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(54) **Improved lightweight high-strength sectional element, in particular for treadable gratings**

(57) An improved high-strength lightweight metal sectional element, for treadable gratings, envisages a cross section presenting one or more bends and/or coun-

ter-bends at at least one of the ends in order to have a high moment of inertia to bending as compared to other metal sectional elements with cross sections of equal area.

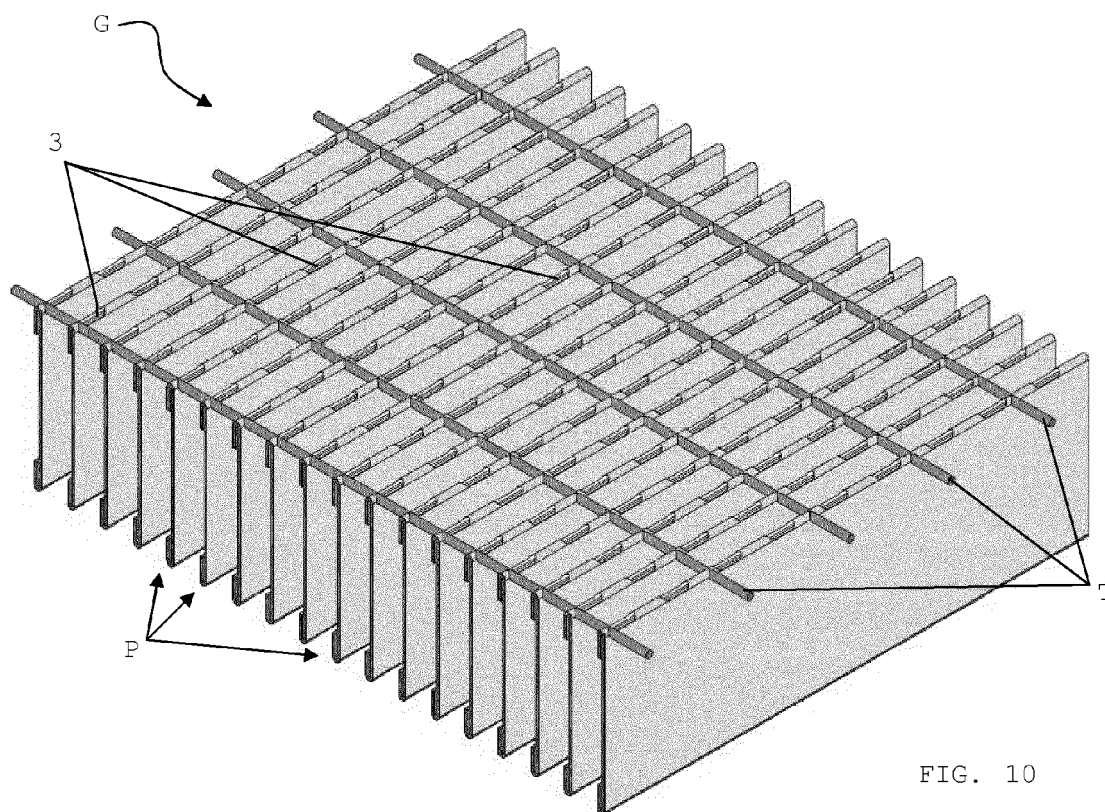


FIG. 10

Description

[0001] The present invention relates to the sector of treadable metal surfaces, permeable to air and light, normally referred to as "gratings".

[0002] The continuous market demand, in the industrial or residential building sector, for surfaces made of steel with characteristics of permeability to air and light, normally referred to as "gratings", has led to the need to tackle, over time, different problems linked to many closely related factors.

[0003] The aeration of premises, ventilated surfaces, and passages for lighting are all design needs that frequently raise problems and difficulties for laying gratings and, to a greater extent, for insertion of secondary beams, with the consequent need to provide supports for fastening to the adjacent building works.

[0004] Hence, the weight of the plates of gratings to be laid and the servo structures (such as intermediate supporting beam elements and various other supporting elements and systems) are the main aspects that are demanding both from the commercial standpoint (for quantifying the costs in the supply stage) and from the technical standpoint (in the stage of drafting of the detailed design).

[0005] From the standpoint of implementation, the prior art basically envisages creating a lattice structure where the flat-bar and round-bar elements form a node at each intersection thereof. On each node (point of connection between load-bearing bars and transverse bars) an electrode is dropped into place, exerting a contact pressure. The subsequent passage of electric current develops heat, causing localized melting of the contact components.

[0006] In any case, with this morphology, at the current state of production it is not possible to go beyond given spans, except by using secondary building works, such as intermediate supporting beams. On the other hand, these spans are somewhat short, entailing burdensome employment of materials and workforce for laying the beams and for the gratings themselves.

[0007] The innovative step that is embarked upon hence stems from the confrontation with requirements, above all (but not only) in the case of the load class 4, i.e., the one involving the heaviest loads and hence the most demanding one, of taking into account the grating-beam system in the design-drafting stage.

[0008] As regards the above load capacity, then, the choice has been to exceed the thresholds envisaged by the canonical load tables of ASSOGRIGLIATI and, albeit always maintaining the configuration of gratings of the 'heel-proof' type, the approach has been towards the lightness of the product in order to have a return in technical terms, as well as in terms of economic advantage and performance.

[0009] To overcome the above problems, according to the present invention, it has been chosen to get away from the limits of currently existing technical solutions,

basically constituted by the classic system of grating formed by the traditional complex of vertical flat sectional elements connected to orthogonal round bars adopting an electro-welding process.

[0010] For this purpose, the metal sectional element according to the invention is characterized by a cross section presenting one or more bends and/or counter-bends at the ends in order to obtain advantageously a high moment of inertia to bending as compared to other metal sectional elements with cross sections of equal area, which renders it suited to being used as load-bearing bar of a new type of grating product that overcomes the limits of the small spans of the traditional grating and at the same time presents characteristics of lightness (and hence lower costs) that are markedly desirable both from the point of view of the designer and from the point of view of the customer in drafting of the designs.

[0011] The solution proposed by the present invention takes the form of creating grating panels with an electro-forging process, recalling that joining of the load-bearing bars to the transverse bars is obtained by the combined action of electro-welding - without use of weld material - and pressure, concentrated on all the nodes.

[0012] The above procedure determines inter-penetration of the transverse bars in the load-bearing bars of the sectional elements according to the invention.

[0013] Advantageously, in this way the section of the sectional element is not penalized in so far as no vertical incisions or openings are made and there is no removal of material that might jeopardize the quality in terms of static characteristics and hence load-bearing characteristics, as instead occurs in certain known implementations adopted in the prior art.

[0014] A better understanding of the invention will be obtained from the ensuing detailed description with reference to the annexed figures, which illustrate, purely by way of non-limiting example, some preferred embodiments of the invention.

[0015] In the drawings:

Figures 1 and 2 are a cross section of a first embodiment of the sectional element according to the invention;

Figures 3 and 4, which are similar to the previous ones, show a slotted sectional element that constitutes a variant of what is illustrated in Figures 1 and 2 provided with anti-slip through holes;

Figures 5, 6, and 7 are, respectively, an axonometric view, a cross-sectional view, and a top plan view of an electro-welded grating obtained using the sectional element according to the invention;

Figures 8 and 9 are partial 3D views of the new sectional element, corresponding to Figures 3 and 4;

Figures 10 and 11 are axonometric views of an electro-welded grating obtained using the slotted sectional element of Figure 8 and that of Figure 9, respectively;

Figures 12 and 13, which are similar to Figures 3

and 4, regard a second embodiment of the sectional element, having 'anti-vertigo' function;

Figures 14 and 15 are partial 3D views of the new sectional element, corresponding to Figures 12 and 13;

Figures 16 and 17 are axonometric views of an electro-welded grating obtained using the slotted sectional element of Figure 12 and that of Figure 13, respectively;

Figures 18 and 19, which are similar to Figures 16 and 17, regard a variant of the invention that can be applied to all the types of the new sectional element described herein, which shows the version of gratings of a "pressed" type;

Figure 20 shows schematically the visibility through the gratings with the anti-vertigo sectional element, assuming a height of the eyes of the observer of 175 cm;

Figures 21 and 22 illustrate, respectively, a third embodiment of the sectional element and a variant thereof having the anti-vertigo function; and

Figure 23 is an axonometric view of an electro-welded grating obtained using the sectional element of Figure 22 provided also with anti-slip slots.

[0016] As has already been mentioned previously, the sectional element according to the invention stems from the requirement of getting away from traditional commercial flat steel bars with rectangular cross section obtained by rolling or from coils using a hot process in order to provide a product that - given the same cross section - has a far higher moment of inertia and hence a greater bending-load capacity.

[0017] The new shape of said cross section of the sectional element has been devised precisely with the intention of providing maximum lightness together with a high static inertia to overcome the limits imposed by the traditional flat bar, without certainly neglecting the economic aspect in the production of the sectional element itself by press-bending.

[0018] According to a peculiar characteristic of the invention, by locating the masses further away from the neutral axis by means of short bends and counter-bends the new sectional element thus constituted is able to combine the static requirements and the requirements of lightness.

[0019] As evidence of the advantages of what has been described so far, the inertia possessed by the new sectional element, which is, for example, 120 mm deep and 2 mm thick, is practically equivalent to that of the sectional element constituted by a flat bar 120 mm deep and 6 mm thick, with the difference that the new sectional element presents an area, and hence a weight, that is approximately 37% less.

[0020] Furthermore, given the same weight (and hence the same area), the inertia possessed by the new sectional element 120 mm deep is 75% greater than that of the sectional element constituted by a flat bar 80 mm

deep and 5 mm thick.

[0021] As a confirmation of what has been set forth above, consider by way of example that a classic grating made up of flat bars of 80 x 5 mm in size (weighing 3.14 kg/m each) with a pitch of 25 mm, subjected to a class-4 load (9000 kg over an area of 250 x 600 mm) can cover up to 763 mm of span, whereas the grating constituted by the new sectional element (weighing 3.56 kg/m each) with a pitch of 25 mm, subjected to the same load guarantees a valid load-bearing capacity over a span of 1700 mm.

[0022] With an almost equivalent weight, a far more advantageous performance is obtained.

[0023] Of course, the foregoing emphasizes the high performance aspect of the new product that can be produced, which results in saving of intermediate supporting beam elements with corresponding fixings given the same weight of the structure, and in the consequent simplification in the use of gratings for heavy traffic far beyond the spans up to now realizable.

[0024] With reference to Figures 1 and 2, a first embodiment of the sectional element P according to the present invention envisages a cross section presenting a basically rectilinear and thin central part 2, with the ends bent back 1 on themselves one or more times.

[0025] According to a peculiar characteristic of the invention, the greater the number of end bends 1, the higher the moment of inertia, and hence the higher the bending strength of the sectional element itself. In other words, by increasing the number of end bends 1 of the cross section of the sectional element P, the bending load that can be withstood by the sectional element itself increases.

[0026] A variant of the invention, illustrated in Figures 3 and 4, envisages a plurality of through holes 3, preferably slotted holes, arranged precisely in the areas of the free ends, of maximum curvature. Advantageously, these holes 3 arranged facing outwards, i.e., towards the treading surface, ensure a valid anti-slip function.

[0027] It should be noted that it is also possible to provide further through holes 4 arranged in the bends facing inwards in order to increase permeability, understood as increase in the ventilated surface considering the empty spaces as if they were full, favour draining of the molten-zinc bath during the manufacturing process, and favour draining in the more generic sense.

[0028] With reference to Figures 5, 6, and 7, the sectional element P according to the invention is designed to be used as load-bearing element or bar for the production of treadable gratings G by joining it to transverse bars T, made up of round bars or twisted square bars, by application of pressure and by electro-welding of all the points of contact between the load-bearing sectional elements P and the transverse bars T.

[0029] Figures 8, 10 and 9, 11 regard, respectively, a slotted anti-slip sectional element P with single and double end bends, as well as the gratings G obtained with said sectional elements.

[0030] A second embodiment of the invention, illustrated in Figures 12 to 17 in different variants, regard the anti-vertigo version of the load-bearing sectional element, designated by the reference P1.

[0031] In this case, the central part of the cross section of the sectional element P1 is shaped so as to have a bend 5, which is preferably (but not exclusively) V-shaped and projects laterally. This projecting bend 5 is designed to limit or eliminate the possibility of seeing through the grating G obtained with these sectional elements (Figures 16-17).

[0032] Advantageously, as a function of the distance or of the pitch between the load-bearing sectional elements P1 that replace the grating G and of how much said bend 5 projects laterally, it is possible to reduce at will the possibility of seeing through the grating G up to the point of excluding said possibility altogether (see Figure 20).

[0033] Advantageously, with this configuration, even people who suffer from dizziness will have no problems in walking over said gratings in so far as they will not be able to see at what height they are.

[0034] A variant of the invention, illustrated in Figures 18 and 19, with the anti-vertigo load-bearing sectional elements P1 but that can evidently be obtained also with the load-bearing sectional elements P, regards the fact that the grating G, instead of being obtained by joining the load-bearing sectional elements P or P1 to the transverse bars T with round or square cross section, is obtained by joining said load-bearing sectional elements P or P1 to the transverse bars TP constituted by flat bars.

[0035] In this variant of the grating G, the union between the load-bearing bars P or P1 and the transverse bars TP is obtained by means of pressure exerted on the transverse bars themselves to constrain them in slots purposely provided on the load-bearing bars P or P1.

[0036] The variant described above replaces the common flat iron bar present in the traditional type of grating referred to as "pressed grating" with the sectional element according to the invention.

[0037] Finally, it should be noted that the second embodiment of the invention described above, in addition to having the anti-vertigo function, also provides a greater resistance to lateral bending: the presence of the lateral bend, in fact, increases the moment of inertia of the cross section in the lateral direction (horizontal as viewed in the figures).

[0038] A third embodiment of the invention, shown in Figures 21-23, regards a sectional element (P' or P1') that derives substantially from division - along the horizontal axis - of the profile according to the first embodiment (P) or second embodiment (P1) of the invention, or of their variants.

[0039] In other words, the cross section of the sectional element P' or P1' in this third embodiment has one end with one or more bends 1, while the other end terminates without any bend but just with a possible lateral inclination.

[0040] This third embodiment is hence constituted by a sectional element P' or P1' that is shallower than the previous ones but presents static characteristics and characteristics of lightness that are in any case superior to the bars that normally constitute customarily produced gratings designed for the loading conditions of the lowest classes (i.e., Classes 1 and 2).

[0041] From what has been said above, this third embodiment of the sectional element according to the invention has a cross section that on one side presents one or more bends 1, with or without the slots 3 already described that have the draining and anti-slip functions, whereas on the other side 2' there are no bends, but there is possibly present just a lateral inclination of the body of the sectional element, where said inclination may be single or else double 5' - in two directions opposite to one another - to achieve an anti-vertigo function.

[0042] One of the reasons for which it is deemed expedient to use this sectional element P' or P1' is the need to intervene - with the same quality, visual, and performance standards as for the sectional element according to the first two embodiments already described - in contexts where the introduction of gratings with deeper profiles proves excessive for the spans and for the loads to be withstood or else when it is necessary to provide steps and landings of stairways.

[0043] Also this latter sectional element may be evidently provided with slots 3 with anti-slip and draining functions.

[0044] With this third embodiment of the invention it is hence intended to create a grating understood as covering mainly the needs for laying Class-1 horizontal stretches (pedestrian load of 600 daN/m²) without necessarily having to use the sectional elements of the previous cases characterized by a deeper section, maintaining, however, the same aesthetic, surface, anti-slip, and draining characteristics thereof.

[0045] The present invention has been described and illustrated in some of its embodiments and variants, but it is evident that any person skilled in the branch may make thereto technically equivalent modifications and/or replacements, without thereby departing from the sphere of protection of the present industrial patent right, as presented in the ensuing claims.

Claims

1. An improved high-strength lightweight metal sectional element (P, P1, P', P1'), for treadable gratings, **characterized in that** it envisages a cross section presenting one or more bends and/or counter-bends at at least one of the ends, in order to present a high moment of inertia to bending as compared to other metal sectional elements with cross sections of equal area and **in that** it is designed to be used as load-bearing element or bar for the production of treadable gratings (G) by joining it to transverse bars (T),

constituted by round bars or twisted square bars, by application of pressure and by electro-welding of all the points of contact between load-bearing sectional elements (P, P1, P', P1') and transverse bars (T).

2. The sectional element (P, P1) according to Claim 1, **characterized in that** it envisages a cross section presenting a central part (2) substantially rectilinear and thin, with the ends (1) bent back on themselves one or more times; wherein the greater the number of end bends (1) the greater the moment of inertia, and hence the bending strength of the section itself. 5
3. The sectional element (P', P1') according to Claim 1, **characterized in that** it envisages a cross section presenting a bottom part (2') which is thin and substantially rectilinear or inclined laterally, with the end (1) of the top part bent back on itself one or more times; wherein the greater the number of end bends (1) the greater the moment of inertia, and hence the bending strength of the section itself. 10 15 20
4. The sectional element according to Claim 2 or Claim 3, **characterized in that** it envisages a plurality of through holes (3), arranged precisely in the areas of maximum curvature of the free ends; said holes (3) being arranged outwards, i.e., towards the treading surface to provide a valid anti-slip function. 25
5. The sectional element according to the preceding claim, **characterized in that** it envisages further through holes (4) arranged in the bends facing inwards, to increase the permeability, understood as the increase in the ventilated surface considering the empty spaces as if they were full, to favour draining of the molten-zinc bath during the manufacturing process, as well as to favour drainage of water. 30 35
6. The sectional element according to the preceding claim, **characterized in that**, in order to have a further, anti-vertigo, function, the central part of the cross section of the sectional element (P1, P1') is shaped so as to present a bend (5, 5') that projects laterally; said projecting bend (5, 5') being designed to limit or eliminate the possibility of seeing through the grating (G). 40 45
7. The sectional element according to the preceding claim, **characterized in that** said projecting bend (5) is V-shaped. 50
8. The sectional element according to Claim 6 or Claim 7, **characterized in that**, as a function of the distance or pitch between the load-bearing sectional elements (P1) that replace the grating (G) and how much said bend (5) projects laterally, it is possible to reduce at will the possibility of seeing through the grating (G) up to the point of excluding said possibility 55

altogether; thus obtaining that even people who were to suffer from dizziness would have no problems in walking over said gratings, in so far as they could not see at what height they are.

9. The sectional element according to Claim 5 or Claim 6, **characterized in that** the grating (G), instead of being obtained by joining the load-bearing sectional elements (P or P1) to transverse bars (T) with round or square cross section, is obtained by joining said load-bearing sectional elements (P or P1) to transverse bars (TP) constituted by flat bars inserted, by exerting pressure, in slots appropriately provided on the load-bearing bars (P or P1).

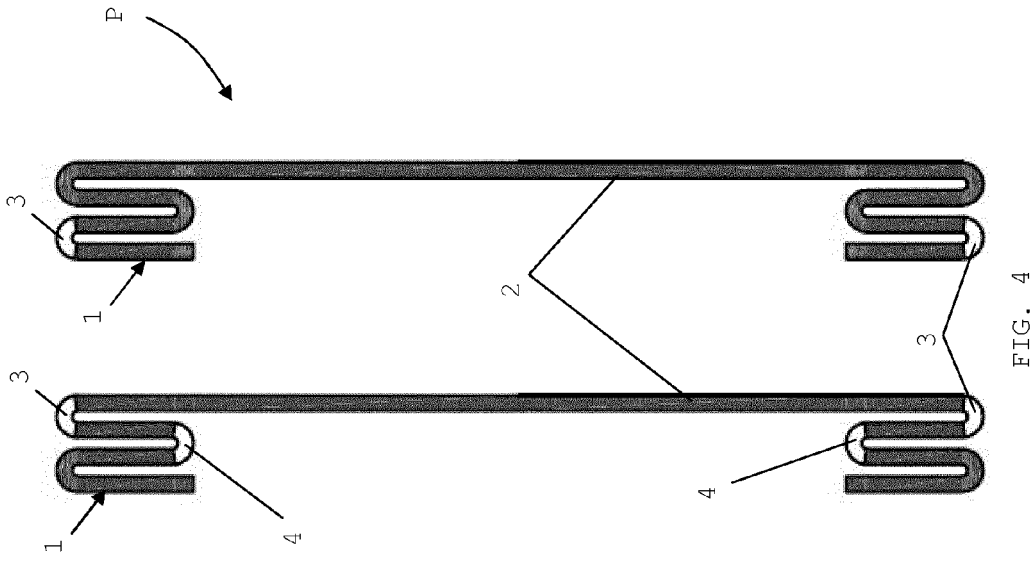


FIG. 1

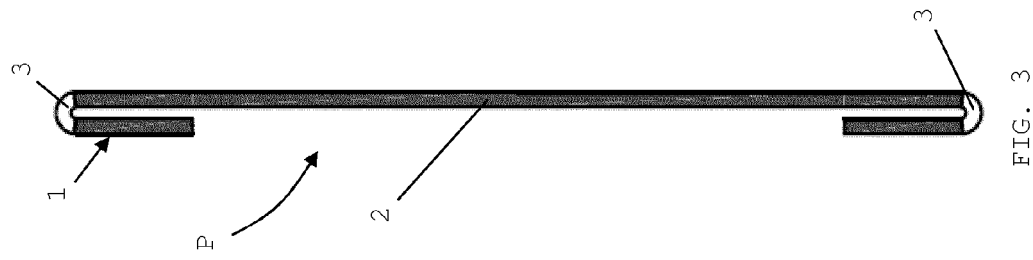


FIG. 2

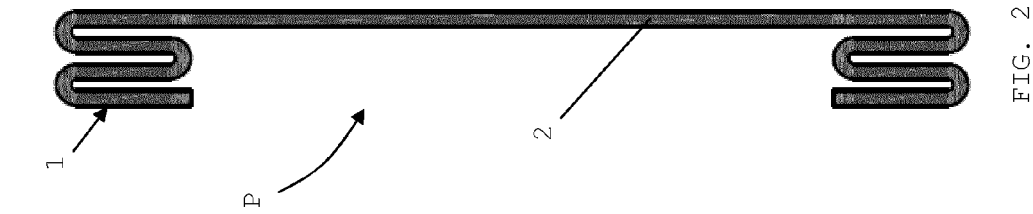


FIG. 3

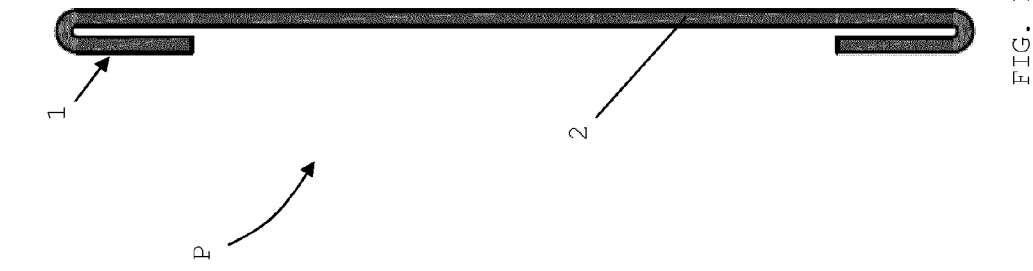
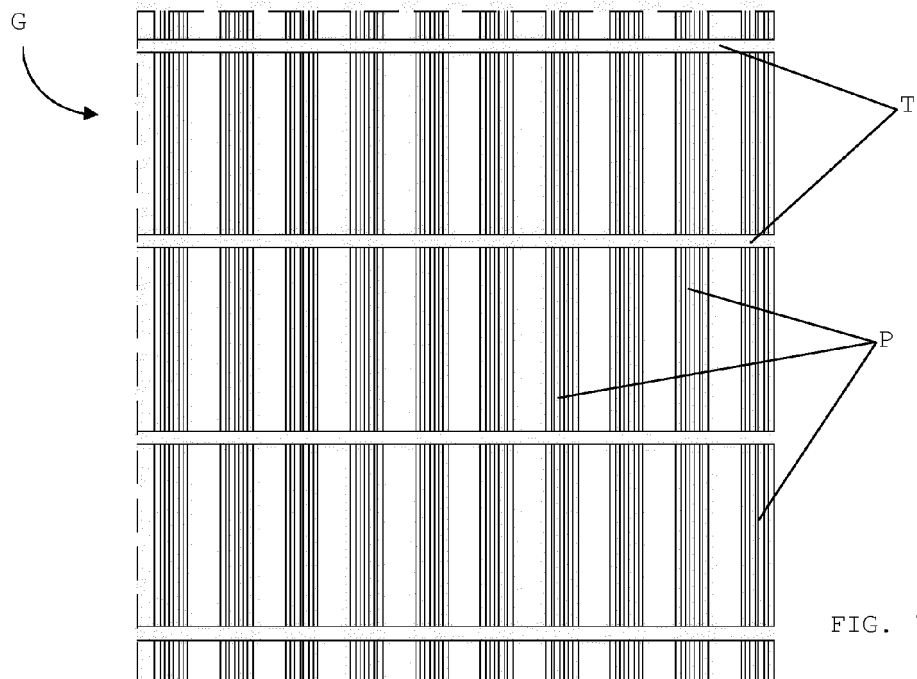
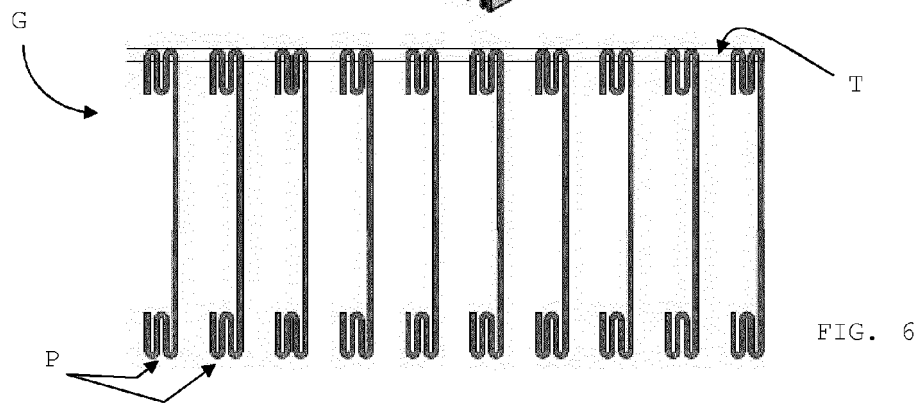
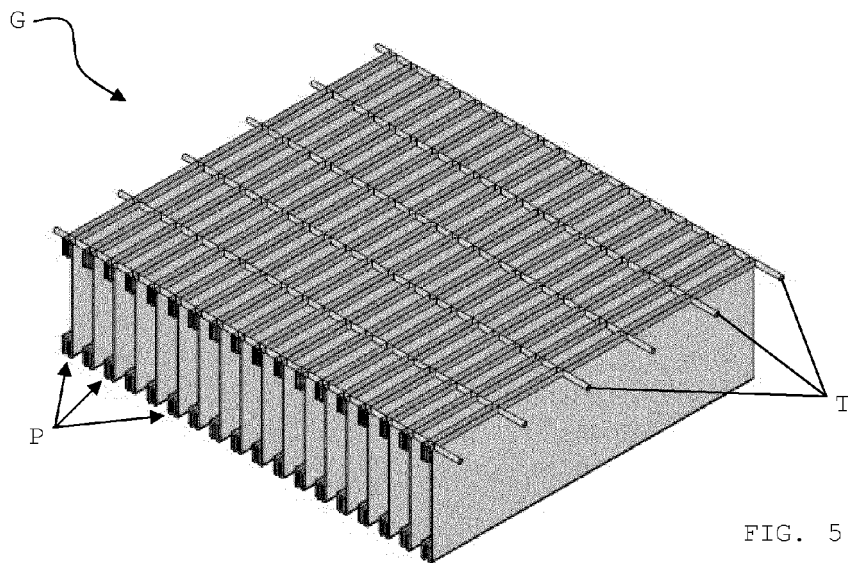


FIG. 4



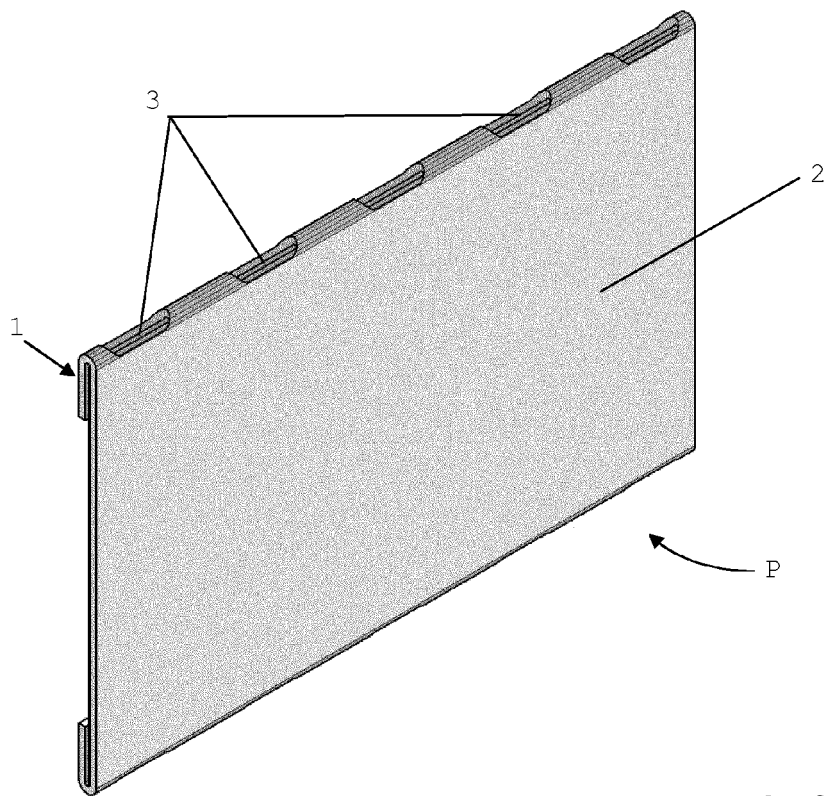


FIG. 8

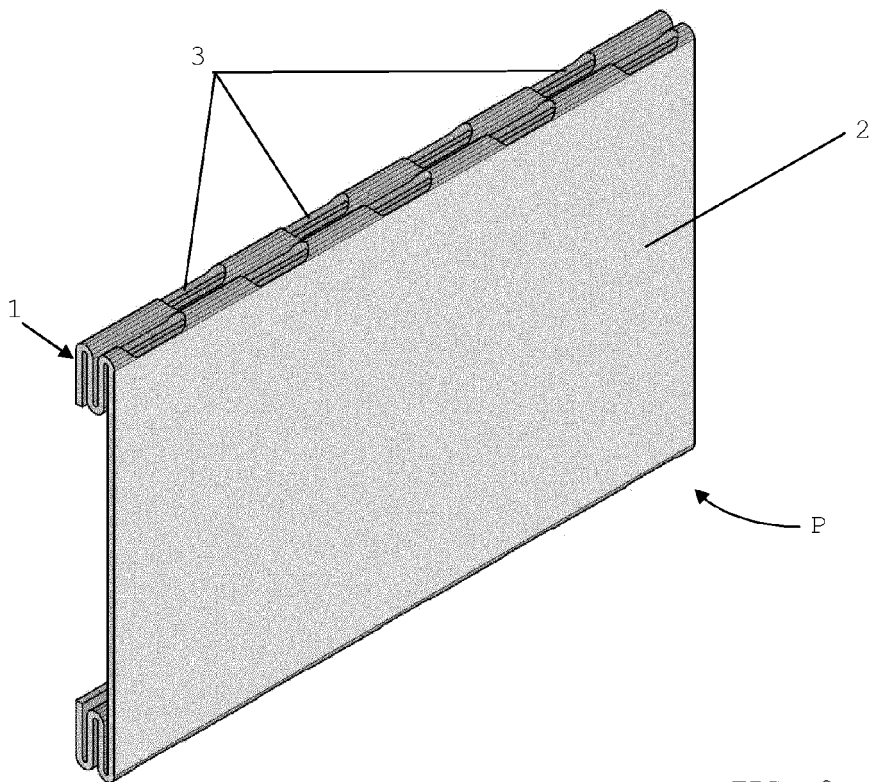
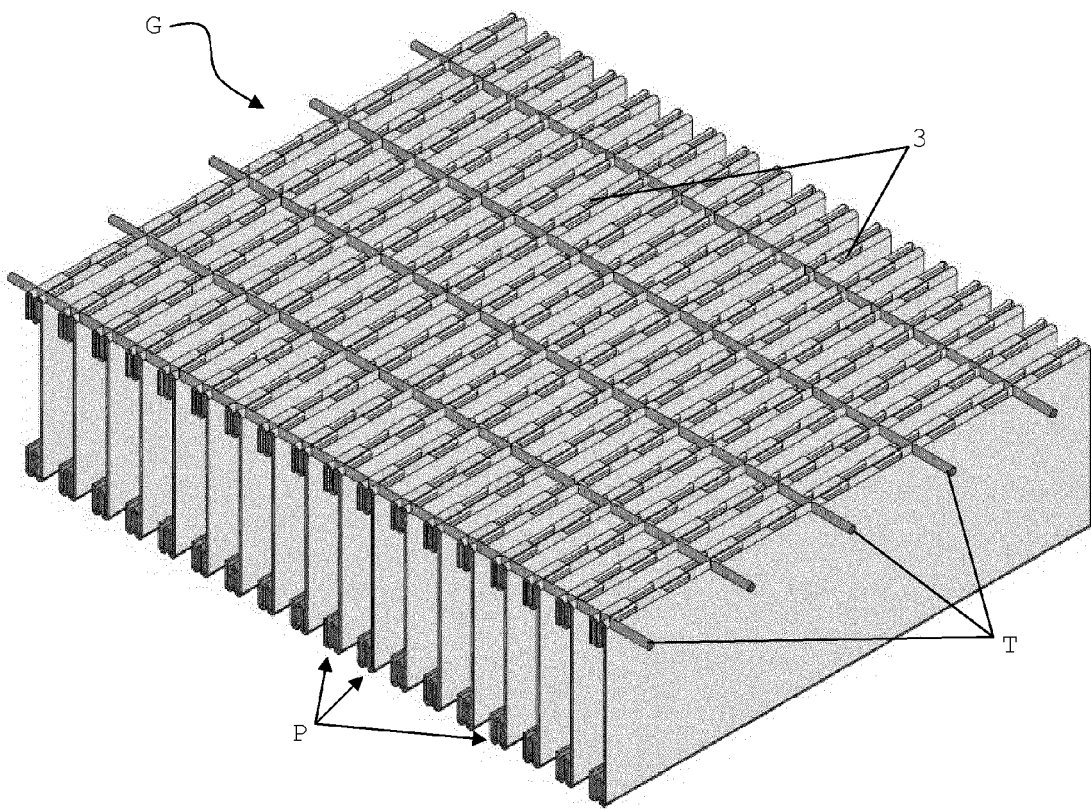
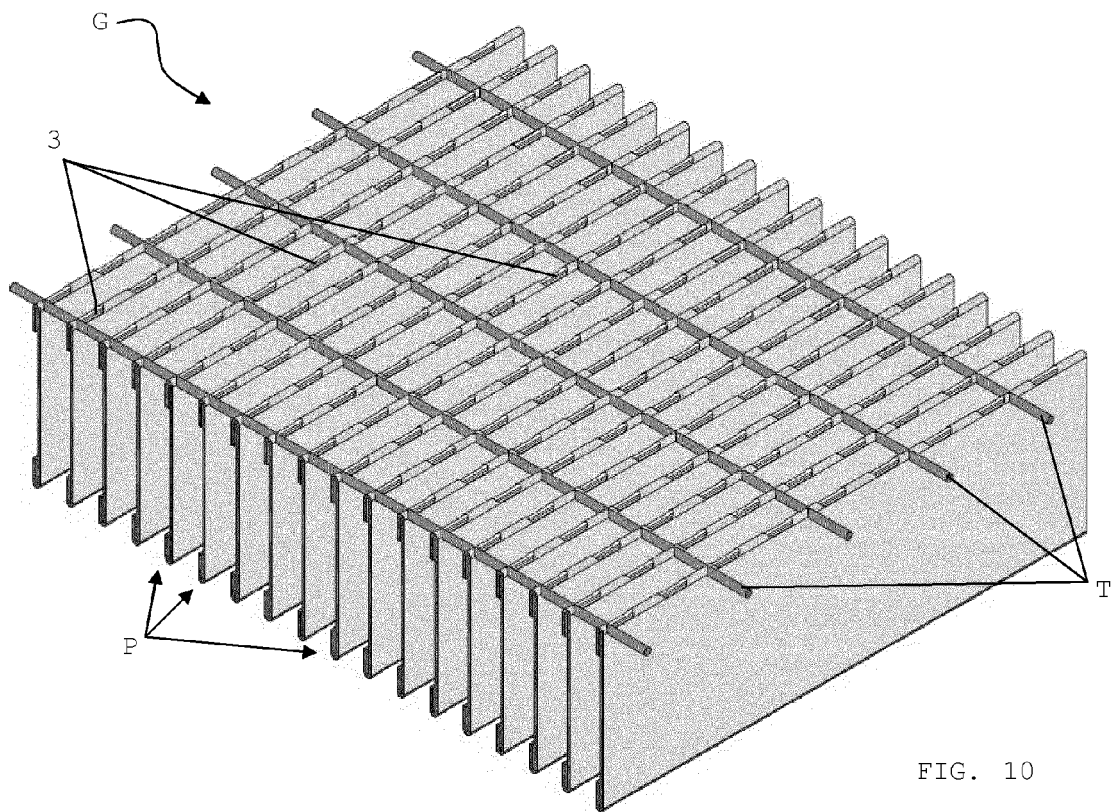


FIG. 9



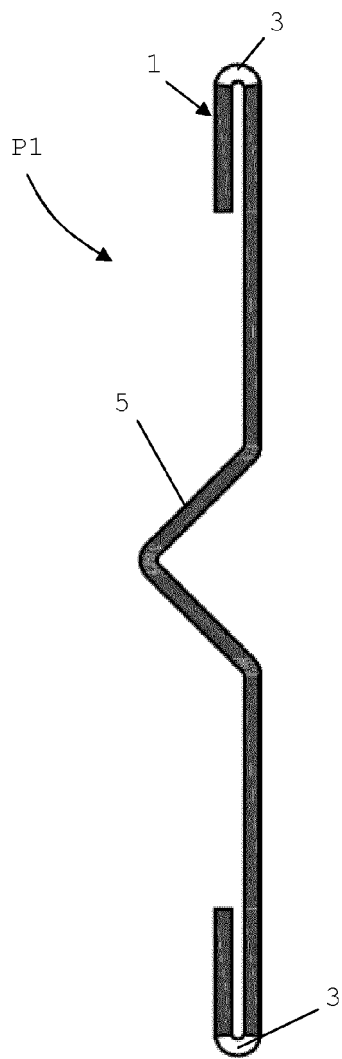


FIG. 12

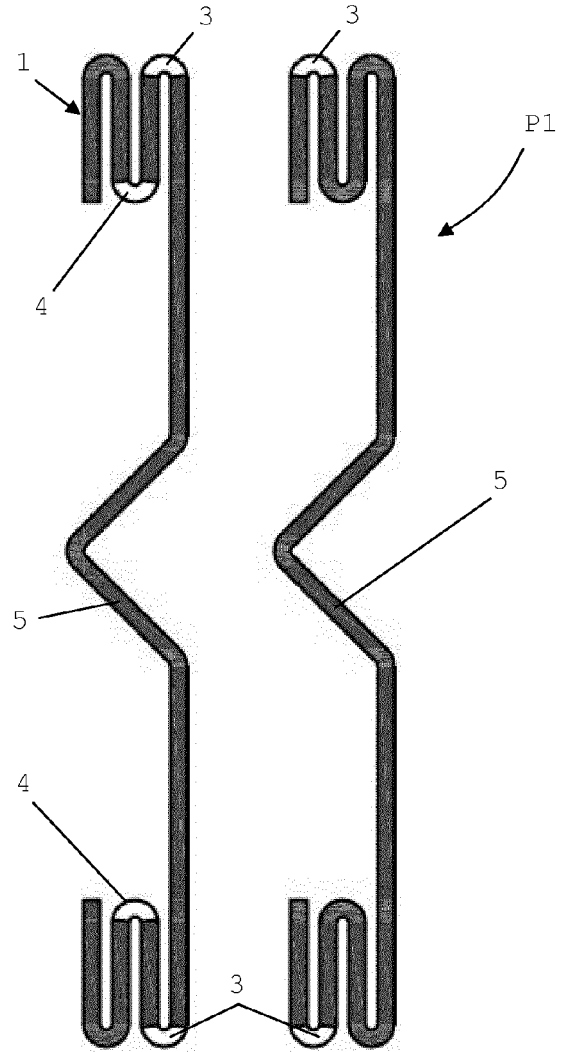


FIG. 13

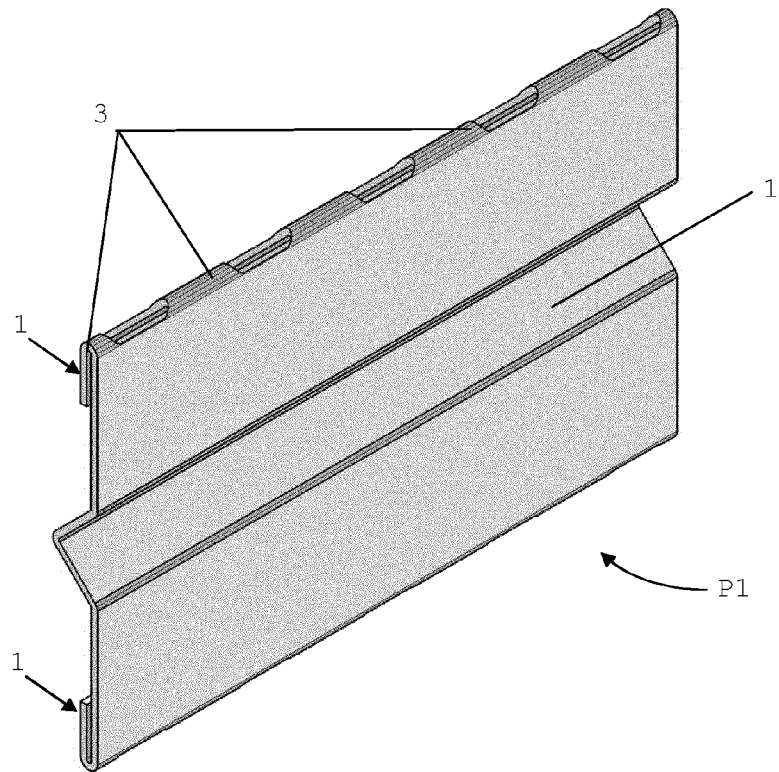


FIG. 14

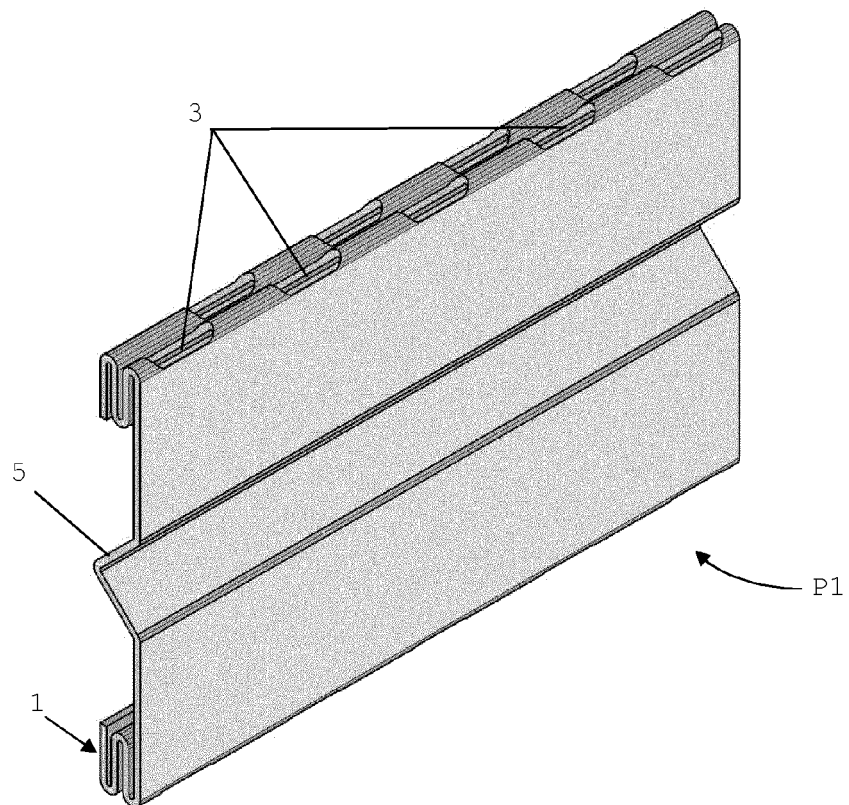


FIG. 15

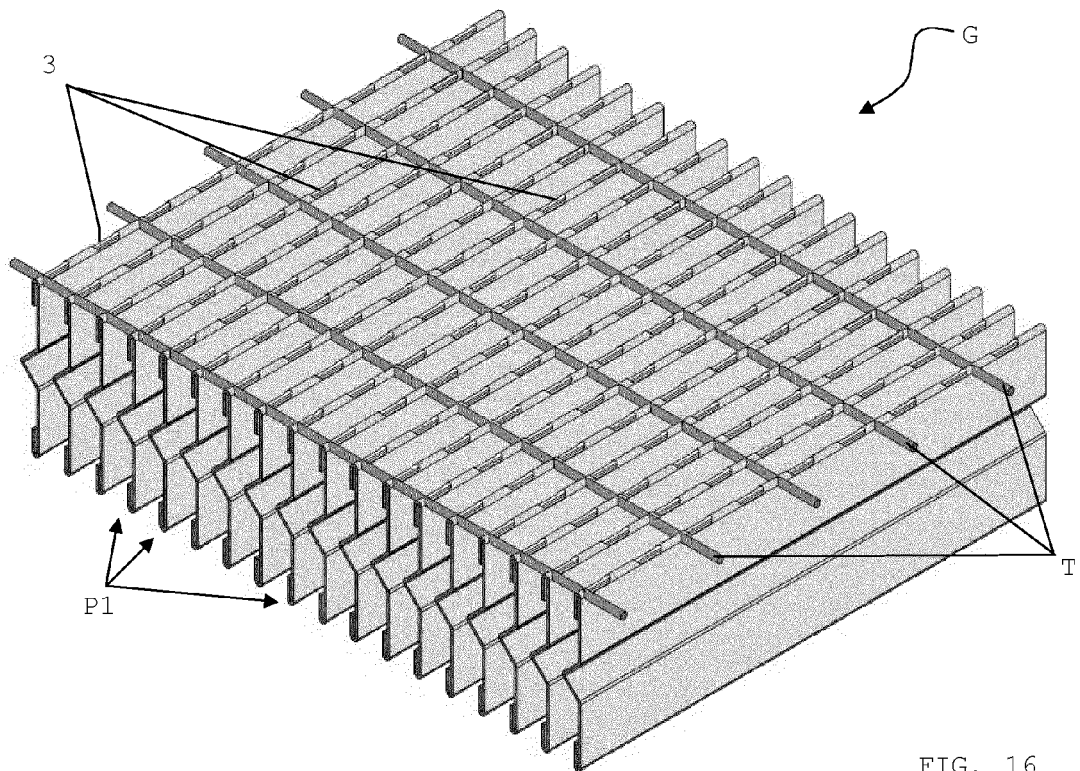


FIG. 16

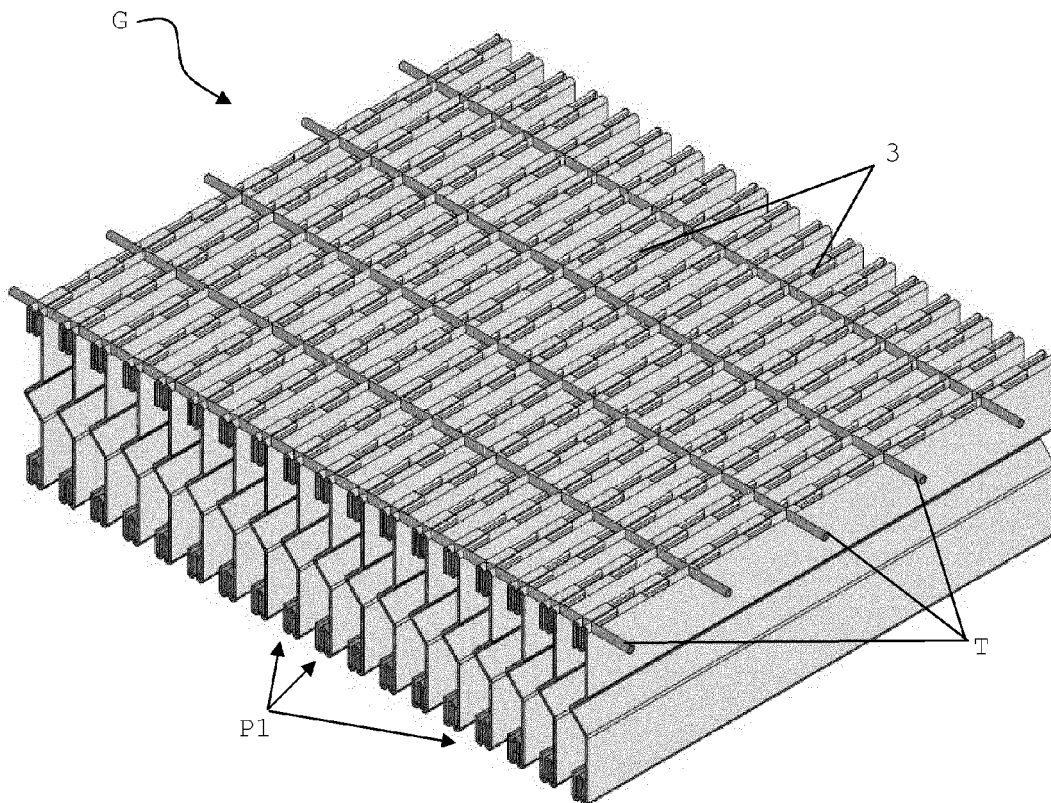


FIG. 17

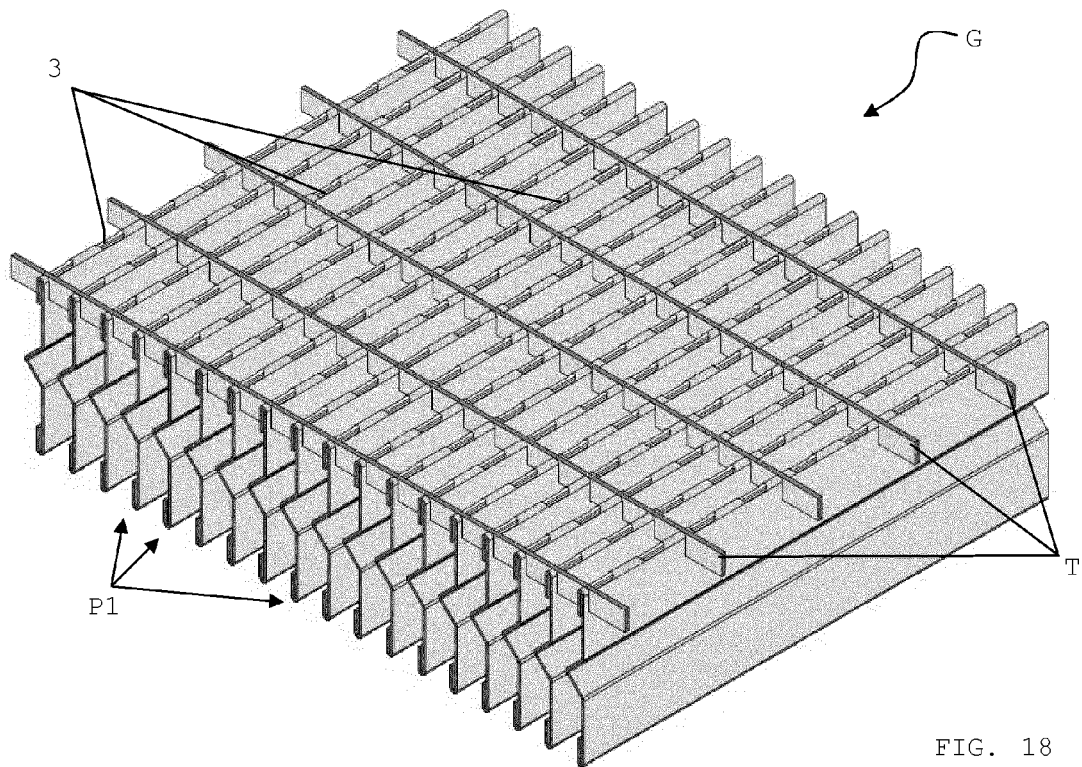


FIG. 18

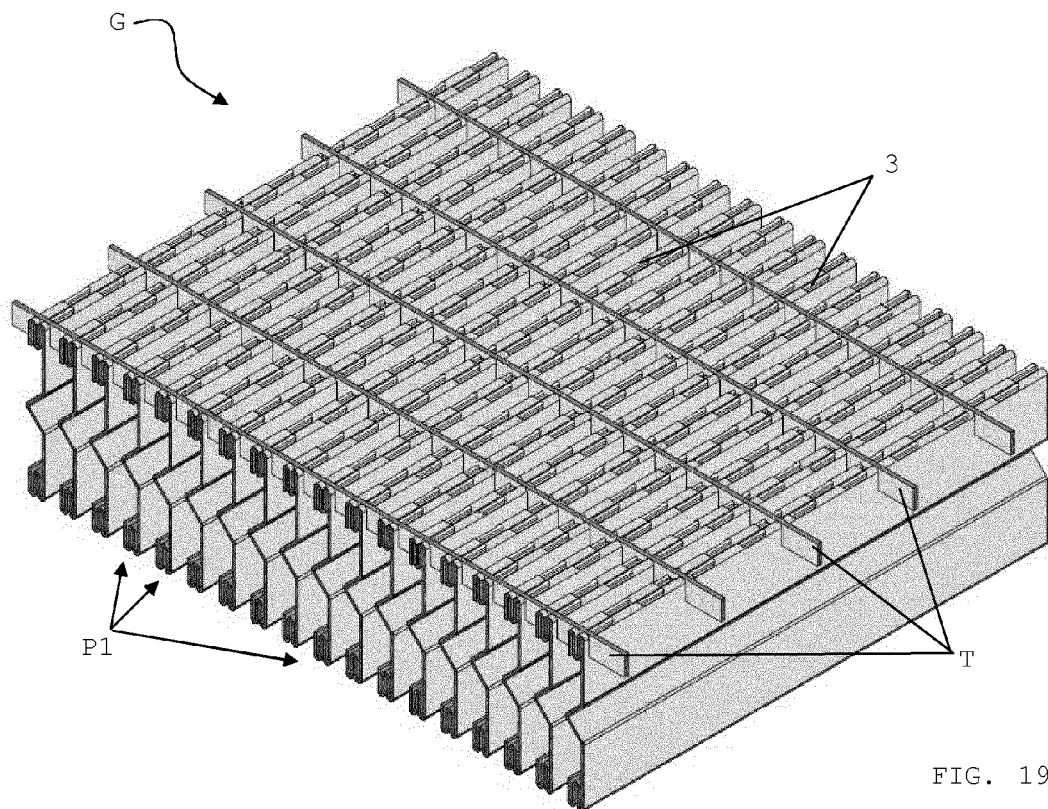


FIG. 19

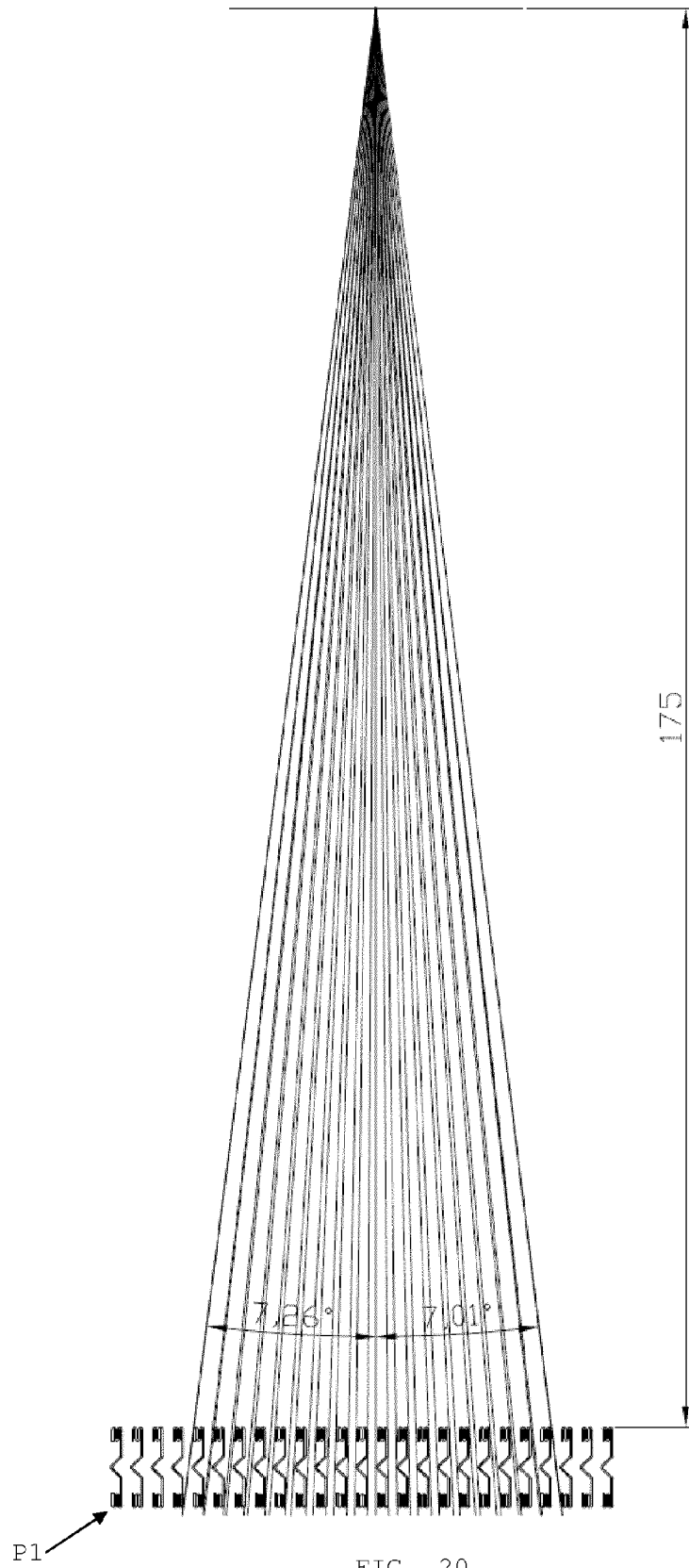


FIG. 20

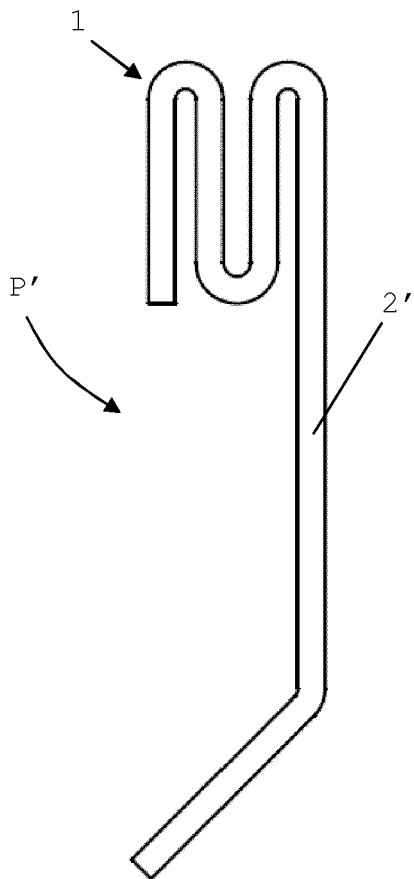


FIG. 21

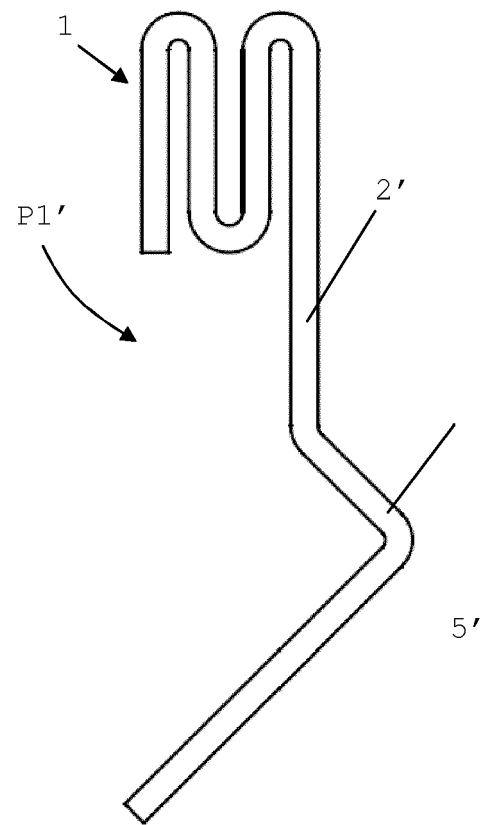


FIG. 22

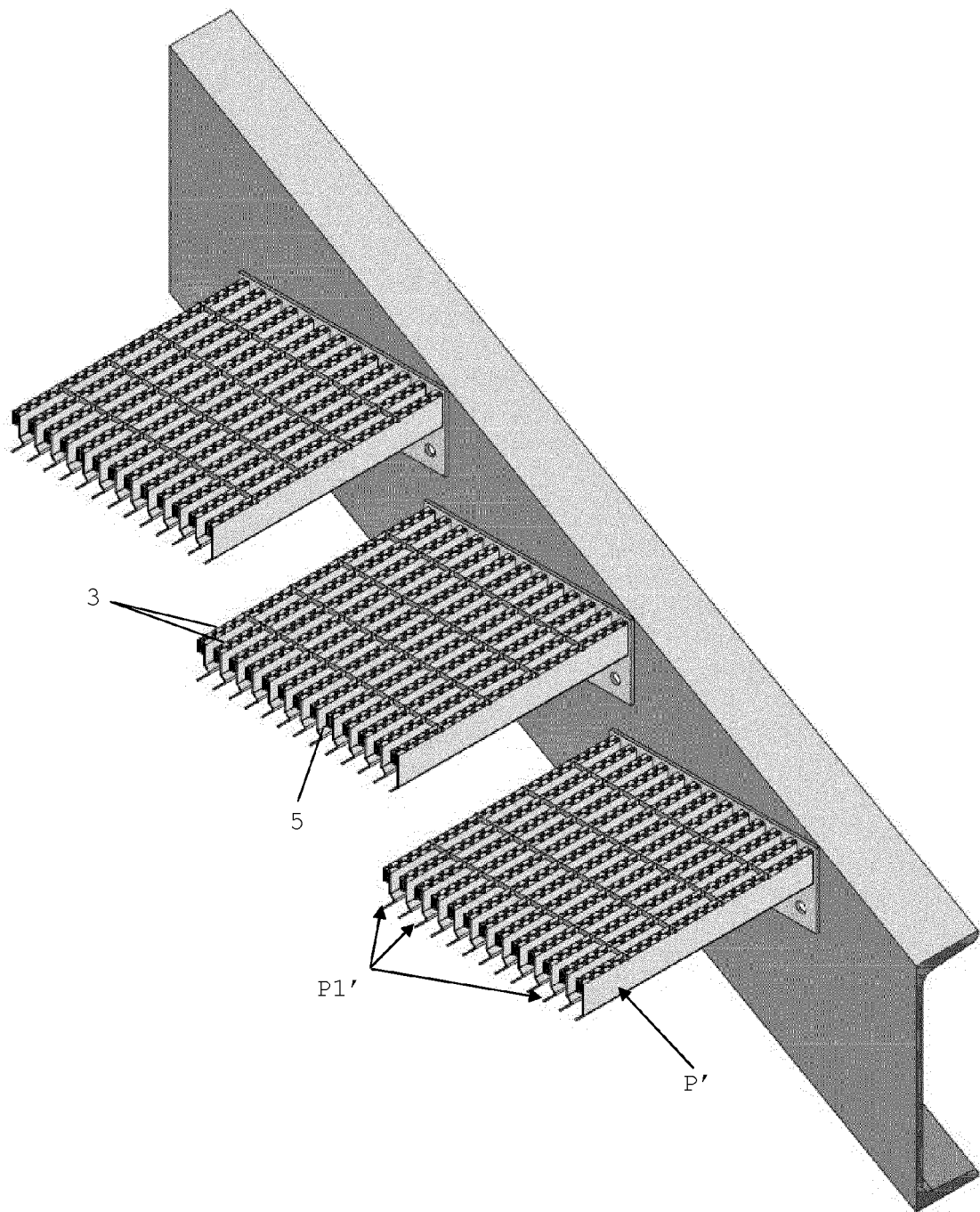


FIG. 23



EUROPEAN SEARCH REPORT

Application Number
EP 13 17 8080

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	WO 2009/029988 A1 (UNITLOAD PTY LTD [AU]; SMOLENAERS PETER JUDOCUS [AU]) 12 March 2009 (2009-03-12) * page 8, line 15 - page 9, line 31; claims 1, 2; figures 2a, b, 7 *	1,2,9	INV. E04C2/42
Y	FR 2 369 499 A1 (CAILLEBOTIS METALLIQUES STE GL [FR]) 26 May 1978 (1978-05-26) * page 3, line 6 - line 26; figures 1-3 *	1,2,9	
A	DE 296 10 417 U1 (BUERKNER LUTZ [DE]) 26 September 1996 (1996-09-26) * claim 1; figures 1, 2 *	3	
A	EP 0 396 136 A1 (RHEINHOLD & MAHLA GMBH [DE]) 7 November 1990 (1990-11-07) * figures 2, 3 *	4,5	
A	US 3 479 777 A (SCHACK JOHN B) 25 November 1969 (1969-11-25) * figure 2 *	6-8	
			TECHNICAL FIELDS SEARCHED (IPC)
			E01C E04C
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 20 November 2013	Examiner Mysliwetz, Wolfgang
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			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 13 17 8080

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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20-11-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2009029988 A1	12-03-2009	NONE	
FR 2369499 A1	26-05-1978	NONE	
DE 29610417 U1	26-09-1996	NONE	
EP 0396136 A1	07-11-1990	DD 300828 A5	06-08-1992
		DE 3914907 A1	17-01-1991
		EP 0396136 A1	07-11-1990
		US 5036639 A	06-08-1991
US 3479777 A	25-11-1969	NONE	

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