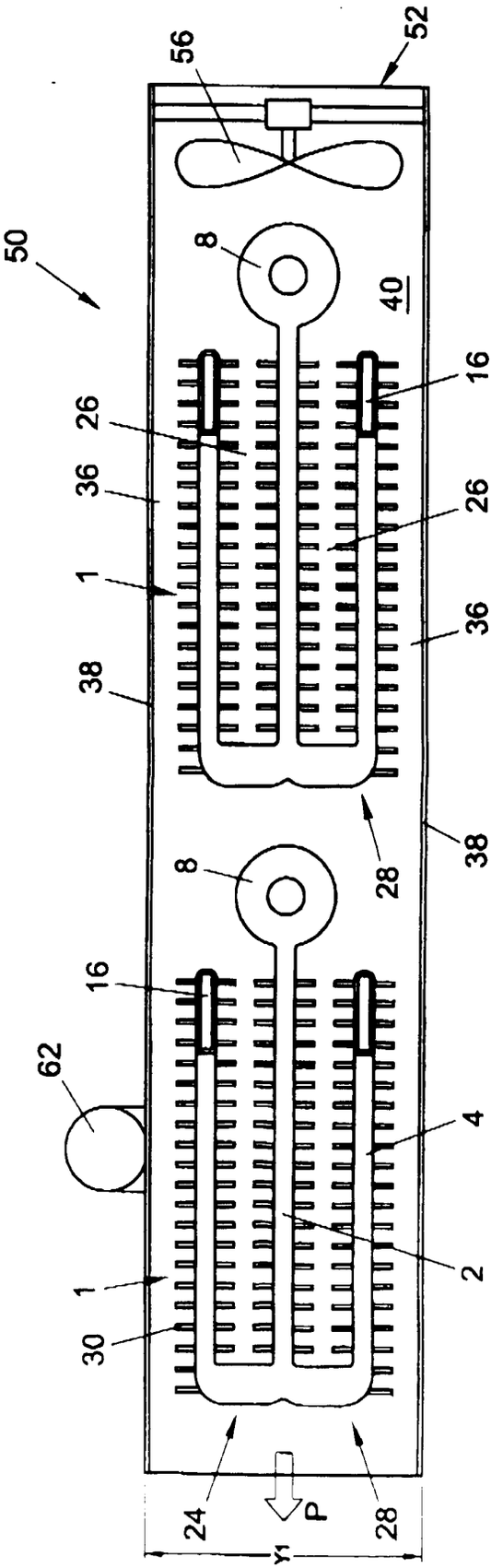

FIG. 5

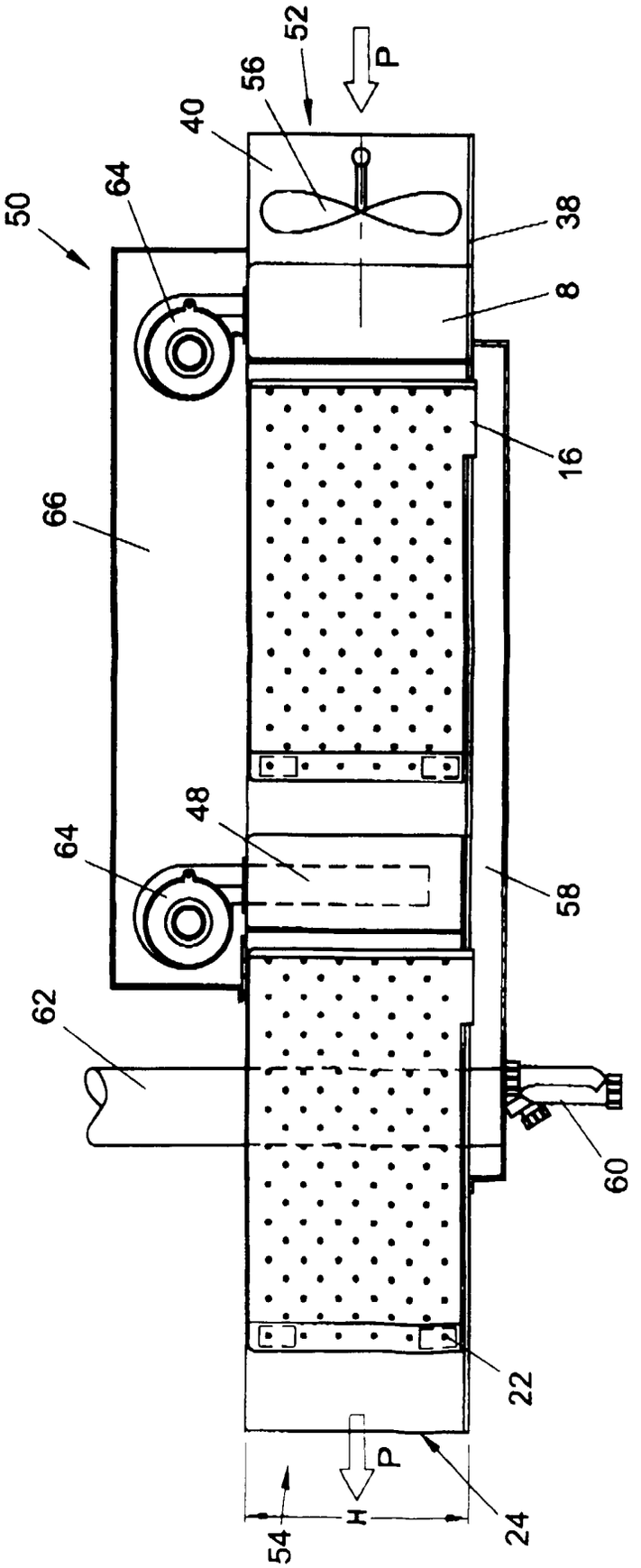

FIG. 6

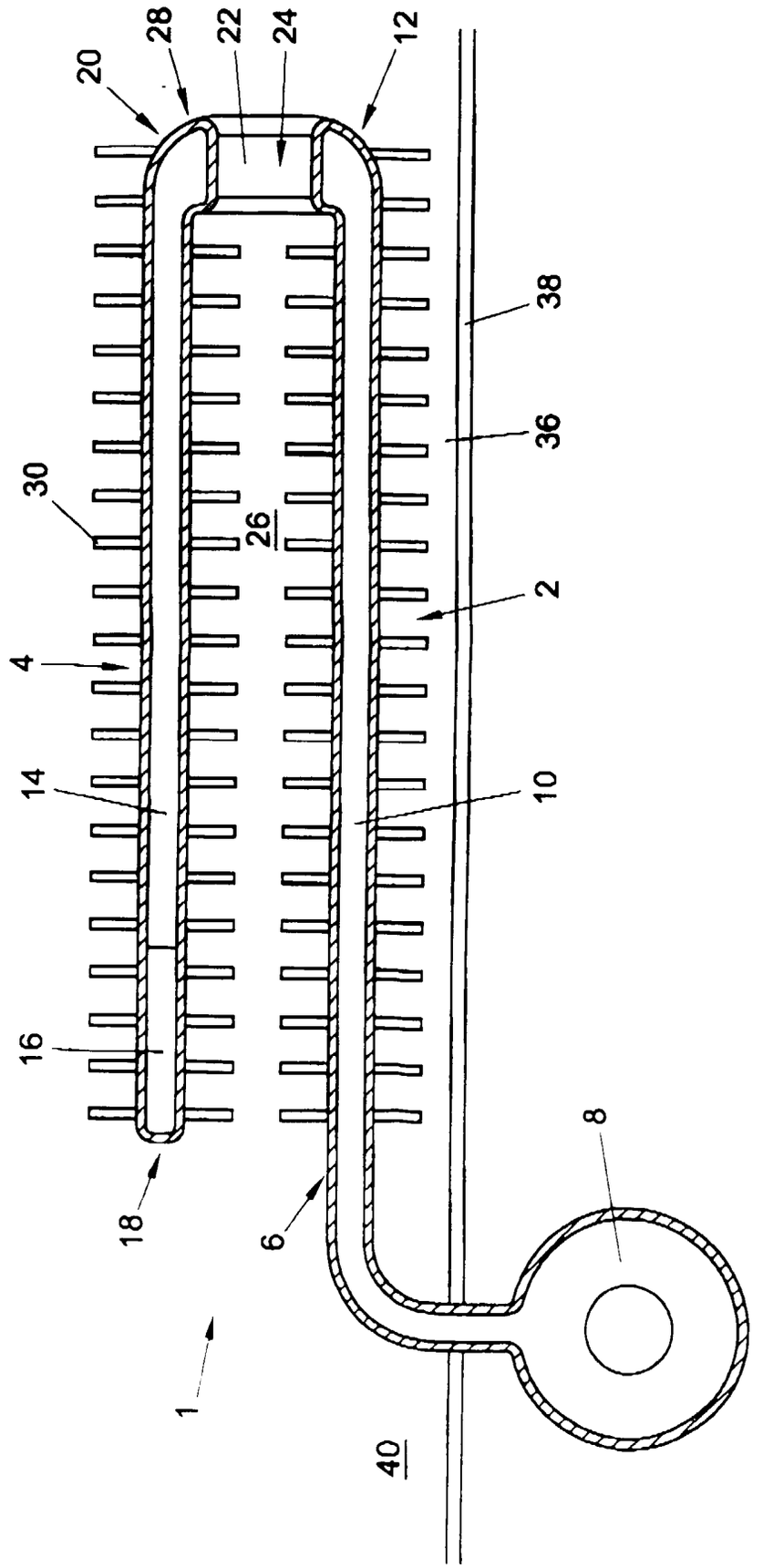

FIG. 7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 20 3949

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A,D	NL 1 009 901 C (HOLDING J H DECKERS N V) 22 February 1999 (1999-02-22) * abstract *	1,7	F24H3/10
A	DE 14 51 223 A (GHELFI) 17 July 1969 (1969-07-17) * figures *	1	
A	US 5 113 844 A (COOK ROBERT W) 19 May 1992 (1992-05-19) * abstract; figures *	1-6	
A	US 3 102 530 A (DIEHL) 3 September 1963 (1963-09-03) * figures *	1-6,9,12	
A	GB 2 011 603 A (POWRMATIC LTD) 11 July 1979 (1979-07-11) * abstract; figures 1,3 *	1-6	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7) F24H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24 January 2001	Van Gestel, H

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 00 20 3949

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.

24-01-2001

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
NL 1009901 C	22-02-1999	NL 1006796 C	22-02-1999
		EP 0898125 A	24-02-1999
DE 1451223 A	17-07-1969	CH 420539 A	15-09-1966
US 5113844 A	19-05-1992	AU 624662 B	18-06-1992
		AU 4619489 A	14-06-1990
		WO 9007091 A	28-06-1990
US 3102530 A	03-09-1963	NONE	
GB 2011603 A	11-07-1979	NONE	

EPO FORM P0459

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