



(51) International Patent Classification:

F28F 1/12 (2006.01) F28F 3/04 (2006.01)
F24D 19/00 (2006.01) F28D 21/00 (2006.01)

(21) International Application Number:

PCT/IT2013/000170

(22) International Filing Date:

13 June 2013 (13.06.2013)

(25) Filing Language:

Italian

(26) Publication Language:

English

(30) Priority Data:

MI2012A 001039 15 June 2012 (15.06.2012) IT

(71) Applicant: DL RADIATORS S.P.A. [IT/IT]; Via L. Seitz, 47, I-31100 Treviso (IT).

(72) Inventors: ZANOLIN, Sergio; Via Piantuzze, 44/A, I-33070 Polcenigo (Pordenone) (IT). SPERANZONI, Renato; Via Cornè, 6/2, I-31045 Motta di Livenza (Trviso) (IT).

(74) Agent: RAPISARDI, Mariacristina; Ufficio Brevetti Rapisardi S.r.l, Via Serbelloni, 12, I-20122 Milano (IT).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,

BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

Published:

— with international search report (Art. 21(3))

— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(54) Title: SHEET METAL CONVECTOR PANEL FOR A RADIATOR FOR HEATING A ROOM

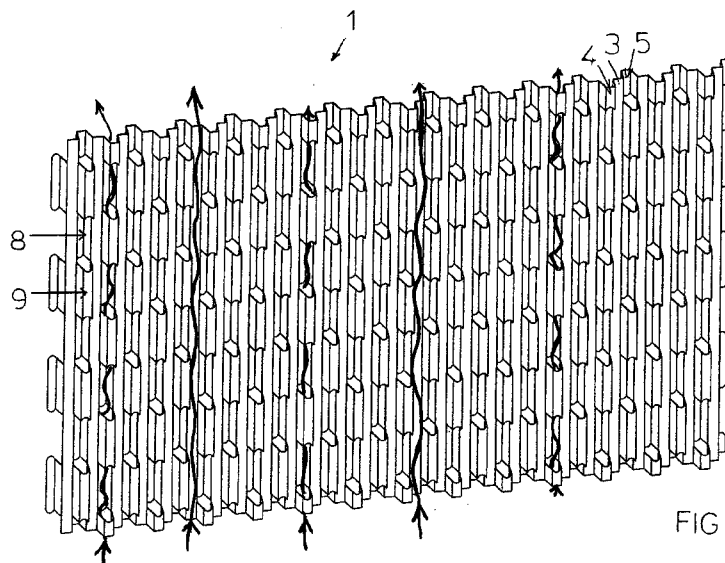


FIG 1

(57) Abstract: A sheet metal convector panel (1) for a radiator for heating a room, which comprises a plurality of parallel longitudinal channels (2) laterally separated from each other by longitudinal separating walls (3), each channel (2) comprising, in the longitudinal direction of extension thereof, an alternating succession of first delimiting walls (4), which extend from one side of the separating walls (3), and second delimiting walls (5), which extend from the opposite side of the separating walls (3).



SHEET METAL CONVECTOR PANEL FOR A RADIATOR FOR HEATING A ROOM

DESCRIPTION

The present invention relates to a sheet metal convector panel for a radiator for heating a room, particularly but not necessarily of the radiant plate type or of another type, for example with flat tubes, a process for the realization thereof, and a method for optimizing the convective exchange efficiency thereof.

A convector consisting of a sheet metal panel, generally steel, and applicable to a radiator has been present on the market for some time.

The panel has a substantially square-wave bent profile, more or less radial, which defines, on the side turned toward the plate, a series of separate parallel convective channels along which an ascending laminar flow of air is created due to a stack effect.

In order to properly perform the function it is designed for, a traditional convector panel must have convective channels with a minimum height that is not below a certain threshold value; this may result in a considerable consumption of raw material, with an impact both on the weight and cost of the finished product.

Thinner sheet metal tends to be used sometimes to overcome such a drawback, but this expedient in turn has a drawback in that below a certain thickness heat conduction through the thickness of the sheet metal is greatly penalized.

The technical task that the present invention sets itself is thus to provide a sheet metal convector panel for a radiator for heating a room, a process for the realization thereof, and a method for optimizing the convective exchange

efficiency thereof which enable the aforementioned technical drawbacks of the prior art to be eliminated.

Within the scope of this technical task, one object of the invention is to realize a sheet metal convector panel for a radiator for heating a room which, while using a sheet metal thickness equal to that of a traditional panel to maintain the efficiency of the conductive exchange through the thickness of the sheet metal, simultaneously achieves an optimization of the convective exchange efficiency and a reduction in the consumption of raw material.

Another object of the invention is to provide a simple and economical method for realizing a sheet metal convector panel with a high convective exchange efficiency.

The technical task, as well as these and other objects, according to the present invention, are achieved by realizing a sheet metal convector panel for a radiator for heating a room characterized in that it comprises a plurality of parallel longitudinal channels laterally separated from each other by longitudinal separating walls, each channel comprising, in the longitudinal direction of extension thereof, an alternating succession of first delimiting walls which extend from one side of the separating walls and second delimiting walls which extend from the opposite side of the separating walls.

The present invention likewise relates to a method for optimizing the convective exchange efficiency of a sheet metal convector panel installed on a radiator for heating a room, said convector panel comprising a plurality of parallel longitudinal channels, and said method being characterized in that it opens each channel

laterally along a succession of longitudinal portions thereof, which are separated and dimensioned so as to obtain maximum turbulence with a minimum loss of flow rate thanks to the ascending air flow created in the channels by virtue of the natural convective exchange triggered by the convector panel.

The present invention relates, finally, to a process for realizing a convector panel for a radiator, characterized in that it comprises a step of shearing and bending a flat metal sheet in which the bend lines are parallel straight lines that define a succession of longitudinal sheet metal strips, and the shearing lines are selectively applied on groups of consecutive longitudinal sheet metal strips which are divided by the shearing lines into a longitudinal succession of cells, the bending step being carried out with bending forces that are orthogonal to the plane in which the flat metal sheet lies and operative in the opposite direction on the adjacent cells of each group of longitudinal strips so as to generate from each group of longitudinal strips a corresponding channel having first delimiting walls which extend from one side of the plane in which the metal sheet lies, alternating with second delimiting walls which extend from the opposite side of the plane in which the metal sheet lies.

The invention achieves numerous advantages, including the fact that the possibility of saving material enables broader design choices and the adoption of a more noble material, such as, for example, aluminium or copper instead of steel, in order to optimize the thermal performance.

The specific configuration of the convector panel offers in itself other advantages, including the possibility of directly exploiting its parts in relief like hooks for attaching the radiator to a wall.

The possibility of having an extremely compact convector panel thus configured likewise enables a protective coating to be evenly applied along the channels and ensures easier accessibility to all its parts for effective cleaning.

Finally, such a convector panel, despite being normally envisaged for vertical installation with the channels oriented vertically, lends itself equally well to vertical installation rotated by 90°, with the channels thus oriented horizontally.

In fact, in this latter case as well, it is possible to advantageously obtain an ascending convective air flow which is rendered conveniently turbulent by virtue of the fact that the first and second delimiting walls of the channels create an obstacle course for the ascending flow of air, which determines greater turbulence and ultimately a benefit in terms of convective exchange efficiency.

Other features of the present invention are moreover defined in the dependent claims.

Additional features and advantages of the invention will be more apparent from the description of a preferred but non-exclusive embodiment of the convector panel according to the invention, illustrated by way of non-restrictive example in the appended drawings, in which:

figure 1 shows an isometric view of the convector panel disposed vertically with the channels vertical, wherein the ascending convective air flow is illustrated by directional lines in boldface;

figure 2 shows an enlarged detail of the convector panel of figure 1;

figure 3 shows a front view of the convector panel of figure 1;

figure 4 shows a plan view of the convector panel of figure 1, applied to the

vertical wall of a radiant plate of a radiator with the channels disposed vertically;
figure 5 shows a side elevation view of the convector panel of figure 1;
figure 6 shows a plan view of a portion of the flat sheet metal panel the convector panel is obtained from, with an indication of the bend lines and cutting lines;
figure 7 shows an isometric view of the convector panel disposed vertically with the channels horizontal, wherein the ascending convective air flow is illustrated by directional lines in boldface.

With references to figures 1 - 7, there is shown a convector panel 1 made of sheet metal, e.g. steel, for a radiator for heating a room, for example, but not necessarily, of the radiant plate type.

The convector panel 1 comprises a plurality of parallel longitudinal channels 2 laterally separated from each other by longitudinal separating walls 3.

Each channel 2 comprises, in the longitudinal direction of extension thereof, an alternating succession of first delimiting walls 4, which extend from one side of the separating walls 3, and second delimiting walls 5, which extend from the opposite side of the separating walls 3.

Preferably, the first delimiting walls 4 and second delimiting walls 5 exhibit overall a checkerboard arrangement on the convector panel 1, and, therefore, the first and second delimiting walls 4, 5 of the channels 2 are ordered in an alternating succession also in the direction along which the channels 2 succeed one another.

The separating walls 3 are flat and in particular they are all coplanar.

The first delimiting walls 4 and second delimiting walls 5 have the same height in a direction orthogonal to the plane in which the separating walls 3 lie.

The first delimiting walls 4 and second delimiting walls 5 preferably have the same configuration, and in particular a radial trapezoidal configuration. Thus each first delimiting wall 4 comprises two flat sides 4a and 4b having an opposite angle of inclination relative to the plane in which the separating walls 3 lie, and a flat side 4c parallel to the plane in which the separating walls 3 lie, while each second delimiting wall 5 comprises two flat sides 5a and 5b having an opposite angle of inclination relative to the plane in which the separating walls 3 lie, and a flat side 5c parallel to the plane in which the separating walls 3 lie.

For each channel 2, each pair of consecutive delimiting walls 4, 5 has adjacent longitudinal ends 4e, 5e which meet at the separating walls 3 in points P1, P2.

The adjacent longitudinal ends 4e, 5e of the consecutive delimiting walls 4, 5 have a mating shape, in particular the end 4e of the first delimiting wall 4 has a straight edge lying in a plane orthogonal to the longitudinal axis of the channel 2 on the sides 4a and 4b, and a concave edge on the side 4c, while the end 5e of the second delimiting wall 5 has a straight edge lying in a plane orthogonal to the longitudinal axis of the channel 2 on the sides 5a and 5b, and a convex edge on the side 5c.

Advantageously, the convector panel 1 delimits a plurality of secondary channels 7, each delimited by a separating wall 3 and by the sides 5a and 5b of the second delimiting walls 5 which start off from the separating wall 3.

The secondary channels 7 have a height that is half that of the main channels 2.

In figure 4, the numerical reference 6 indicates the vertical wall of the radiant plate of the radiator, on which the convector panel 1 is applied with its long side in a horizontal direction.

The plate generally has a heating fluid circuit comprising a plurality of parallel longitudinal wet channels alternating with dry channels.

The wall 6 of the radiant plate closes off one side of the channels 2 and 7.

Preferably, the main channels 2 overlie the wet channels of the plate, whereas the secondary channels 7 overlie the dry channels of the plate.

Given how the convector panel 1 is configured, the main channels 2 have a direct exposure to the atmosphere in the longitudinal portions 8 where the second delimiting walls 5 are present, and are laterally in fluid communication with the secondary channels 7 in the longitudinal portions 9 where the first delimiting walls 4 are present.

We shall make reference to the installation of the convector panel 1 with the main channels 2 oriented in a vertical direction. During normal operation of the radiator, the convective exchange is due to the ascending air flow, which, by virtue of the stack effect, rises up the main vertical channels 2, the secondary vertical channels 7, and the oblique channels that are created as a result of the lateral fluid communication between the main channels 2 and secondary channels 7.

Advantageously, the ascending air flow due to the stack effect along the main channels 2 is rendered turbulent by the alternating exposure to the air of the outside atmosphere and the air that flows in the secondary channels 7.

The increase in turbulence has a beneficial effect on the efficiency of the convective heat exchange of the convective panel 1.

In particular, at least the length of the longitudinal portions 8 of the channels 2 exposed to the atmosphere is dimensioned so as to obtain an ascending air flow

along the channels 2 having maximum turbulence with a minimum loss of air flow rate. In fact, excessively short channel portions 8 would preclude creating an appreciable turbulence in the ascending flow, while excessively long portions 8 would cause a cooling of the ascending air and a consequent loss in air flow rate.

Compared to conventional panel of equal thickness and having channels of equal height, this innovative convector panel 1 is capable of achieving the same thermal efficiency, but with considerable savings in raw materials.

With reference to figure 7, it may be noted that the convector panel lends itself equally well to a vertical installation rotated by 90°, with the channels 2 oriented in a horizontal direction.

In fact, in the latter case as well, one may advantageously obtain a conveniently turbulent ascending convective air flow by virtue of the fact that the first delimiting walls 4 and second delimiting walls 5 of the channels 2 create an obstacle course for the ascending air flow, which determines greater turbulence and ultimately a benefit in terms of convective exchange efficiency. In practical terms, the first delimiting walls 4 intercept and divert the ascending air flow, which in this case has an ascending path that is no longer prevalently straight but rather prevalently zigzag.

The process for realizing the convector panel 1 comprises a step of shearing and bending a flat metal sheet 10 in which the bend lines 11 are parallel straight lines that define a succession of longitudinal sheet metal strips 12, 17, and the shearing lines 13 are selectively applied on groups of consecutive longitudinal sheet metal strips 12, which are divided by the shearing lines 13 into a longitudinal succession

of cells 14, 15.

The bending step is carried out with bending forces that are orthogonal to the plane in which the flat metal sheet 10 lies and operative in the opposite direction on the adjacent cells 14, 15 of each group of longitudinal strips 12 so as to generate from each group of longitudinal strips 12 a corresponding channel 2 comprising the alternating succession of the first and second delimiting walls 4, 5.

In particular, the two inner bend lines 11 of each group of three consecutive longitudinal sheet metal strips 12 go to form the edges joining the sides 4c, 5c of the delimiting walls 4, 5 to the sides 4a, 5a and 4b, 5b of the delimiting walls 4, 5 themselves, whereas the two outer bend lines 11 of each group of three consecutive longitudinal sheet metal strips 12 go to form the edges joining the sides 4a, 4b and 5a, 5b of the delimiting walls 4, 5 to the separating walls 3, which in turn derive from the longitudinal strips 17 not affected by the shearing lines 13.

The convector panel thus conceived is susceptible of numerous modifications and variants, all falling within the scope of the inventive concept; moreover, all the details may be replaced with other technically equivalent ones.

In practice, all of the materials used, as well as the dimensions, can be any whatsoever according to need and the state of the art.

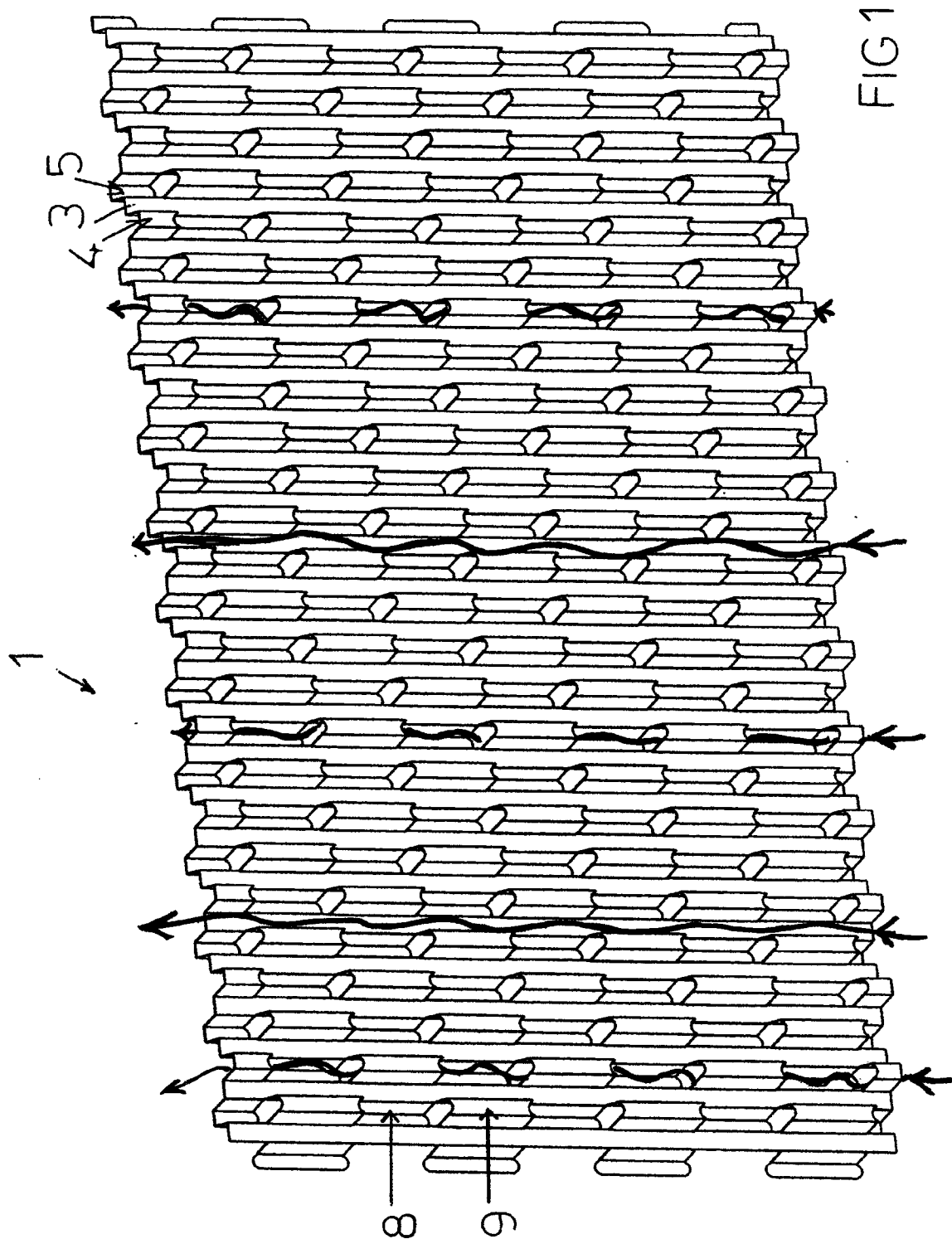
CLAIMS

1. A sheet metal convector panel (1) for a radiator for heating a room, characterized in that it comprises a plurality of main parallel longitudinal channels (2) laterally separated from each other by longitudinal separating walls (3), each main channel (2) comprising, in the longitudinal direction of extension thereof, an alternating succession of first delimiting walls (4), which extend from one side of the separating walls (3), and second delimiting walls (5), which extend from the opposite side of the separating walls (3), the first and second delimiting walls (4, 5) of the main channels (2) being ordered in an alternating succession also in the direction along which the main channels (2) succeed one another.
2. The sheet metal convector panel (1) for a radiator for heating a room according to the preceding claim, characterized in that said first and second delimiting walls (4, 5), in cooperation with said separating walls (3), define secondary longitudinal channels (7) which are parallel to and alternate with the main channels (2), and channels that obliquely intersect the main channels (2) and secondary channels (7).
3. The sheet metal convector panel (1) for a radiator for heating a room according to any preceding claim, characterized in that said separating walls (3) are flat.
4. The sheet metal convector panel (1) for a radiator for heating a room according to any preceding claim, characterized in that said separating walls (3) are coplanar.

5. The sheet metal convector panel (1) for a radiator for heating a room according to any preceding claim, characterized in that said first and second delimiting walls (4, 5) have the same height in a direction orthogonal to the plane in which said separating walls (3) lie.
6. The sheet metal convector panel (1) for a radiator for heating a room according to any preceding claim, characterized in that said first and second delimiting walls (4, 5) have the same configuration.
7. The sheet metal convector panel (1) for a radiator for heating a room according to any preceding claim, characterized in that said first and second delimiting walls (4, 5) have a radial trapezoidal configuration.
8. The sheet metal convector panel (1) for a radiator for heating a room according to any preceding claim, characterized in that, for each channel (2), each pair of consecutive delimiting walls (4, 5) has adjacent longitudinal ends (4e, 5e) which meet at the separating walls (3).
9. A radiator for heating a room characterized in that it comprises at least one sheet metal convector panel (1) according to any preceding claim.
10. The radiator for heating a room according to the preceding claim, characterized in that said panel is applied vertically with the channels oriented horizontally.
11. The radiator for heating a room according to claim 9, characterized in that said panel is applied vertically with the channels oriented vertically.
12. A method for optimizing the convective exchange efficiency of a sheet metal convector panel (1) installed on a radiator for heating a room, said convector

panel (1) comprising a plurality of parallel longitudinal channels (2), characterized in that it opens each channel (2) laterally along a succession of longitudinal portions (8) thereof, which are separated and dimensioned so as to obtain maximum turbulence with a minimum loss of flow rate due to the ascending air flow created in the channels (2) by virtue of the natural convective exchange triggered by the convector panel (1).

13. A process for realizing a convector panel (1) for a radiator for heating a room, characterized in that it comprises a step of shearing and bending a flat metal sheet (10) in which the bend lines (11) are parallel straight lines that define a succession of longitudinal sheet metal strips (12, 17), and the shearing lines (13) are selectively applied on groups of consecutive longitudinal sheet metal strips (12), which are divided by the shearing lines (13) into a longitudinal succession of cells (14, 15), the bending step being carried out with bending forces that are orthogonal to the plane in which the flat metal sheet (10) lies and operative in the opposite direction on the adjacent cells (14, 15) of each group of longitudinal strips (12) so as to generate from each group of longitudinal strips (12) a corresponding channel (2) having first delimiting walls (4) which extend from one side of the plane in which the metal sheet (10) lies, alternating with second delimiting walls (5) which extend from the opposite side of the plane in which the metal sheet (10) lies.



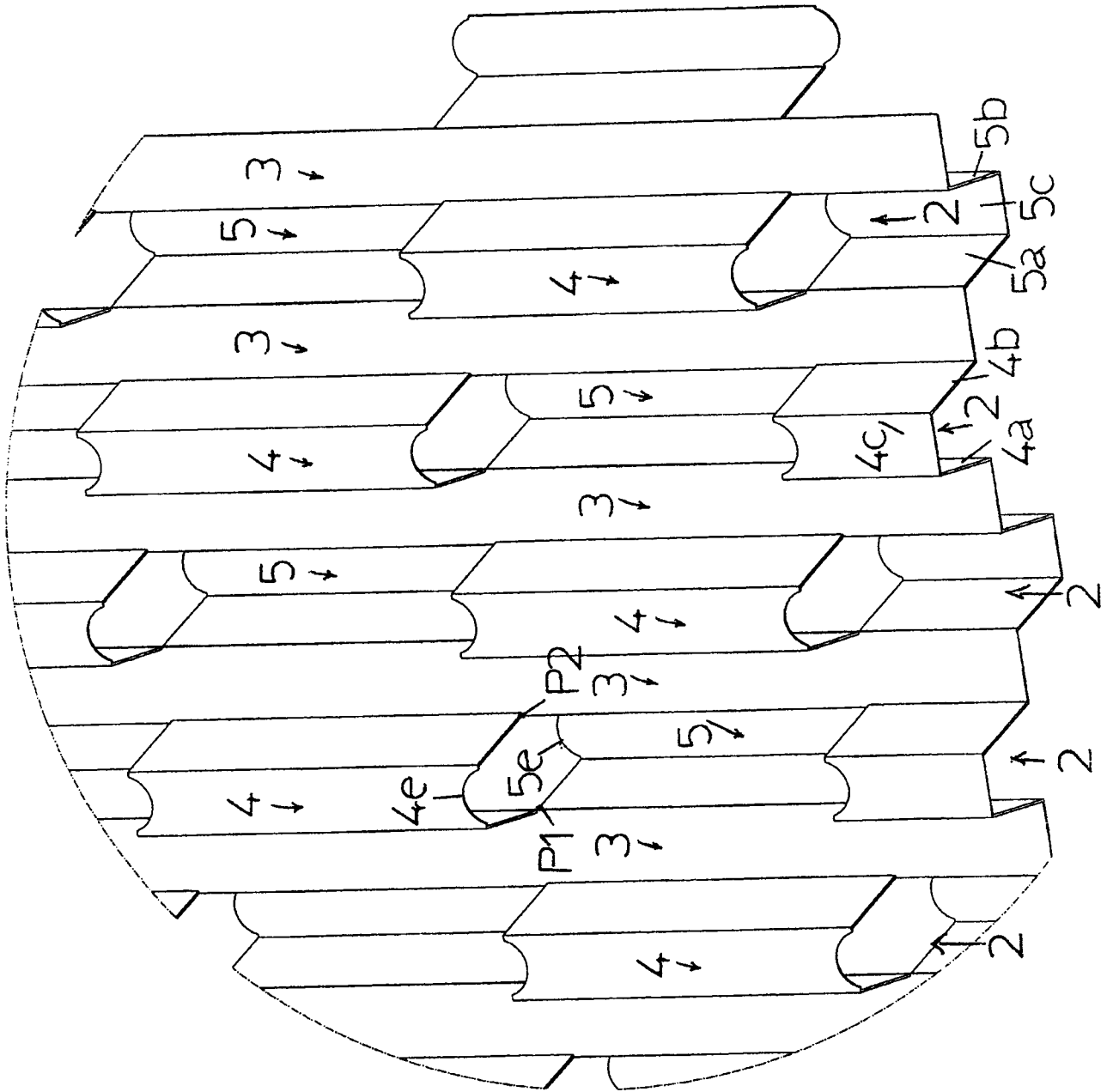


FIG 2

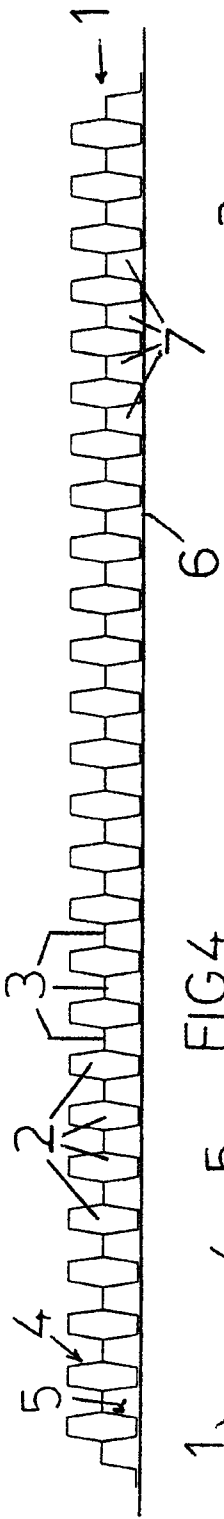


FIG 4

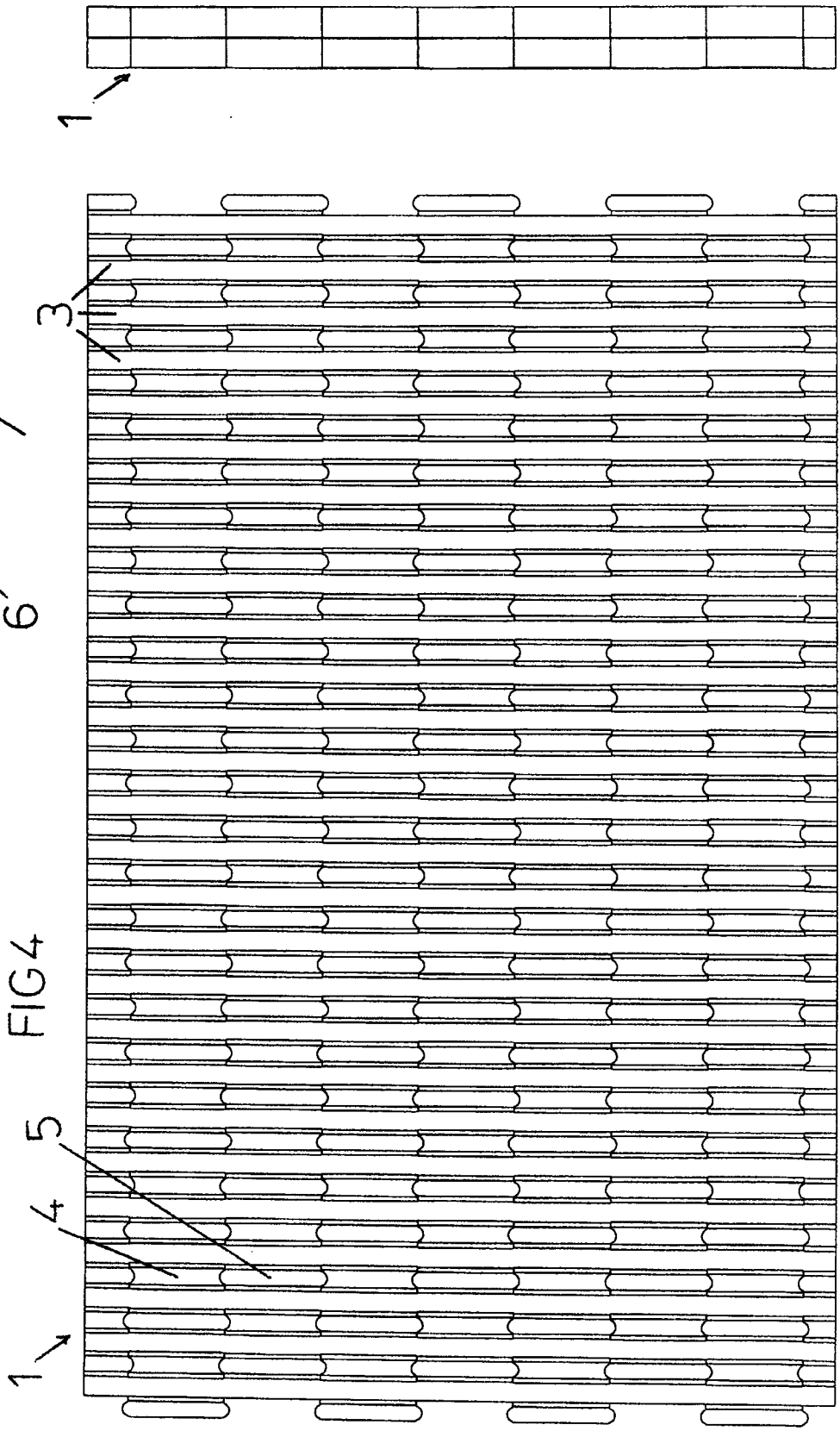


FIG 3

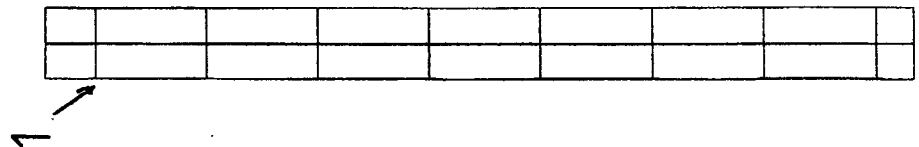


FIG 5

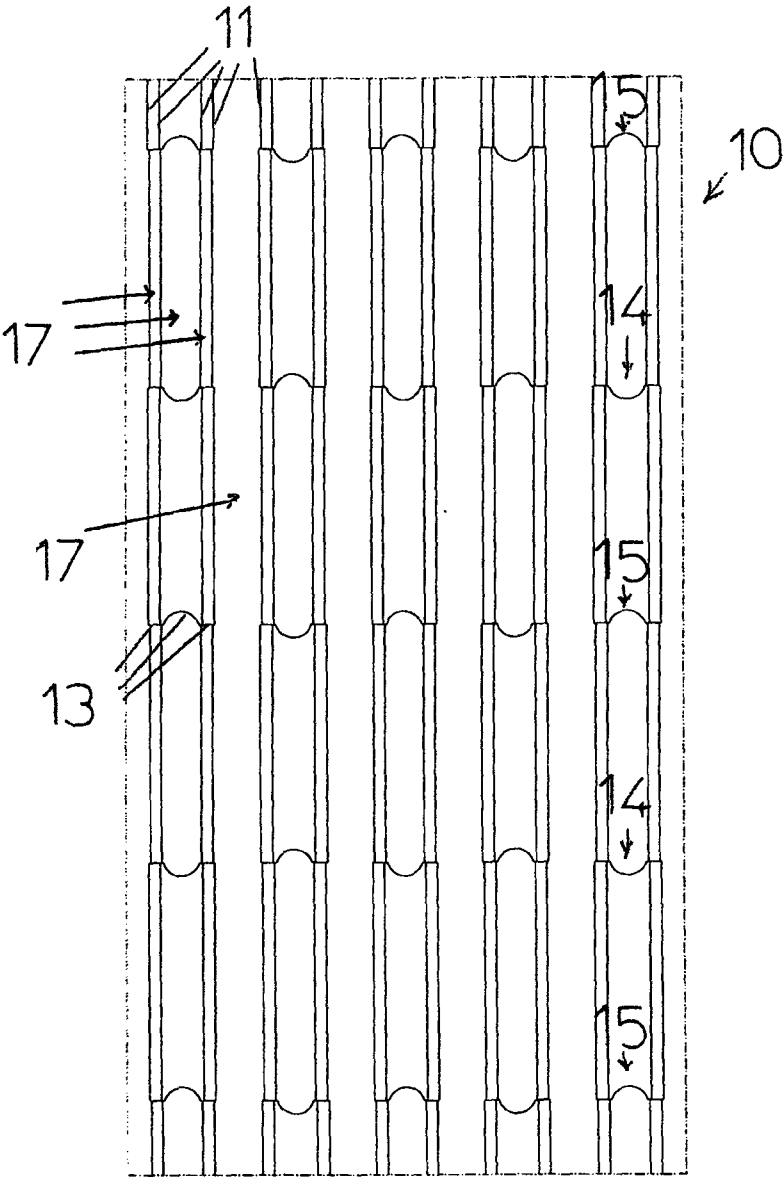


FIG6

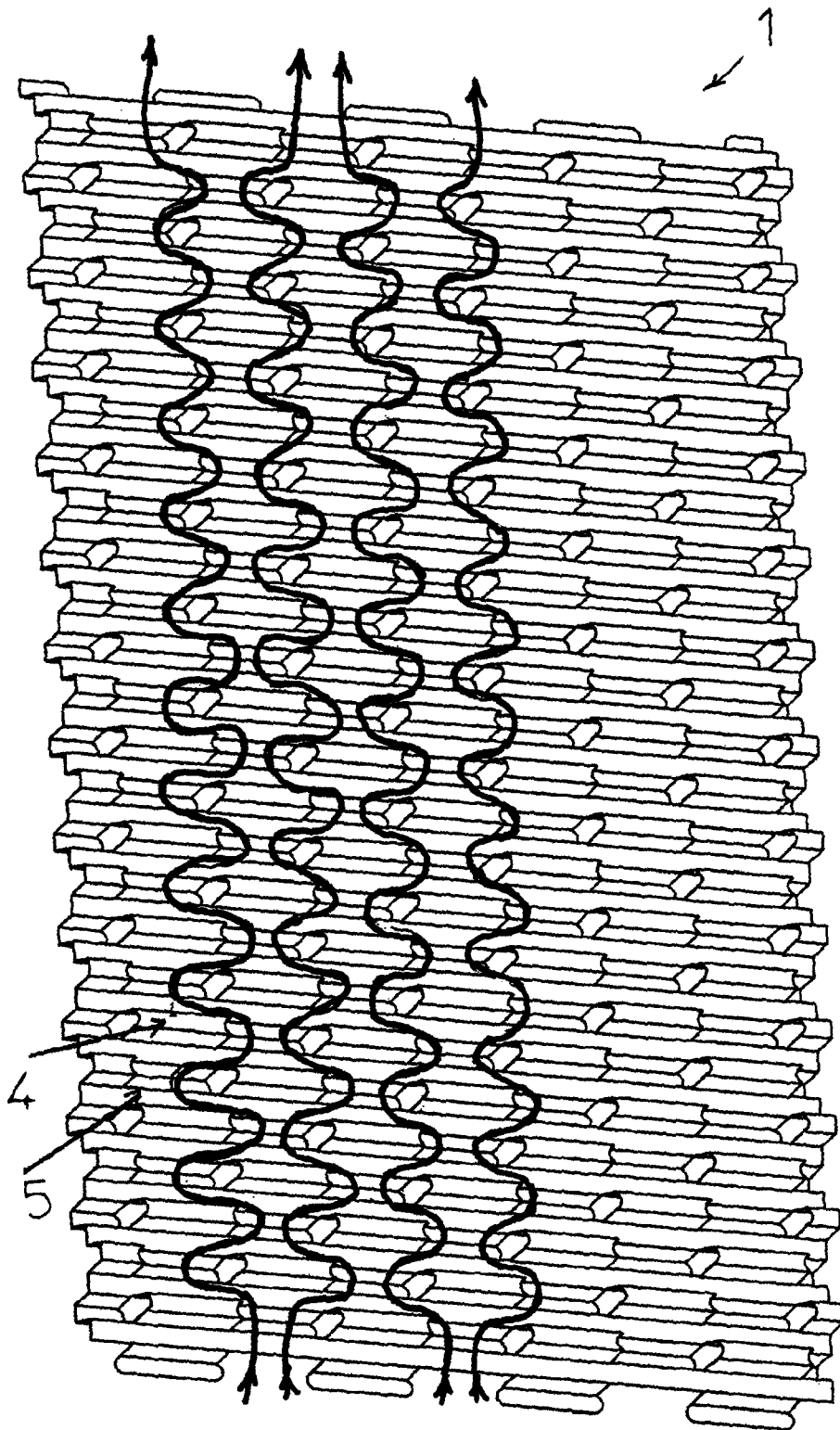


FIG 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2013/000170

A. CLASSIFICATION OF SUBJECT MATTER

INV. F28F1/12 F24D19/00
ADD. F28F3/04 F28D21/00

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F28F F24D

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 practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 39 17 278 A1 (KERMİ GMBH [DE]) 29 November 1990 (1990-11-29) figures 1,4	1-13
X	DE 71 25 678 U (SCHÄFER WERKE KG) 16 May 1974 (1974-05-16) figures 1-3	1-12
A	GB 1 030 129 A (SERVOTOMIC LTD) 18 May 1966 (1966-05-18) figure 2	1-13
A	DE 32 27 146 A1 (SCHAEFER WERKE GMBH [DE]) 26 January 1984 (1984-01-26) figures 5-8	1
	----- -/-	



Further documents are listed in the continuation of Box C.



See patent family 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 application or patent 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

8 November 2013

Date of mailing of the international search report

18/11/2013

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Vassoille, Bruno

INTERNATIONAL SEARCH REPORT

International application No

PCT/IT2013/000170

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1 050 734 A1 (CARADON HEATING EUROP BV [BE] CARADON HEATING EUROP BV [NL]) 8 November 2000 (2000-11-08) figures 5-6 -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IT2013/000170

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 3917278	A1	29-11-1990	NONE
DE 7125678	U	16-05-1974	NONE
GB 1030129	A	18-05-1966	NONE
DE 3227146	A1	26-01-1984	NONE
EP 1050734	A1	08-11-2000	AT 290679 T 15-03-2005
		CZ 20001351 A3	16-05-2001
		DE 19921144 A1	16-11-2000
		DE 50009692 D1	14-04-2005
		EP 1050734 A1	08-11-2000
		PL 340000 A1	20-11-2000
		TR 200001211 A2	21-12-2000