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

(11) **EP 2 687 804 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
22.01.2014 Bulletin 2014/04

(51) Int Cl.:
F28F 1/32 *(2006.01)*

(21) Application number: **12177307.1**

(22) Date of filing: **20.07.2012**

(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

(71) Applicant: **Spasovic, Slobodan**
32000 Cacak (RS)

(72) Inventor: **Spasovic, Slobodan**
32000 Cacak (RS)

(74) Representative: **Lucke, Andreas**
Boehmert & Boehmert
Pettenkoferstrasse 20-22
80336 München (DE)

(54) **Heating device and lamella for assembling the same**

(57) Disclosed is a heating device (10) comprising one or more elongate heating means and a plurality of lamellae (12) consecutively arranged along said one or more elongate heating means. Each lamella comprises a base portion and two side portions (14), wherein said base portion comprises one or more first through holes for receiving said one or more elongate heating means as well as two first engagement means. Said two side portions (14) are provided at two opposite ends of said lamella base portion and are tilted with regard to a lamella plane defined by said base portion, and each side portion (14) has a fixed end which is connected with said base portion as well as a free end portion which is provided with second engagement means. The second engagement means, which are provided at the free end portions of the side portions, each engage with corresponding first engagement means of a respective adjacent lamella, wherein the side portions of plural lamellae in combination form side walls (16) of the heating device (10).

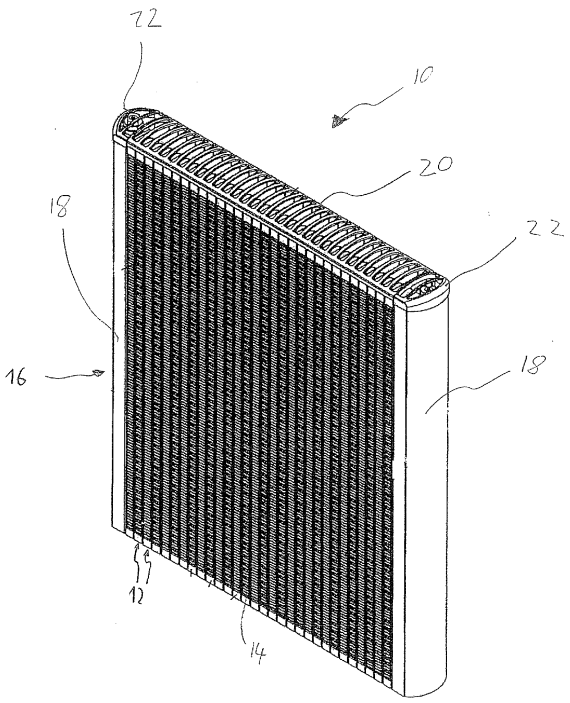

Fig. 1

EP 2 687 804 A1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a heating device comprising a plurality of lamellae as well as to a lamella for assembling a respective heating device.

BACKGROUND ART

[0002] Heating devices are widely used in private households or office buildings.

[0003] Prior art heating devices comprise heating means which are heated by means of a heating fluid, such as water, as well as electrical heating means. Conventional heating devices may comprise lamellae which are in heat conductive contact with the heating means, be it heating fluid pipes or electrical heaters, for providing a large surface area for heat radiation. Due to their typically large number, the lamellae add severely to the manufacturing cost and the amount of material used, which again adds to the cost but also the weight of the heating device. Material can in principle be saved if the thickness of the lamellae is reduced. However, such thickness reduction would normally be at the price of a reduced stability. In practice, this means that the thin lamellae would have to be enclosed in a protective housing of some kind to avoid any mechanical contact with the lamellae when in use, which housing would then again add to the material and manufacturing costs as well as to the total weight of the heating device. Furthermore, the assembly of known heating devices is complex and time-consuming as many different sub-pieces need to be connected, for example by welding, to create safe and long-lasting connections.

[0004] It is an object of the present invention to provide a heating device which overcomes the above-mentioned problems and in particular to provide a heating device which is constituted by a small amount of material, which is cheaper, less bulky and easier to assemble compared to the heating devices of the prior art.

SUMMARY OF THE INVENTION

[0005] This object is solved by a heating device according to claim 1 and by a lamella according to claim 15. Preferred embodiments are defined in the dependent claims.

[0006] The heating device according to the present invention comprises one or more elongate heating means and a plurality of lamellae. Herein, the elongate heating means could for example be an electrical heating rod or a pipe for feeding heating fluid such as water therethrough. The lamellae are consecutively arranged along said one or more elongate heating means, and each lamella comprises a base portion and two side portions. Said base portion comprises one or more first through holes for receiving said one or more elongate heating means and further comprises two first engagement means. The two side portions are provided at two opposite ends on the lamella base portion and are tilted with regard to a lamella plane which is defined by the base portion. Each side portion has a fixed end which is connected with said base portion and a free end portion which is provided with second engagement means. Said second engagement means are provided at said free end portions of said side portions. Each second engagement means engages with a corresponding first engagement means of an adjacent lamella. The side portions of plural lamellae in combination form side walls of the heating device.

[0007] Herein, it is to be understood that the second engagement means of the first or the last lamella in the row or stack of lamellae may not engage with a corresponding first engagement means of an adjacent lamella (because there is none) but with a suitable engagement means of a further element, as described further below. However, for all other lamellae of the plurality of lamellae, each second engagement means engages with a corresponding first engagement means of an adjacent lamella.

[0008] The structure of the heating device of the invention has a number of advantages that are obtained with remarkably little manufacturing effort.

[0009] In particular, the side portions are provided at the lamellae, so that by simply stacking the lamellae along the elongate heating means, the side walls of the heater are automatically formed, without need for any additional pieces or manufacturing steps. Instead, the biggest part of the heating device can be built up by a plurality of identical pieces - the lamellae - which can still be manufactured cost efficiently and quickly.

[0010] What is more, it turns out that the side walls of the heating device as constituted by the side portions of said lamella provide excellent protection of the lamellae base portions, even if the entire lamella has a delicate structure for being made of a metal sheet as thin as 0.5 mm only. Owing to the fact that the fixed ends of the side portions are attached to typically integrally formed with the base portion, and that the second engagement means at the free ends of the side portions engage with first engagement means at the base portion of the adjacent lamella, the side wall formed by the side portions of plural adjacent lamella turn out to be very stiff and robust, in spite of being constituted of comparatively delicate pieces. Finally, since adjacent lamellae engage with each other via the first and second engagement means, a stable wide wall may be formed by simply pressing or tightening the stack of lamellae in a direction along the length of the elongate heating means, which in the preferred embodiment makes any additional bonding between lamella dispensable, thereby further reducing manufacturing costs.

[0011] Because the heating device is easy to assemble, it can be shipped in a plurality of small sub-pieces before assembly, and a comparatively low number of different parts needs to be manufactured. In operation, heat

is transferred from the elongate heating means received in the corresponding first through hole via the lamella base portion to both side portions which form the side walls of the heating device. Thus, under operation, heating energy is radiated off the surfaces of the side walls and of the base portion. Furthermore, the surrounding medium (usually air) which directly contacts the heated lamella is heated and leads to convection between the lamellae and out of the heating device. Hence, under operation the heating device heats the nearby environment by radiation as well as by convection.

[0012] In a preferred embodiment, a lamella further comprises one or more collar portions surrounding said one or more first through holes, wherein said collar portions are in thermal contact with said one or more elongate heating means. Throughout this disclosure, the term "a lamella" should be understood to mean "at least some (but possibly all) of the lamellae" of the heating device. By means of these collar portions, the contacting area between the elongate heating means and the lamella is increased such that the transfer of thermal energy from the elongate heating means to the side walls of the heating device is more effective.

[0013] In the simplest case, the first and second "engagement means" may be simply formed by contact portions or contact surfaces, and the engagement may simply consist of the contact portions or contact surfaces abutting each other. Accordingly, gaps between adjacent lamellae are closed and the side portions form a closed side wall surface. Furthermore, due to said abutment, the side portions of adjacent lamellae are in thermal contact with each other such that heat may be transferred from one lamella to another. This way, thermal differences are prevented resulting in a uniform temperature distribution over the side walls of the heating device.

[0014] Preferably, the first and second engagement means are engagement means strictu sensu in that they are suitable to prevent a relative shift of two adjacent lamellae in a direction transverse to the elongate heating means by engagement rather than friction only (as would be the case for abutting contact portions). In the heating device, this type of engagement of adjacent lamellae has a mutual reinforcing effect providing a stiffness of the sidewall in spite of a possibly thin material constituting the lamella. The side portions of the lamella thereby form a particularly solid surface of the side walls of the heating device.

[0015] Corresponding engagement means of a pair of first and second engagement means engaged with each other may be formed by a recess and by a projection, respectively. Preferably, one of the first (second) engagement means of the lamella is formed by a recess and the other first (second) engagement means of the same lamella is formed by a projection. Thereby, the outer two engagement means of the first and of the last lamella of the plurality of lamellae arranged consecutively along the elongate heating means are both comprised of a recess and a of a projection. Therefore, it is possible to use identical end pieces for both ends of the heating device abutting against the first and last lamella in the stack or sequence, respectively. No different end pieces, e.g. one with two projections and one with two recesses, are needed, such that the heating device is even more simplified.

[0016] In a preferred embodiment the side portions are tilted with regard to the lamella plane by an angle α wherein α is preferably $\geq 60°$, more preferably $\geq 70°$ and in particular $\geq 85°$. In the preferred embodiment, the side portions are orthogonal with regard to the lamella plane, i.e. $\alpha = 90°$. These ranges are particularly advantageous as the resulting even side walls of the heating device result in a radiation direction nearly perpendicular to the side wall plane. Furthermore, the engagement means may then engage in a direction perpendicular to the lamella plane which results in an increased stability of the heating device. However, in order to achieve a radiation in other directions with respect to the surface of the side walls, any other suitable angle can also be chosen as well.

[0017] In order to increase the surface of a lamella - and thereby simultaneously the heating efficiency by convection and radiation, it is preferred that a lamella comprises a corrugated structure. The corrugated structure may be provided on at least one side portion and/or on the base portion of the lamella. When provided on the side portions, the corrugated structure is preferably parallel to the elongate heating means since this further increases the stiffness of the side walls of the heating device.

[0018] Preferably, the lamella is integrally formed from a single sheet of metal and in particular from a single sheet of aluminum. This allows for a fast and cost-effective manufacturing process of the lamella. For example, a lamella may be formed by cutting and bending a thin sheet of metal in a single, integrated rolling process. No sub-pieces need to be connected or assembled for forming a lamella, thereby avoiding a comparatively time-consuming and expensive manufacturing process. A further advantage of an integrally formed lamella is that no connecting joint between different pieces is required which would be a potential weakness possibly reducing the lifetime and the stability of the device.

[0019] The shape of the lamella can be characterized by a width w, a depth d and a thickness t of the metal sheet forming the lamella. The "depth" of a lamella corresponds to the distance that the free end portions at one end of the side portions project from the base portion and generally correspond to the pitch of adjacent lamellae in the stack or sequence of lamellae. In case the side portions are tilted by 90° with respect to the base portion, the depth of a lamella corresponds to the length between the fixed end and free end of the side portion.

[0020] In a preferred embodiment the dimensions of a lamella are as follows: The width w preferably lies in the range $50\ mm \leq w \leq 110\ mm$ and more preferably in the range $70\ mm \leq w \leq 90\ mm$, and/or the depth preferably lies in the range $8\ mm \leq d \leq 25\ mm$ and more preferably

in the range 13 mm ≤ d ≤ 17 mm, and/or the thickness lies preferably in the range 0.3 mm ≤ t ≤ 0.5 mm and more preferably in the range 0.4 mm ≤ t ≤ 0.6 mm, and/or the ratio between thickness and depth t:d preferably lies in the range 1:90 ≤ t:d ≤ 1:10 and more preferably in the range 1:60 ≤ t:d ≤ 1:15, and/or the ratio t:w preferably lies in the range 1:400 ≤ t:d ≤ 1:50 and more preferably in the range 1:300 ≤ t:d ≤ 1:80. These absolute dimensions have proven to give a favorable compromise between stability and material savings. In particular, it is seen that surprisingly, a very rigid overall structure can be obtained with a metal sheet thickness of as little as 0.5 mm, allowing for a light weight, material saving design.

[0021] In one embodiment the heating device according to the present invention further comprises a tightening means and the base portion of each lamella comprises a second through hole for receiving this tightening means. In the heating device the plurality of lamellae are consecutively arranged in a row on the elongate heating means and the tightening means extends through each second through hole of each lamella and thereby through the row of the lamellae. The tightening means tightens the first and the last lamellae directly or indirectly towards each other causing an engagement of corresponding first and second engagement means of adjacent lamellae. Thereby the lamellae within the row are locked and a relative shift of the lamellae is prevented. Herein, an example of "indirect tightening" could be tightening two end pieces against each other, said end pieces sandwiching the stack or row of lamellae.

[0022] The lamellae preferably comprise a top end and a bottom end and preferably the base portion of the lamellae further comprises a flap portion projecting from said lamella plane between the top end and said one or more first through holes. Thereby, the flap portion at least partially covers the view onto the elongate heating means when viewing from the top end to the bottom end along the base portion of a lamella. In this way the user does not see the heating means when looking through the heating device from the top towards the bottom and the appearance of the heating device is improved. This is particularly advantageous in case the elongate heating means is an electrical heating rod which would glow in operation which could be a disturbing look for the user.

[0023] In order to reduce the thermal conductance between the elongate heating means and at least one of the two side portions via the base portion, the lamella may comprise one or more slits perforating the base portion. Due to the slits a heat transfer to the side portion can be locally reduced resulting in a more uniform temperature distribution along the side portions and preventing a local overheating of the side portions. This is again particularly true for electric heaters, where an excessive heating of the side portions can be prevented.

[0024] Additionally, the lamella may comprise a window provided in the base portion for enhancing convection through the lamella. The window is preferably formed by initially forming a contour perforating the base portion, e.g. by a punching or a cutting step, followed by bending out the aforementioned flap portion from the base portion whereby the window is created. The window connects adjacent chambers which are defined by opposite side portions of one lamella and adjacent base portions of adjacent lamellae. Due to the windows under operation the upward flow of hot air of chambers mixes with hot air of adjacent chambers resulting in a more even temperature distribution of the air leaving the heating device as well as of the heating device itself.

[0025] In one embodiment the heating device preferably comprises an elongate temperature sensing means and the base portions of the lamellae comprise a further third through hole for receiving said elongate temperature sensing means. Additionally, this embodiment preferably comprises a safety thermostat which is operationally connected with said elongate temperature sensing means for shutting off further heating in case a temperature threshold is exceeded. Thus, if the temperature of the entire heating device or only of a local portion thereof should be too high for any reason, further heating will be suppressed ensuring a safe operation. Local overheating can for example occur if the heating device is locally covered by a towel or the like. Since the elongate temperature sensing means extends through the entire stack of lamellae, even local temperature peaks can be noticed.

[0026] In one embodiment, the one or more elongate heating means may comprise one or more pipes for carrying a heating fluid. The lamellae may then be fixed to the pipes for example by gluing, soldering or press-fitting. For a gluing connection, the pipes may be coated with a thermostable glue before the device is assembled. For a soldering joint the pipes may be coated with a soldering agent in a first step before the lamellae are consecutively arranged. In a second step after the device has been assembled the device may be heated, e.g. in a furnace, whereby the soldering agent melts and creates a soldering connection between the pipes and the lamellae. Upon cooling down of the heating device the final stability of the soldering connection is achieved. For a press-fitting joint, the lamellae may first be arranged on the pipes wherein the first through holes receive said pipes, and then the pipes may be expanded with a special tool, whereby the press-fitting joint between the lamellae and the one or more pipes is created. In all of the examples, fixing the lamellae to the pipes may be sufficient for the permanent assembly of the lamellae, no further fixation or bonding will typically be necessary.

[0027] Preferably, the heating device further comprises two end piping portions being in heating fluid connection with said pipes. Preferably, the end piping portions are connected with the pipes by a screwing and/or by a gluing/flange and/or by a soldering connection.

[0028] The present invention also comprises a lamella for use in a heating device, in particular for use in a heating device as described above. The lamella according to

the present invention is suitable to be arranged along an elongate heating means of the heating device and comprises a base portion and two side portions. The base portion comprises one or more first through holes for receiving the elongate heating means and two first engagement means. The two side portions are provided at two opposite ends of the lamella base portion and are tilted with regard to a lamella plane defined by the base portion. Further, each side portion has a fixed end which is connected with a base portion and a free end portion which is provided with second engagement means. The second engagement means which are provided at the free end portions of the side portions are each suitable for engaging with corresponding first engagement means of a further adjacent lamella of the same kind. The side portions of plural lamellae in combination are suitable for forming side walls of the heating device.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0029] Further advantages and features of the heating device and the lamella according to the present invention will be described in the following section in which the invention is explained in further detail with reference to two embodiments which are depicted in the attached drawings, wherein

Fig. 1 shows a first embodiment of the heating device according to the present invention,

Fig. 2 is an exploded view of the first embodiment of the heating device,

Fig. 3 is an exploded view of an alternative development of the first embodiment of the heating device according to the present invention,

Fig. 4 is a front view onto a lamella as used in the first embodiment,

Fig. 5 is a side view onto a lamella as used in the first embodiment,

Fig. 6 is a top view of a lamella as used in the first embodiment from the direction denoted as "C" in Fig. 5,

Fig. 7 is a detailed view of the lamella section denoted as "A" in Fig. 6,

Fig. 8 is a detailed view of the lamella section denoted as "B" in Fig. 6,

Fig. 9 shows a detailed section through the side portion of a lamella along the line denoted as "B-B" in Fig. 5,

Fig. 10 is a schematic sectional top view of a version of the first embodiment of the heating device,

Fig. 11 I is a sectional side view on a first embodiment of the heating device,

Fig. 12 is a partly exploded perspective view of a second embodiment of the heating device according to the present invention,

Fig. 13 is a perspective view of the lamella used in the second embodiment of the heating device,

Fig. 14 is a bottom view of the lamella used in the second embodiment from the direction denoted as "E" in Fig. 13,

Fig. 15 is a front view of the lamella used in the second embodiment,

Fig. 16 is a sectional view as indicated by the line denoted as "C-C" in Fig. 15,

Fig. 17 is a sectional view as indicted by the line denoted as "D-D" in Fig. 15,

Fig. 18 is a detailed view of the section denoted as "B" in Fig. 17 and

Fig. 19 is a schematic sectional side view of the second embodiment of the heating device.

[0030] Fig. 1 shows a perspective view of a heating device 10 according to a first embodiment of the present invention. The heating device 10 comprises a plurality of lamellae 12 shown in more detail in Fig. 1 to 11 which are arranged consecutively in a row, thereby forming a horizontal stack of vertical lamellae. Each lamella 12 has two side portions 14. Together the plurality of side portions 14 of the lamellae 12 form the side walls 16 of the heating device 10. At two opposing ends of the heating device 10, i.e. at the first and at the last lamella 12 of the row or stack of lamellae 12, respectively, respective end piping portions 18 are disposed. On top of the heating device a grid cover 20 and two side covers 22 are disposed.

[0031] Fig. 2 shows an exploded view of the heating device 10. As seen therein, the plurality of lamellae 12 are arranged along six pipes 24 which are received by first through holes 26 of the lamellae 12. The end piping portions 18 comprise receiving holes 28 and the pipes 24 are connected to the end piping portions 18 by means of pipe connectors 30.

[0032] The pipe connectors 30 comprises a thread 32 and a flange 34, wherein the threads 32 are screwed into corresponding receiving holes 28 of the end piping portions 18 and the flanges 34 are connected to corresponding ends of the pipes 24 by a gluing connection, prefer-

ably using a thermostable glue. For the screwing connection between each thread 32 and the corresponding receiving hole 28 of the end piping portions 18 preferably a sealing material, e.g. Teflon tape, is used. This way, a reliable and waterproof connection may be formed between the end piping portions 18 and the pipes 24.

[0033] For fixing the plurality of lamellae 12 onto the pipes 24, the pipes 24 are inserted through the respective first through hole 26 of each lamella 12 and the lamellae 12 are pushed together to form a tight stack. Thereafter, the pipes 24 are expanded for example by inserting a suitable tool into the pipes whereby each lamella 12 is press-fitted to the pipes 24 and a stable press-fitting connection is formed. During operation of the heating device 10 the pipes 24 are carrying a heating fluid, typically water which heats the pipes 24. The heat is transferred via the press-fitting connection to each of the lamellae 12 and further to the side walls 16 of the heating device 10 formed by the side portions 14 of the lamellae.

[0034] Fig. 3 shows an exploded view of the heating device 10 which is generally the same as that of Fig. 1 except that it dispenses with pipe connectors 30 used in the embodiment of Fig. 2. In this alternative first embodiment shown in Fig. 3, the pipes 24 are connected to the end piping portions 18 and to the plurality of lamellae 12 by means of a soldering connection. For this purpose, the pipes 24 are coated with a soldering agent in a first step, and then the heating device 10 is preliminarily assembled by arranging the plurality of lamellae 12 along the pipes 24 and inserting the pipes 24 into corresponding receiving holes 28 of the end piping portions 18. After the heating device 10 has been preliminarily assembled and tightened, the heating device 10 is heated, e.g. in a furnace, whereby the soldering agent disposed on the pipes 24 melts and forms a soldering connection between the pipes 24 and each of the lamellae 12 as well as between the pipes 24 and the end piping portions 18. Upon cooling down of the heating device 10 a stable and watertight connection is formed between the pipes 24 and the end piping portions 18 as well as between the pipes 24 and each of the lamellae 12. The latter allows for an efficient heat transfer between the pipes 24 and the lamellae 12.

[0035] Fig. 4 shows a front view onto the lamella 12 used for the first embodiment of the heating device 10. The lamella 12 comprises a base portion 36, the base portion 36 comprising said first through holes 26 and a corrugated structure 38. The first through holes 26 are disposed for receiving the pipes 24 (not shown) and the corrugated structure 38 is disposed for increasing the surface of the base portion 38 of the lamella 12 whereby the heat transfer by convection and radiation to the environment is improved. In the embodiment of Fig. 4 the corrugated structure 38 is disposed at two opposite ends of the base portion 36 but it could be disposed at other positions as well. In other embodiments, the corrugated structure 36 may be omitted.

[0036] Fig. 5 shows a side view onto the lamella 12 of Fig. 4. The lamella 12 comprises side portions 14 which are tilted with respect to the base portion 36 by 90° and collar portions 40 which surround the first through holes 26 and extend in a direction perpendicular to the base portion 36 of the lamella 12. A plurality of side portions 14 of the plurality of lamellae 12 of the heating device 10 together forms the side walls 16 of the heating device 10 (see Fig. 1). As depicted in Fig. 5, the side portions 14 may comprise a corrugated structure 38 as well in order to increase the surface of the side walls 16 of the heating device 10 thus improving the efficiency of heat transfer from the heating device 10 to the surrounding space. The corrugated structure 38 provided at the side portions 14 also improves the stability and the stiffness of the side walls 16 of the heating device 10 formed by the plurality of side portions 14.

[0037] In the embodiment shown, the width w of the lamella 12 (see Fig. 4) is 80 mm and the depth d (see Fig. 5) is 18 mm. The thickness t of the metal sheet (see Fig. 7) constituting the lamella 12 is 0 - 5 mm only.

[0038] Fig. 6 shows a top view onto the lamella 12 from the direction denoted as "C" in Fig. 5. At two opposite ends of the base portion 36 the side portions 14 with respective free end portions 42 are provided. The side portions 14 extend in a direction which is about perpendicular to a lamella plane defined by the base portion 36, and the free end portions 42 extend about vertically at an end of a respective side portion 14 towards the inner side of the heating device 10. The collar portion 40 projecting in a direction vertically to the base portion 36 and surrounding a corresponding first through hole 26 provides an area for contacting a corresponding pipe 24 and ensures an efficient heat transfer from the pipe 24 to the lamella 12.

[0039] Figs. 7 and 8 show the two enlarged views of side portions 14 provided at opposite ends of the base portion 36 with free end portions 42 corresponding to the same lamella 12, where Fig. 7 corresponds to the section denoted as "A" in Fig. 6 and Fig. 8 corresponds to the section denoted as "B" in Fig. 6. The base portion 36 of the lamella 12 comprises two first engagement means 44a, 44b and each of the two free end portions 42 of a lamella comprise a second engagement means 46a, 46b. The first engagement means comprise one projection 44b (Fig. 7) and one recess 44a (Fig. 8). The second engagement means likewise comprises one projection 46b (Fig. 8) and one recess 46a (Fig. 7). This way, identical end piping portions 18 can be used for engaging with the first and last lamella 12 of the stack.

[0040] In the assembled heating device 10, the free end portions 42 of a lamella 12 abut against the base portion 36 of the adjacent lamella 12, with the second engagement means 46a, 46b of the lamella 12 engaging with a corresponding first engagement means 44a, 44b of the adjacent lamella 12. Due to the engagement of first and second engagement means (44a, 44b; 46a, 46b) the lamellae 12 are locked within the heating device 10 and prevented from shifting in the direction of the lamella

plane defined by the base portion 36. Each second engagement means 46a, 46b - except for the engagement means 46a, 46b of the first or last lamella 12 - engages with a corresponding first engagement means 44a, 44b of an adjacent lamella 12. This way, the free end portions 42 are fixed in their positions thus preventing the side portion 14 from being bent with respect to the lamella plane. This results in a remarkably stiff and solid surface of the side walls 16 of the heating device 10 despite the thin material forming a lamella 12. The corrugated structure 38 further improves the stiffness of the side walls 16 as the flexibility of the side portions 14 is reduced as can be seen from Figs. 7 and 8. This is also apparent from Fig. 9 showing a section through the side portion 14 along the line denoted as "B-B" in Fig. 5.

[0041] Fig. 10 shows a schematic sectional top view of the heating device 10 in which a pipe 24 is received by first through holes 26 of lamellae 12 arranged along a pipe 24. The pipe 24 carries a heating fluid such as water and heat is transferred from the pipe 24 to the side portions 14 via the base portions 36 of the lamellae 12, wherein the heat transfer is improved by means of the collar portions 40. The heated side portions 14 forming the side walls 16 of the heating device 10 radiate heat to the environment. This is indicated by arrows in Fig. 10. The air inside the heating device is heated by convection and radiation. In Fig. 10 the hot air inside the heating device 10 is indicated by dots.

[0042] Fig. 11 shows a schematic sectional side view of the entire heating device 10 of the first embodiment wherein the section extends through the pipes 24 received by the first through holes 26 of the plurality of lamellae 12. In Fig. 11 the flow of the upwardly directed hot air inside and out of the heating device 10 is indicated by straight upwardly directed arrows. The flow of the heating fluid inside the pipes 24 and inside the end piping portions 18 is indicated by bent arrows. While Fig. 10 illustrates the effect or heat radiation in a direction perpendicular to the side walls 16 of the heating device 10, Fig. 11 illustrates the heating effect by convection caused by upwardly flowing hot air leaving the heating device 10 through the grid cover 20.

[0043] Fig. 12 shows a perspective and partly exploded view of a heating device 48 according to a second embodiment of the present invention. The heating device 48 according to the second embodiment differs from the heating device 10 according to the first embodiment of the present invention in that it is operated electrically instead of being heated by means of a heating fluid.

[0044] The heating device 48 comprises a plurality of lamellae 12 which are arranged along electrical heating elements 50 which form another example of an elongate heating means. The lamellae 12 are arranged in a row and tightened by means of two tightening means 52 such as a threaded rod. An elongate temperature sensing means 54 extends through the stack of lamellae 12 for sensing the temperature inside the heating device 48. The elongate temperature sensing means 54 is connected to a safety thermostat 56. The thermostat 58 is operationally connected with a regulating button 60 and is mounted within a receiving portion 62. At opposing ends of the row of lamellae 12 side covers 64 are disposed. On top of the heating device 48 a grid cover 20 is provided.

[0045] For adjusting a desired temperature, the user may turn the regulating button 60, thereby providing the corresponding set value of the desired temperature to the thermostat 58. The thermostat 58 allows regulating the power applied to the electrical heating element 50 in a way per se known from prior art. In case the temperature of the heating device 48 or of a portion thereof exceeds a predetermined threshold, this is detected by the safety thermostat 56 via the elongate temperature sensing means 54 which then prevents further heating. This safety function works independently from the user input and ensures a safe operation of the heating device 48.

[0046] Fig. 13 shows a perspective view of a lamella 12 used in the heating device 48 of the second embodiment. The lamella 12 comprises first through holes 26 for receiving the electrical heating elements 50, second through holes 66 for receiving the tightening means 52 and a third through hole 68 for receiving the elongate temperature sensing means 54. Furthermore, the lamella 12 comprises slits 70, a flap portion 72 and a window 74. The slits 70 and the window 74 are provided in the base portion 36 of the lamella 12 and the flap portion 72 projects from the lamella plane defined by the base portion 36 between the first through holes 26 and the top end 76 of the lamella 12.

[0047] Fig. 14 shows a bottom view of the lamella 12 from the direction denoted as "E" in Fig. 13. As can be seen in Fig. 14, the flap portion 72 projects from the lamella plane defined by the base portion 36 whereby the view onto the electrical heating elements 50 is at least partially covered by the flap portion 72 when viewing from the top to the bottom of the heating device 48 along the lamella plane. This way, the user does not see the electrical heating elements 50 when viewing from the above into the heating device 48 whereby the flap portions 72 provide a more pleasant appearance of the heating device 48.

[0048] Fig. 15 shows a front view onto the lamella 12 showing again two pairs of slits 70 provided at opposite ends of the base portion 36. Between the pairs of slits 70 the first through holes 26 are provided in the base portion. The slits 70 perforate the base portion 36 and reduce the thermal conductance from the electrical heating elements 50 received in the first through holes 26 to the side portions 14 via the base portion 36. The reduction of thermal conductance by the slits 70 is provided only locally and close to the first through holes 26 such that the heating uniformity of the side portions 14 is improved and local excessive heating of the side portions 14 can be avoided.

[0049] Fig. 16 shows a sectional top view onto the lamella 12 from the direction denoted as "E" in Fig. 13,

where the lamella is cut along the line denoted as "C-C" in Fig. 15. As can be seen from Fig. 16 the slits 70 are provided within the base portion 36 of the lamella 12 and interrupting locally the heat transfer from the electrical heating element 50 (not shown) which is received in the first through hole 26 to the side portions 14 via the base portion 36.

[0050] Fig. 17 shows a sectional side view of the lamella 12 when the lamella is cut along the line denoted as "D-D" in Fig. 15. The area denoted as "D" in Fig. 17 is depicted detail in Fig. 18. As can be seen in Fig. 18, the flap portion 72 projects from the lamella plane defined by the base portion 36 of the lamella 12, thereby covering the view onto the electrical heating elements 50 (not shown) when viewing from the top end 76 along the lamella plane. The flap portion 72 is preferably created by creating a contour perforating the base portion 36, e.g. by cutting or punching, and by bending the material surrounded by the contour out of the lamella plane, thereby creating the window 74.

[0051] During operation of the heating device 48, the flow of hot air is redirected by the flap portions 72 and the hot air streams through the windows 74 of corresponding lamellae 12 whereby the hot air distributes among the chamber formed between adjacent lamellae 12, resulting in a more uniform airflow leaving the heating device 48 through the grid cover 20 and heating the environment by convection.

[0052] Fig. 19 shows a schematic sectional side view of the entire heating device 48, the section extending through the electrical heating elements 50 received in the first through holes 26 of the plurality of lamellae 12. In Fig. 19 the flow of the upwardly directed hot air inside and out of the heating device 48 is indicated by straight upwardly directed arrows, illustrating the heating effect by convection caused by upwardly flowing hot air leaving the heating device 48 through the grid cover 20.

[0053] Although the present invention has been described with specific reference to a first and second embodiment shown in Figs. 1 to 19, it is understood that changes can be made and features can occur in different combinations without departing from the present invention. The described embodiments are to be considered as only illustrative and not restrictive. In particular, the slits 70, the window 74, the flap portion 72, the collar portion 40 and the assembly by means of the tightening means 52 which have been described only with respect to the second embodiment may be applied to the first embodiment in the same manner.

LIST OF REFERENCE NUMBERS

[0054]

10	heating device
12	lamella
14	side portions
16	side wall
18	end piping portion
20	grid cover
22	side cover
24	pipes
26	first through hole
28	receiving hole
30	pipe connector
32	thread
34	flange
36	base portion
38	corrugated structure
40	collar portion
42	free end portion
44a, b	first engagement means
46a, b	second engagement means
48	heating device
50	electrical heating element
52	tightening means
54	elongate temperature sensing means
56	safety thermostat
58	thermostat
60	regulating button
62	receiving portion
64	side cover
66	second through holes
68	third through holes
70	slit
72	flap portion
74	window
76	top end

Claims

1. A heating device (10, 48) comprising:

- one or more elongate heating means (24, 50), and
- a plurality of lamellae (12) consecutively arranged along said one or more elongate heating means (24, 50), each lamella (12) comprising:

  • a base portion (36), said base portion (36) comprising one or more first through holes (26) for receiving said one or more elongate heating means (24, 50) and two first engagement means (44a, 44b), and
  • two side portions (14), said side portions (14) being provided at two opposite ends of said lamella base portion (36) and being tilted with regard to a lamella plane defined by said base portion (36), each side portion (14) having a fixed end connected with said base portion (36), and a free end portion (42) being provided with second engagement means (46a, 46b),

  wherein said second engagement means (46a, 46b) provided at said free end portions

(42) of said side portions (14) each engage with corresponding first engagement means (44a, 44b) of a respective adjacent lamella (12), wherein the side portions (14) of plural lamellae (12) in combination form sidewalls (16) of the heating device (10, 48).

2. The heating device (10, 48) according to claim 1, wherein a lamella (12) further comprises one or more collar portions (40) surrounding said one or more first through holes (26) receiving said one or more elongate heating means (24, 50), and
wherein said one or more collar portions (40) are in thermal contact with said one or more elongate heating means (24, 50).

3. The heating device (10, 48) according to one of the preceding claims, wherein said first and second engagement means (44, 46) are formed by contact portions and said engagement is formed by the contact portions abutting each other.

4. The heating device (10, 48) according to one of the preceding claims, wherein the first and second engagement means (44a, 44b, 46a, 46b) are suitable to prevent a relative shift of two adjacent lamellae (12) in a direction transverse to the elongate heating means (24, 50).

5. The heating device (10, 48) according to one of the preceding claims, wherein one engagement means of a corresponding pair of first and second engagement means (44a, 44b, 46a, 46b) engaging with each other is formed by a recess and the other one is formed by a projection,
wherein preferably one of the first (second) engagement means of each lamella (12) is formed by a recess (44a, 46a) and the other first (second) engagement means of the same lamella (12) is formed by a projection.

6. The heating device (10, 48) according to one of the preceding claims, wherein said side portions are tilted with regard to said lamella plane by an angle α, wherein α is preferably $\geq 60°$, more preferably $\geq 70°$ and in particular $\geq 85°$.

7. The heating device (10, 48) according to one of the preceding claims, wherein a lamella (12) further comprises a corrugated structure (3 8) provided on at least one of said side portions (14) and/or on the base portion (36).

8. The heating device (10, 48) according to one of the preceding claims, wherein a lamella (12) is integrally formed from a single sheet of metal, in particular from a single sheet of aluminum.

9. The heating device (10, 48) according to claim 8, wherein a lamella (12) has a width w and a depth d corresponding to the distance a free end portion (42) projects from the base portion (36), and wherein the metal sheet forming a lamella (12) has a thickness t, wherein
preferably $50\ mm \leq w \leq 110\ mm$ and more preferably $70\ mm \leq w \leq 90\ mm$, and/or
preferably $8\ mm \leq d \leq 25\ mm$ and more preferably $13\ mm \leq d \leq 17\ mm$, and/or
preferably $0{,}3\ mm \leq t \leq 1{,}5\ mm$ and more preferably $0{,}4\ mm \leq t \leq 0{,}6\ mm$, and/or
the ratio t:d is preferably $1:90 \leq t:d \leq 1:10$ and more preferably $1:60 \leq t:d \leq 1:15$, and/or
the ratio t:w is preferably $1:400 \leq t:d \leq 1:50$ and more preferably $1:300 \leq t:d \leq 1:80$.

10. The heating device (10, 48) according to one of the preceding claims, further comprising a tightening means (52),
wherein the plurality of lamellae (12) are consecutively arranged in a row on said one or more elongate heating means (24, 50), the row comprising a first and a last lamella (12),
wherein the base portion (36) of each lamella (12) comprises a second through hole (66) for receiving said tightening means (52), and
wherein said tightening means (52) tightens said first and last lamella (12) directly or indirectly towards each other such that corresponding first and second engagement means (44, 46) of adjacent lamellae (12) engage whereby the lamellae (12) are locked within said row.

11. The heating device (10, 48) according claim 10, wherein said lamella (12) further comprises a top end (76) and a bottom end, and wherein the base portion (36) of a lamella (12) further comprises

- one or more slits (70) perforating the base portion (36) for reducing the thermal conductance between the elongate heating means (24, 50) and at least one of the two side portions (14) via the base portion (36), and/or
- a flap portion (72) projecting from said lamella plane between the top end (76) and said one or more first through holes (26), wherein said flap portion (72) at least partially covers the view onto the elongate heating means (24, 50) when viewing from said top end (76) to said bottom end along said base portion (36), and/or
- a window (74) provided in the base portion (36) for enhancing convection through said lamella (12), wherein said window (74) is preferably formed by punching and bending out said flap portion (72) from said base portion (36).

12. The heating device (48) according claim 11, further

comprising an elongate temperature sensing means (54), wherein the base portions (36) of said lamellae (12) further comprise a third through hole (68) for receiving said elongate temperature sensing means (54),
said heating device (48) preferably further comprising a safety thermostat (56) operationally connected with said elongate temperature sensing means (54) for shutting off further heating in case a temperature threshold is exceeded.

13. The heating device (10) according to one of claims 1 to 9, wherein the one or more elongate heating means (24) of the heating device (10) comprise one or more pipes (24) for carrying a heating fluid, and wherein said lamellae (12) are preferably fixed to said pipes (24), in particular by gluing, soldering or press fitting.

14. The heating device (10) according to claim 13, further comprising two end piping portions (18) being in heating fluid connection with said pipes (24), said pipes (24) being connected to said end piping portions (18) by a connection, wherein said connection is preferably formed by a screwing, gluing/flange or soldering connection.

15. A lamella (12) for use in a heating device (10, 48), one of claims 1 to 14, and suitable to be arranged along an elongate heating means (24, 50) of said heating device (10, 48), said lamella (12) comprising:

- a base portion (36), said base portion (36) comprising one or more first through holes (26) for receiving said elongate heating means (24, 50) and two first engagement means (44), and
- two side portions (14), said side portions (14) being provided at two opposite ends of said lamella base portion (36) and being tilted with regard to a lamella plane defined by said base portion (36), each side portion having a fixed end connected with said base portion (36), and a free end portion (42) being provided with second engagement means (46),

wherein said second engagement means (46) provided at said free end portions (42) of said side portions (14) are each suitable for engaging with corresponding first engagement means (44) of a further adjacent lamella (12) of the same kind, wherein the side portions (14) of plural lamellae (12) in combination are suitable for forming sidewalls (16) of the heating device (10, 48).

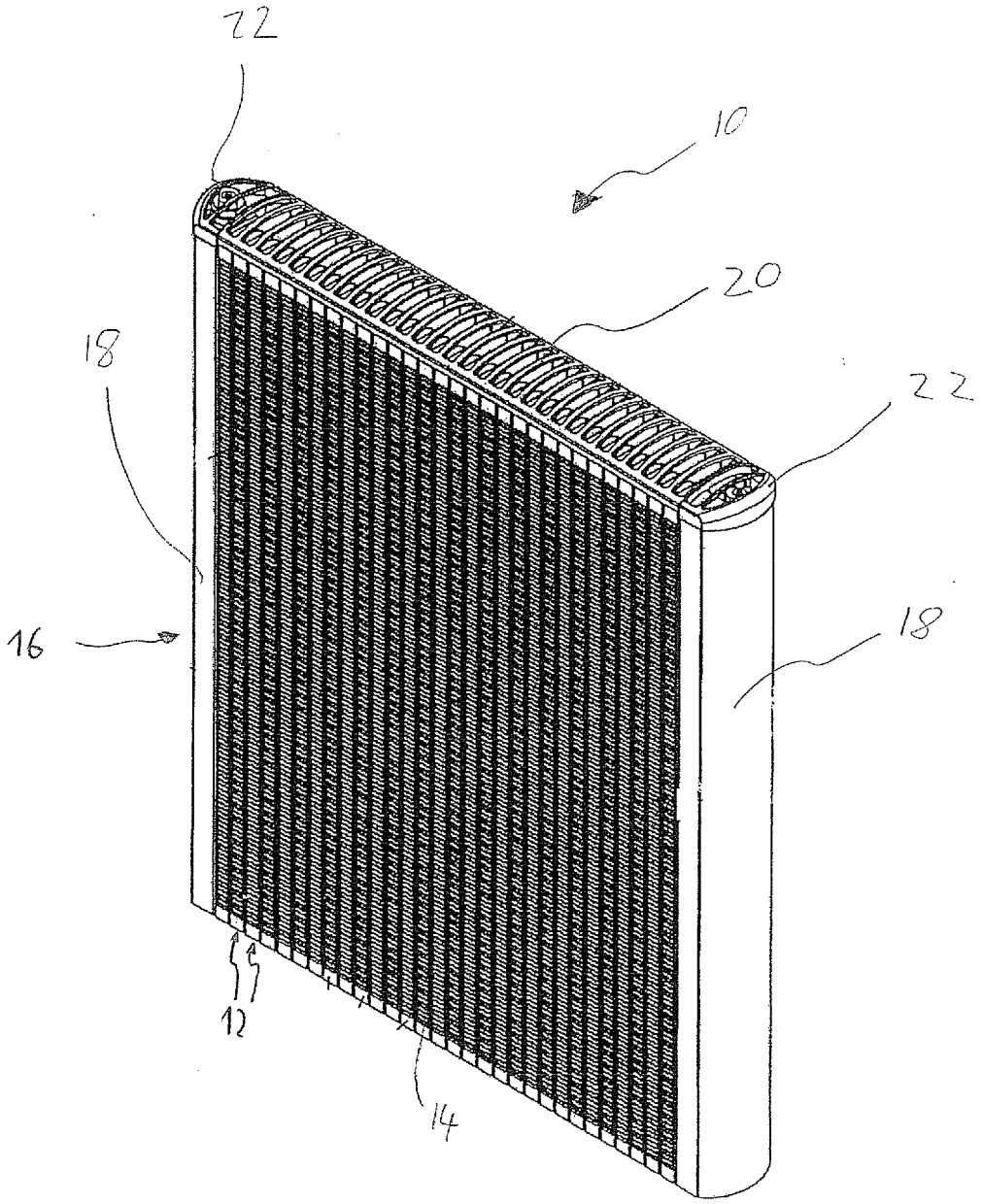

Fig. 1

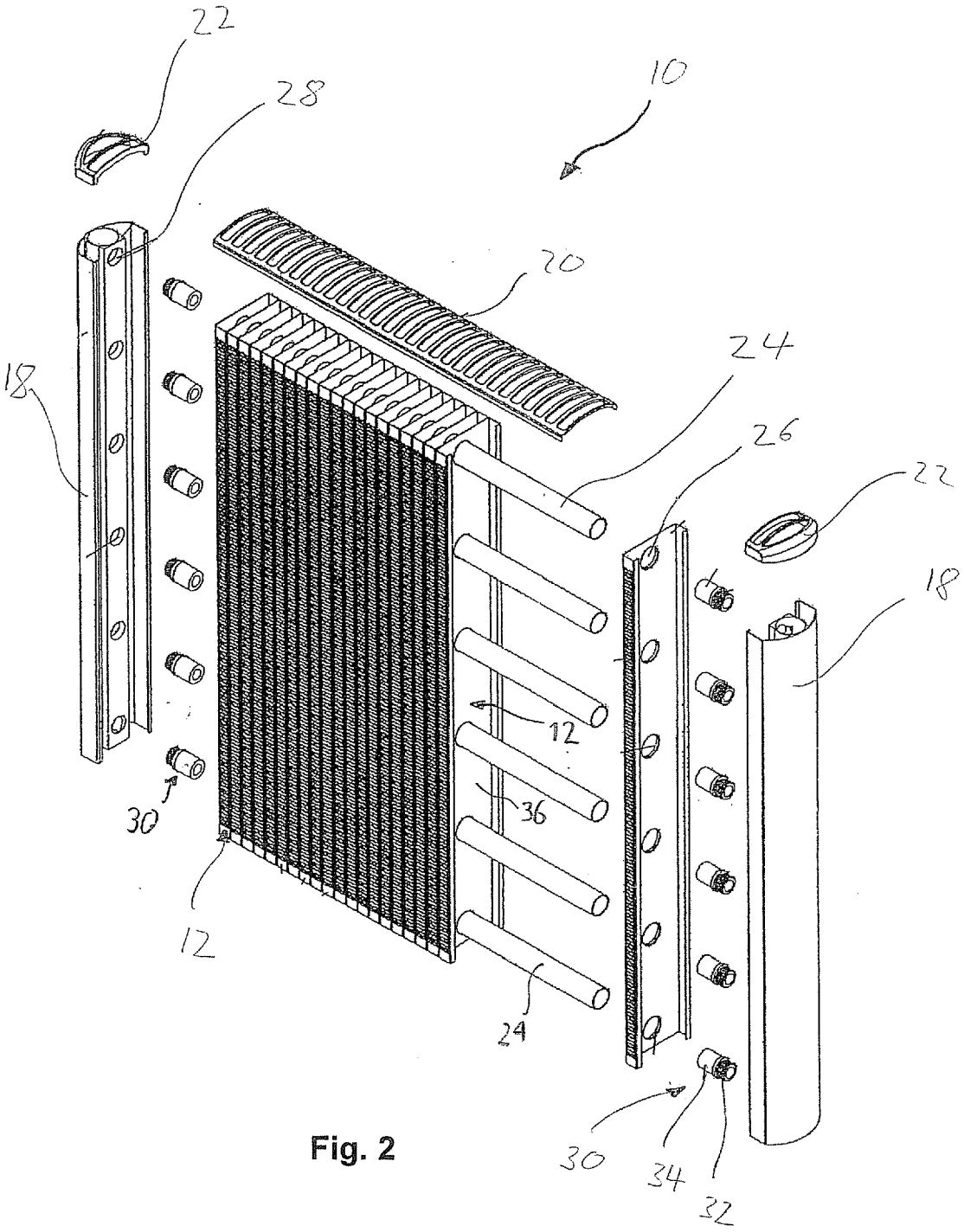

Fig. 2

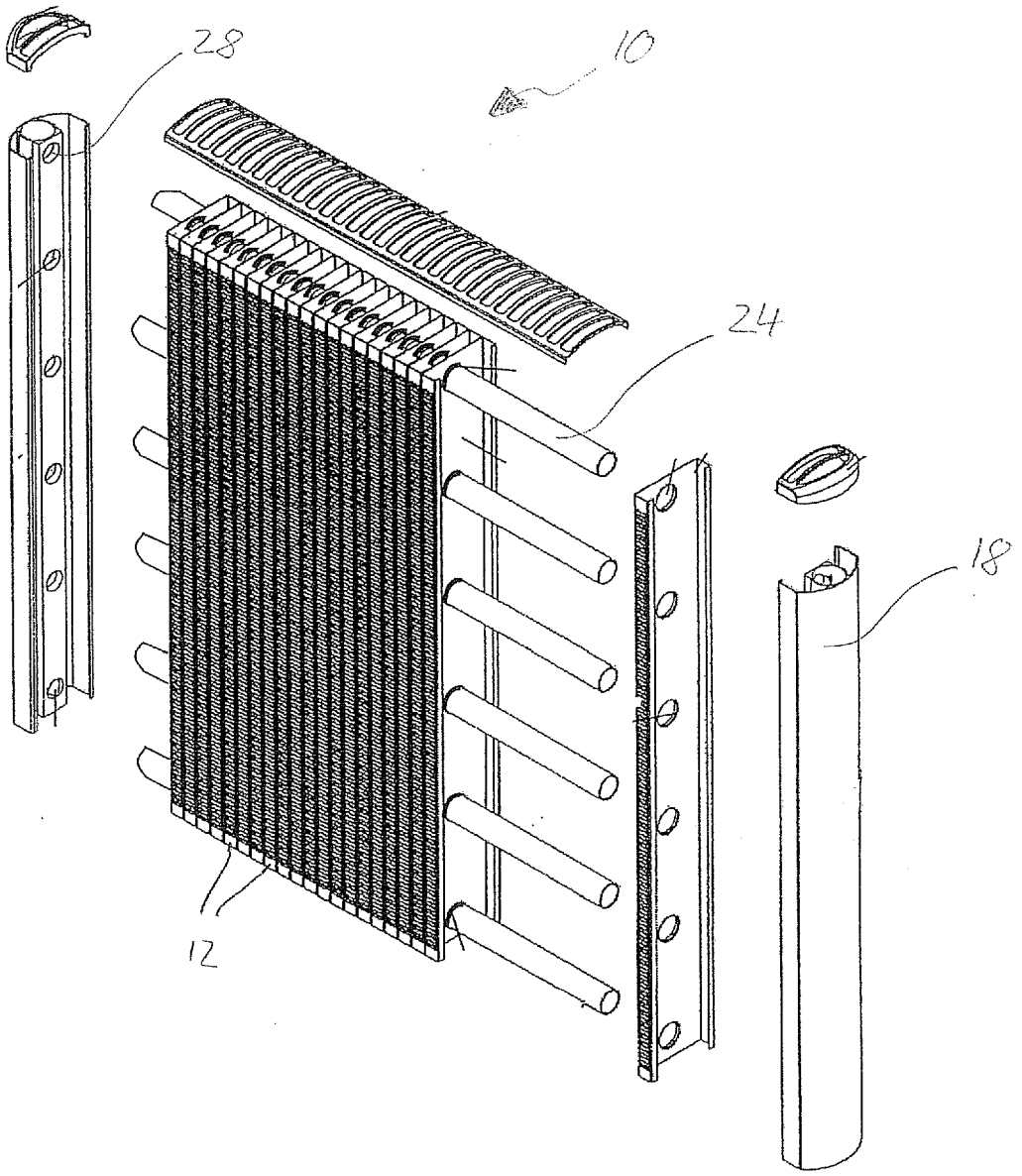

Fig. 3

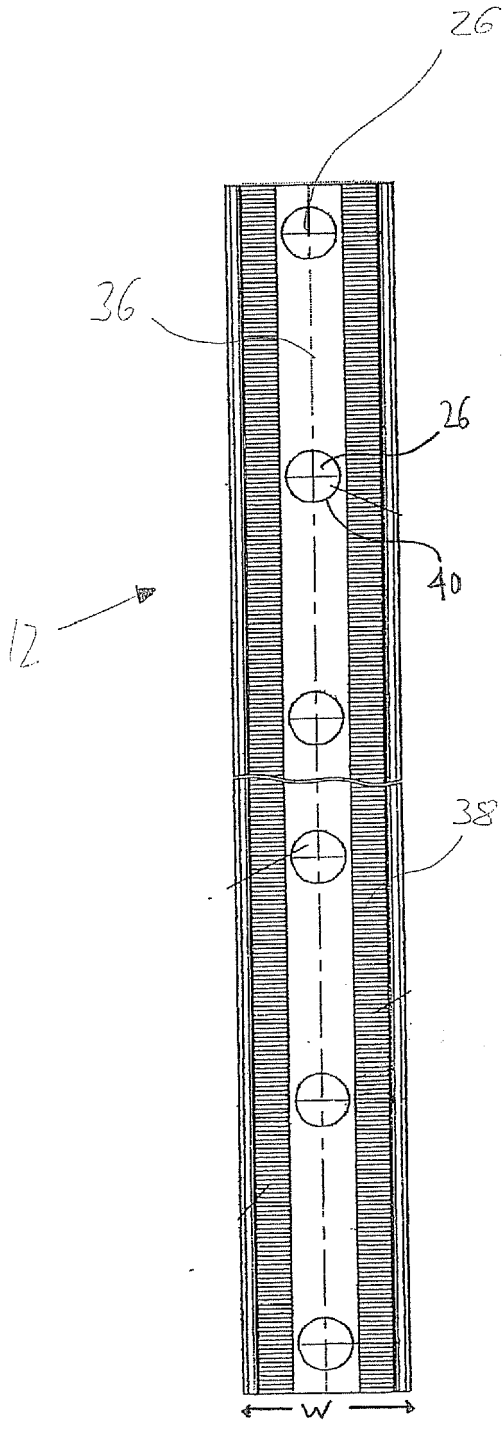

Fig. 4

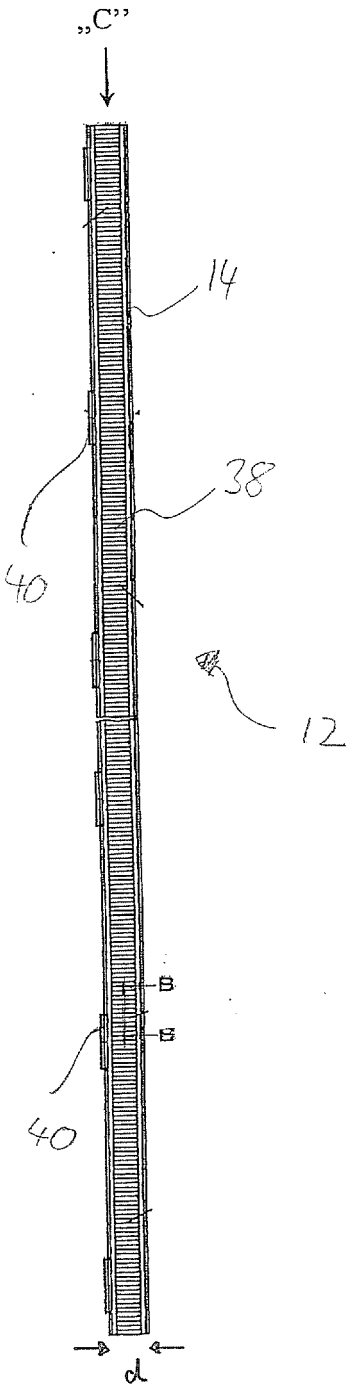

Fig. 5

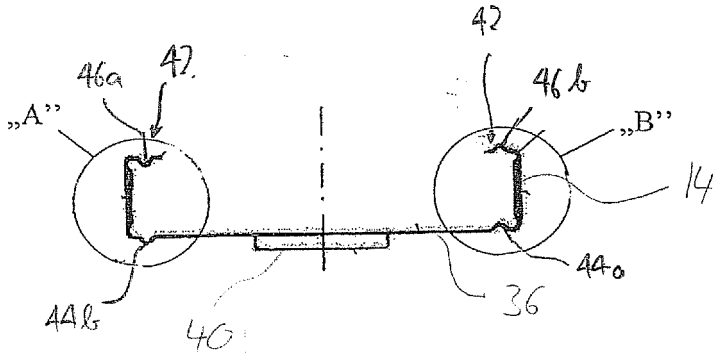

Fig. 6

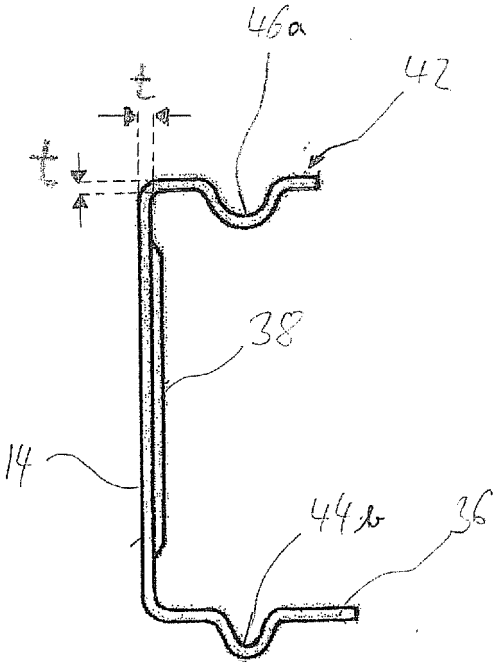

Fig. 7

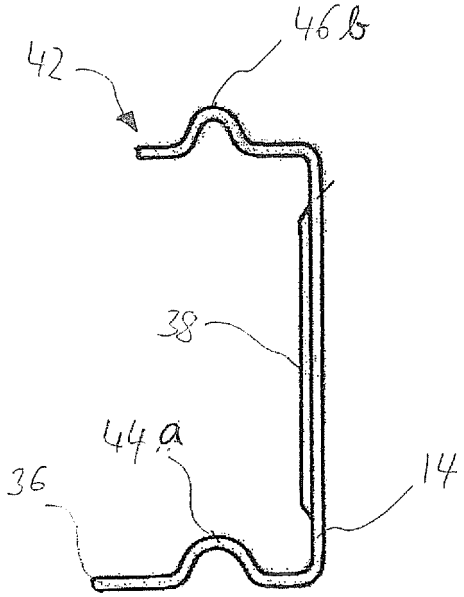

Fig. 8

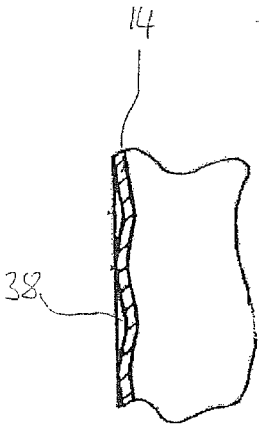

Fig. 9

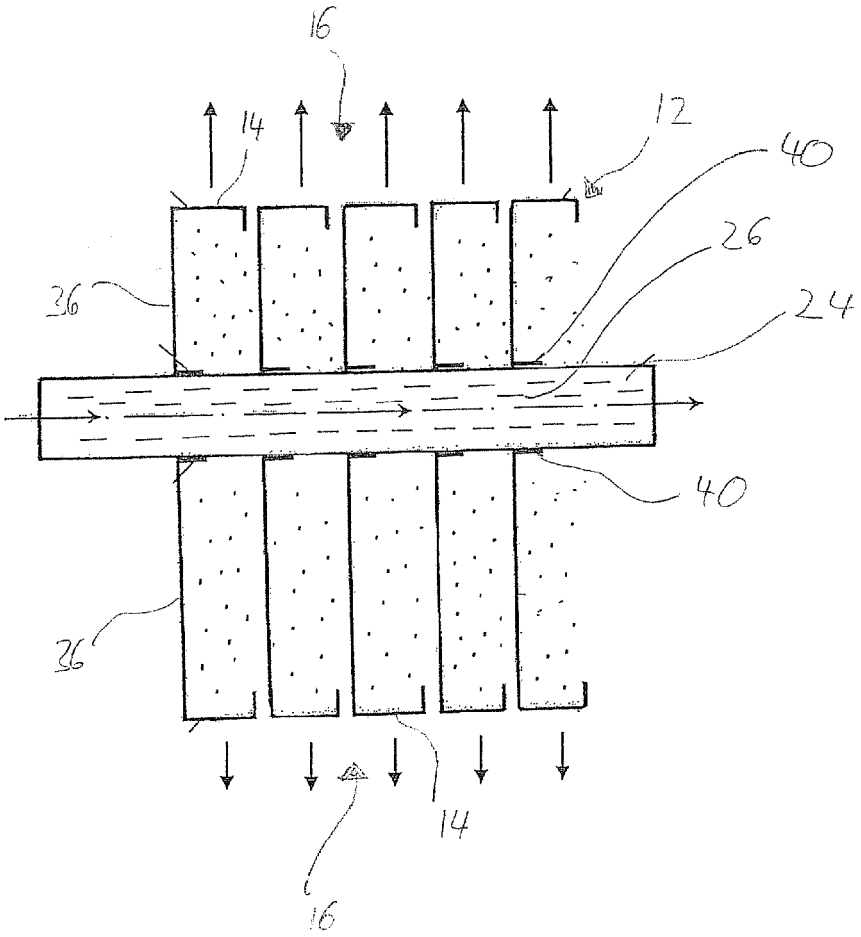

Fig. 10

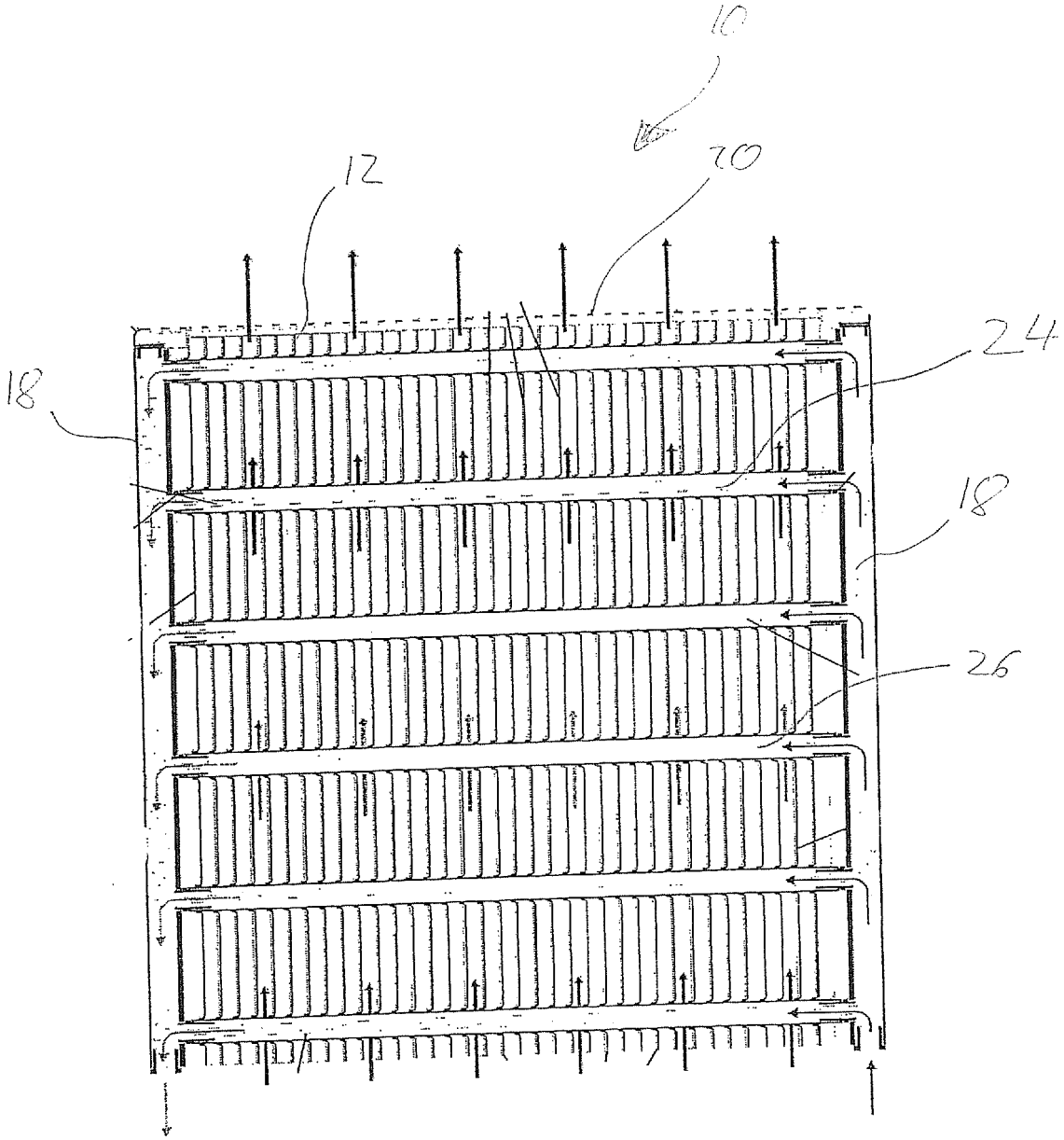

Fig. 11

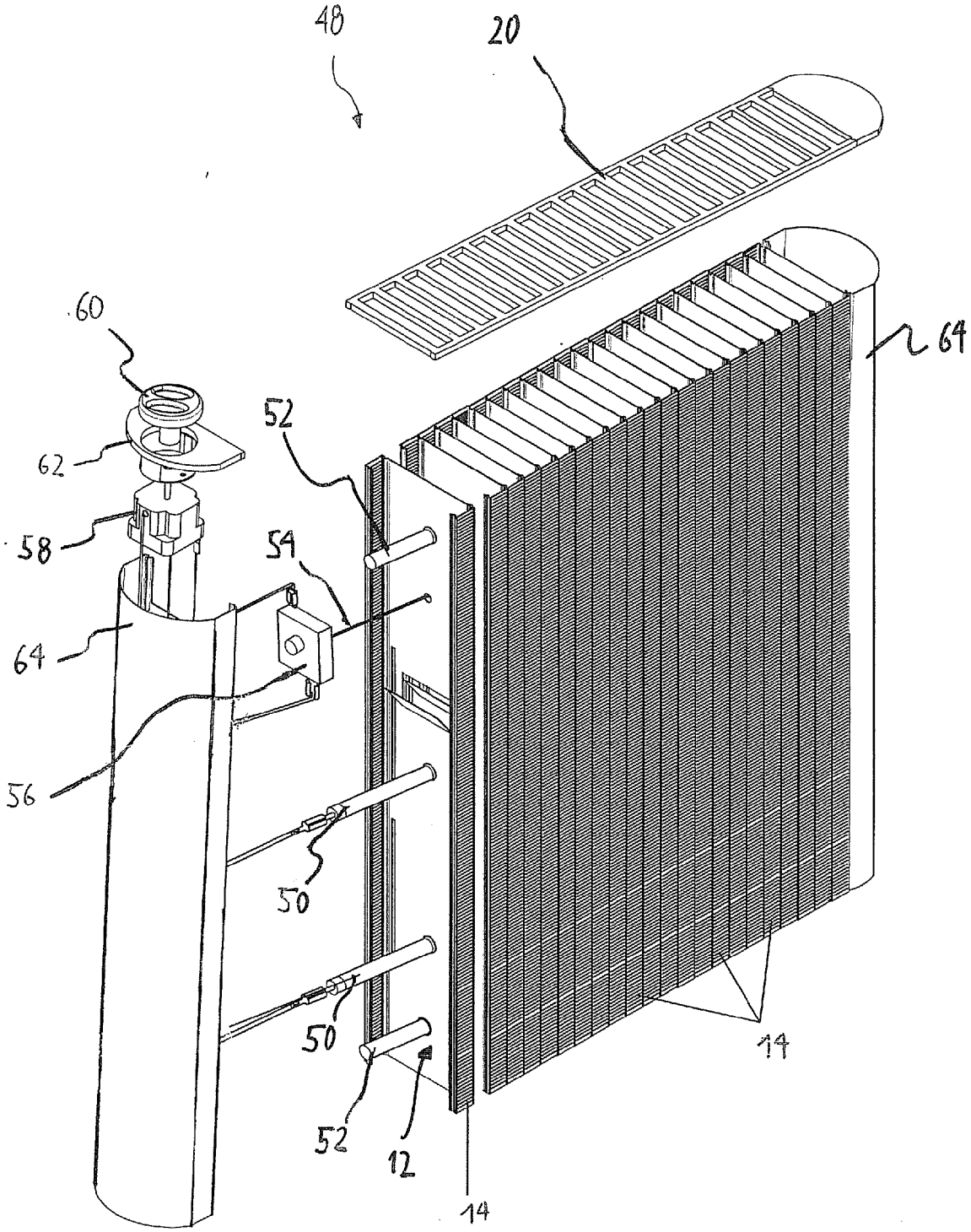

Fig. 12

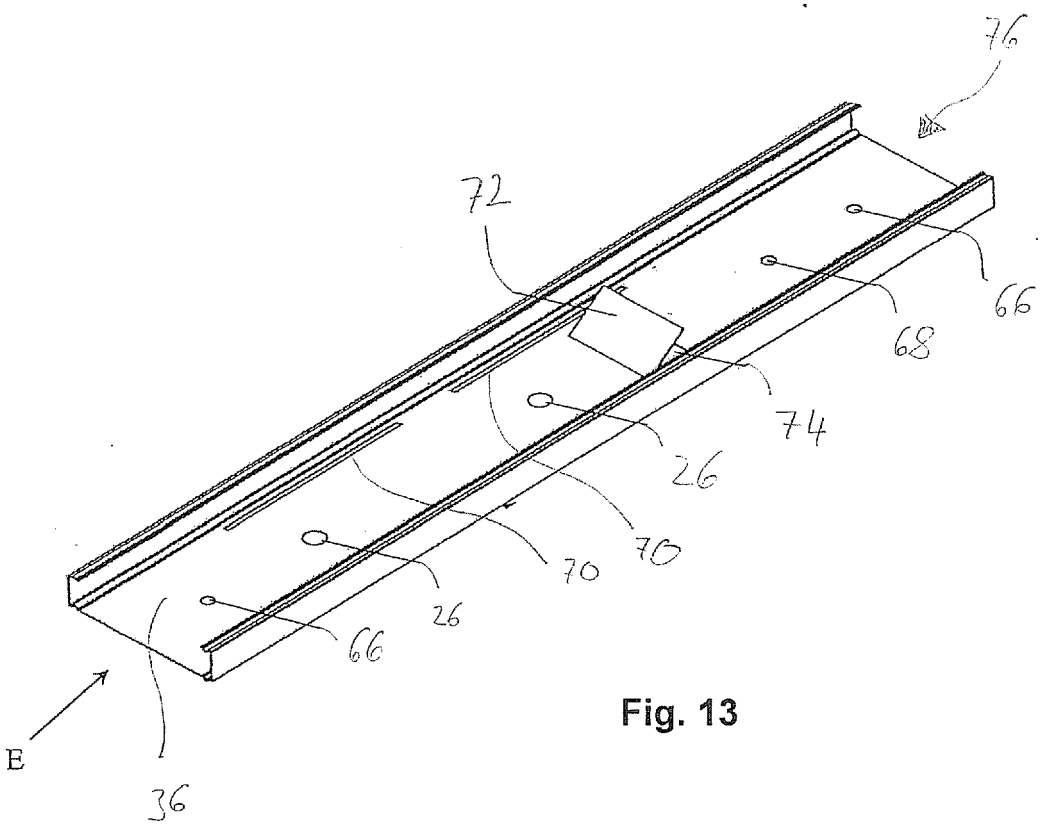

Fig. 13

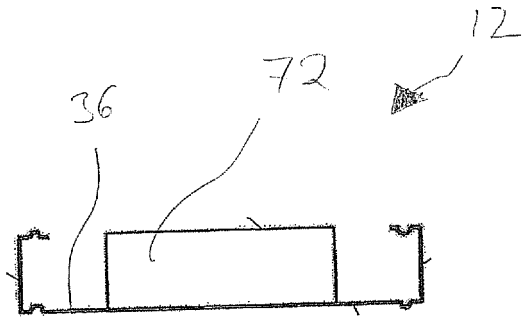

Fig. 14

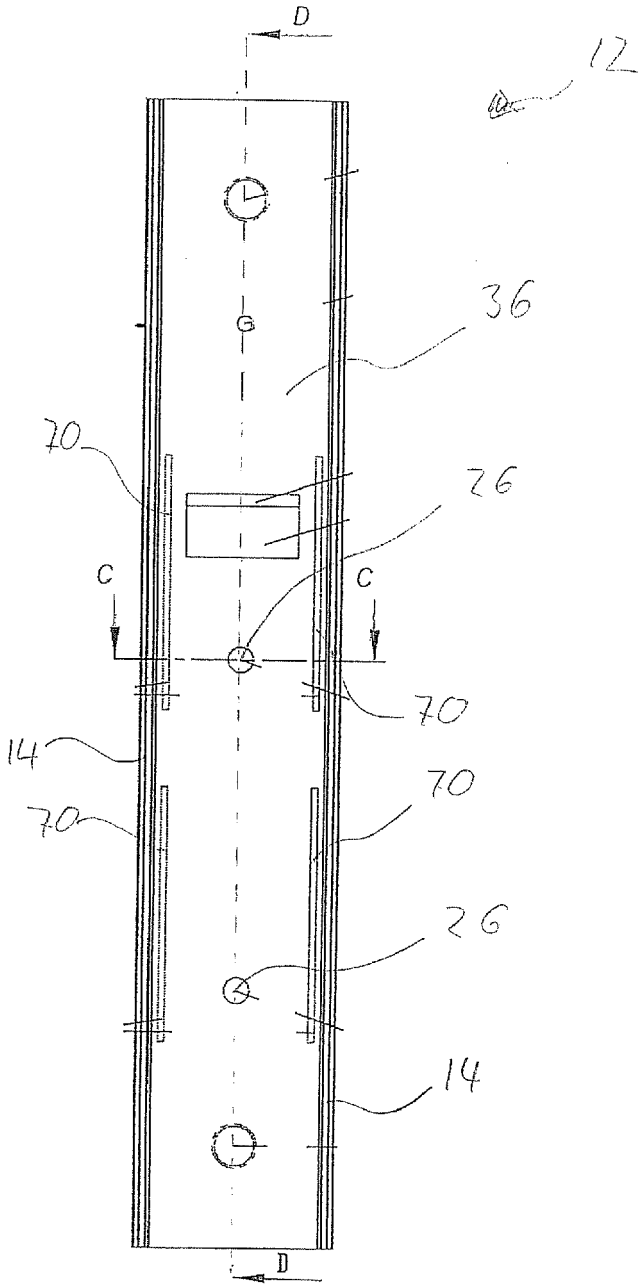

Fig. 15

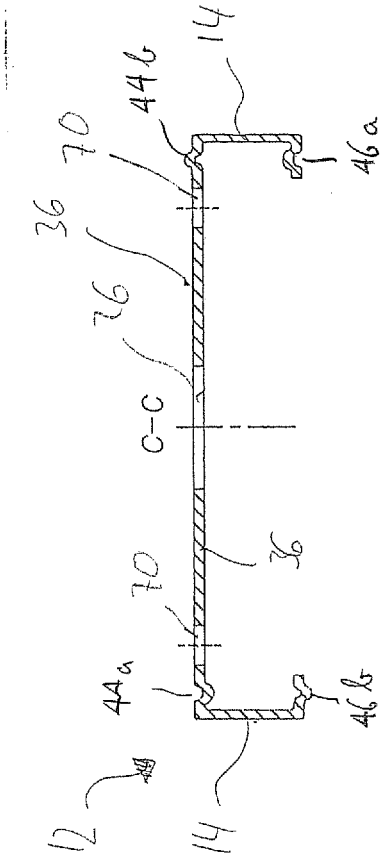

Fig. 16

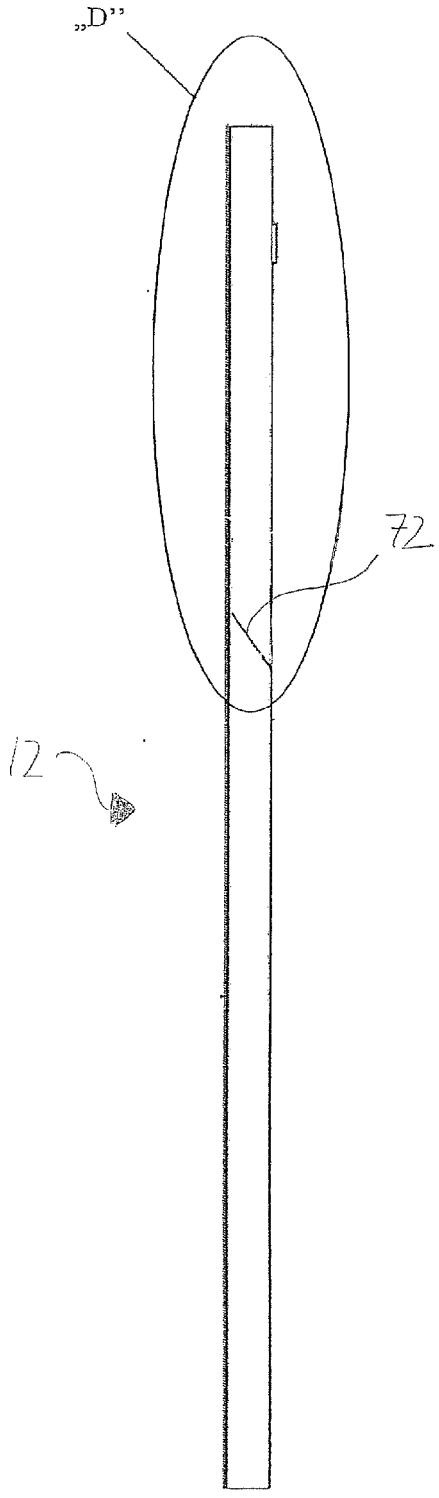

Fig. 17

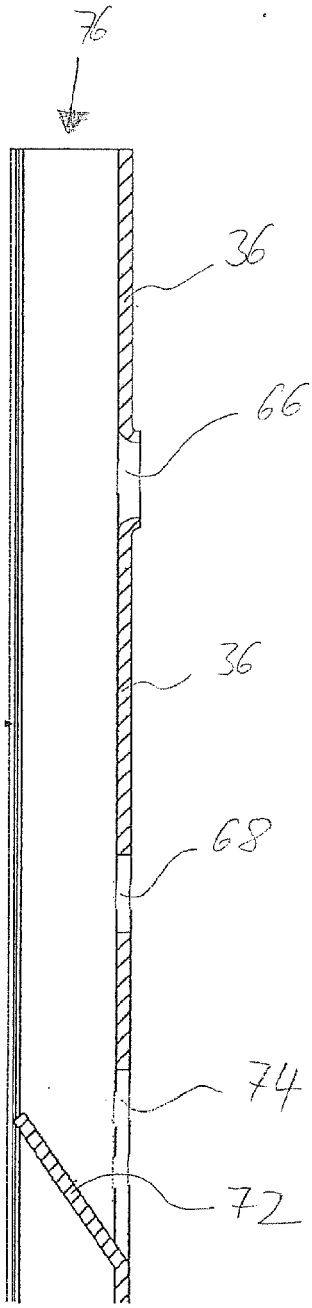

Fig. 18

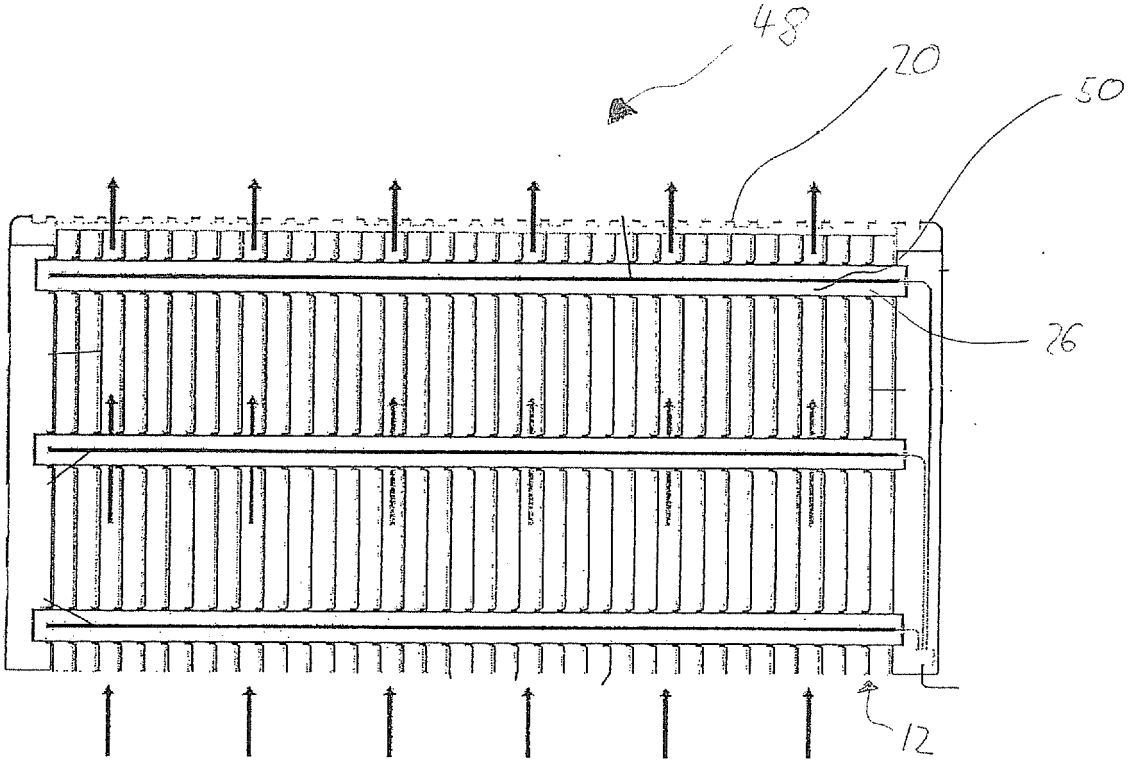

Fig. 19

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 12 17 7307

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 6 646 875 B1 (HORNG ALEX [TW] ET AL) 11 November 2003 (2003-11-11) * abstract; figure 1 *	1-15	INV. F28F1/32
X	NL 1 024 423 C1 (BETHERMA B V [NL]) 27 September 2004 (2004-09-27) * figure 2 *	1,15	
A	WO 2005/053977 A1 (UWE VERKEN AB [SE]; HESOUN PETER [SE]; KARLSSON TOMAS [SE]) 16 June 2005 (2005-06-16) * the whole document *	1-15	
A	JP 2002 162057 A (MATSUSHITA ELECTRIC IND CO LTD) 7 June 2002 (2002-06-07) * the whole document *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

F28F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	13 December 2012	Bain, David

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 12 17 7307

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.

13-12-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6646875 B1	11-11-2003	NONE	
NL 1024423 C1	27-09-2004	NONE	
WO 2005053977 A1	16-06-2005	CA 2546795 A1	16-06-2005
		EP 1697152 A1	06-09-2006
		SE 526428 C2	13-09-2005
		SE 0303258 A	04-06-2005
		US 2007114003 A1	24-05-2007
		WO 2005053977 A1	16-06-2005
JP 2002162057 A	07-06-2002	NONE	

EPO FORM P0459

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