



US 20120233961A1

(19) **United States**

(12) **Patent Application Publication**  
**Matos**

(10) **Pub. No.: US 2012/0233961 A1**

(43) **Pub. Date: Sep. 20, 2012**

(54) **MODULAR MULTIFUNCTIONAL  
MOTHER-BEAM**

(52) **U.S. Cl. .... 52/846**

(57) **ABSTRACT**

(76) **Inventor: Sergio Francisco da Silva Matos,**  
**Sever do Vouga (PT)**

Multifunctional modular mother-beam built in structural steel or similar light, sturdy material, with a "U" configuration and provided with holes along its entire length, either on the back side, on the flanks, or on the edges, by which said mother-beams connect to one another either through their back sides, their flanks, or their edges, at any angle. They are fastened with screws inserted into said holes, with no need for welding. The flanks and edges are bended to facilitate fitting and fastening of the mother-beams. Mother-beams may connect by overlapping their back sides, by joining their edges, by joining their flanks, by joining flanks with edges, edges or flanks with the back side, through direct or reversed connection. It can act as a beam, pillar, trussed beam or bar, being especially useful in the construction of large areas, such as pavilions or similar constructions.

(21) **Appl. No.: 13/423,056**

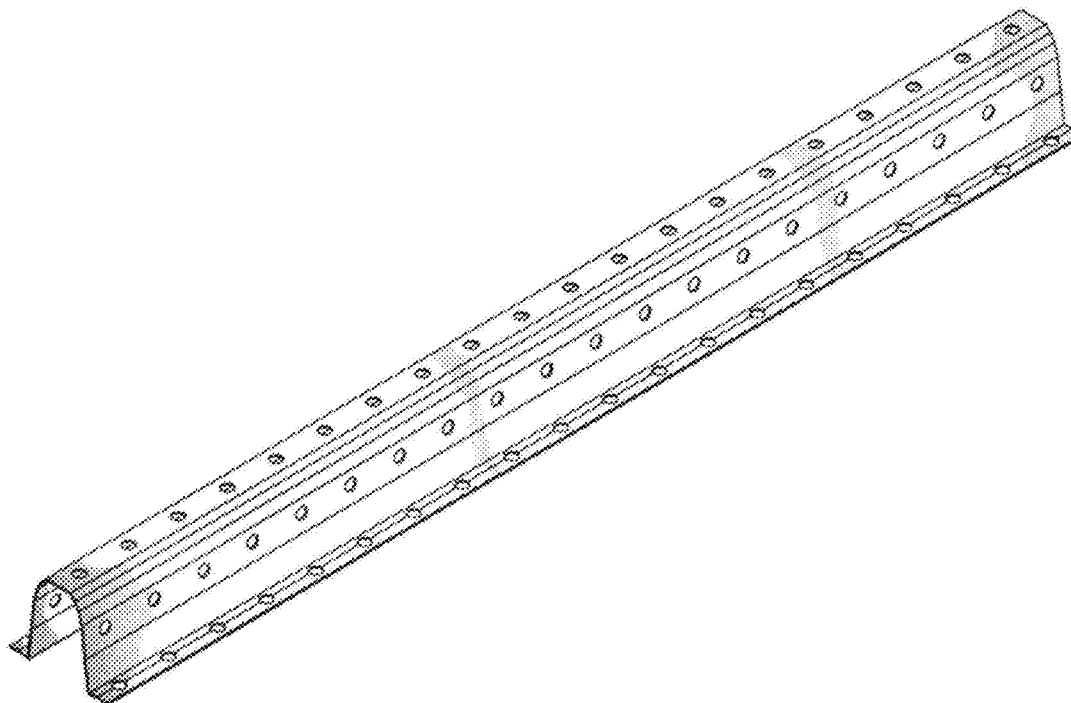
(22) **Filed: Mar. 16, 2012**

(30) **Foreign Application Priority Data**

Mar. 16, 2011 (PT) ..... 105579

**Publication Classification**

(51) **Int. Cl.**  
**E04C 3/07** (2006.01)



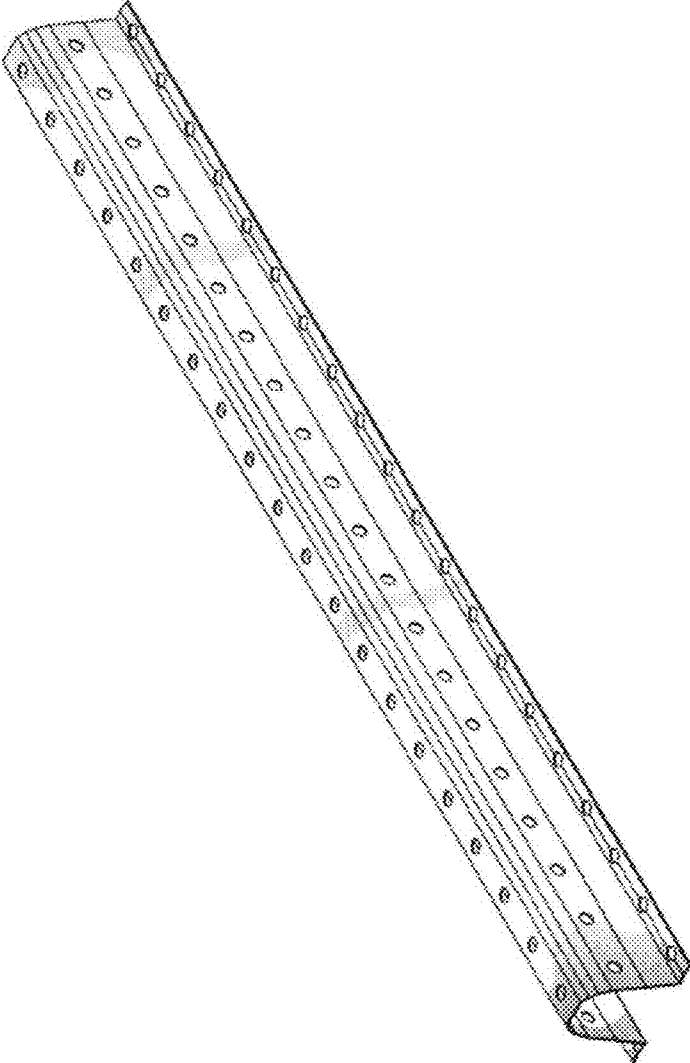


FIG.1

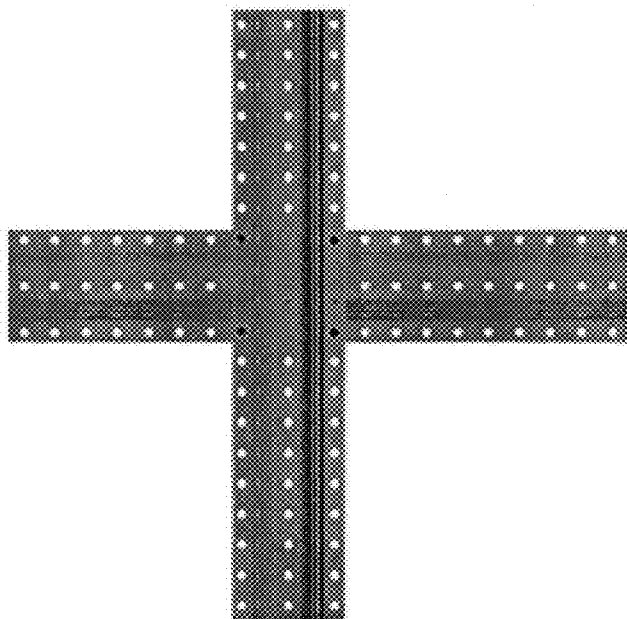


FIG.2

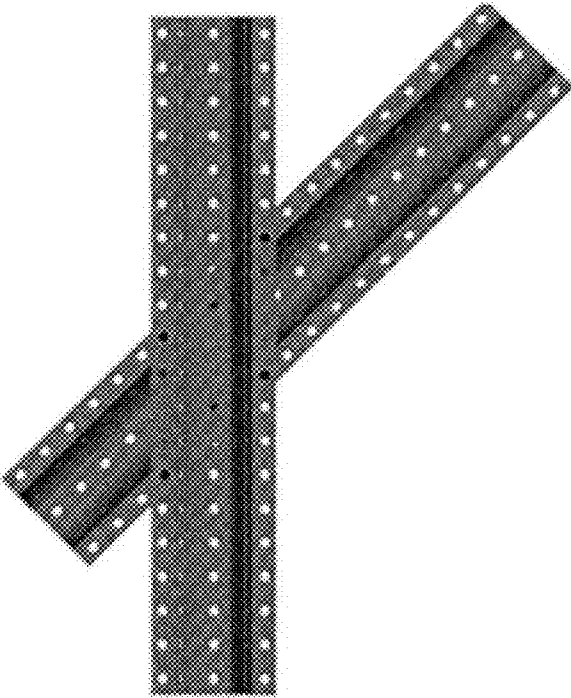


FIG.3

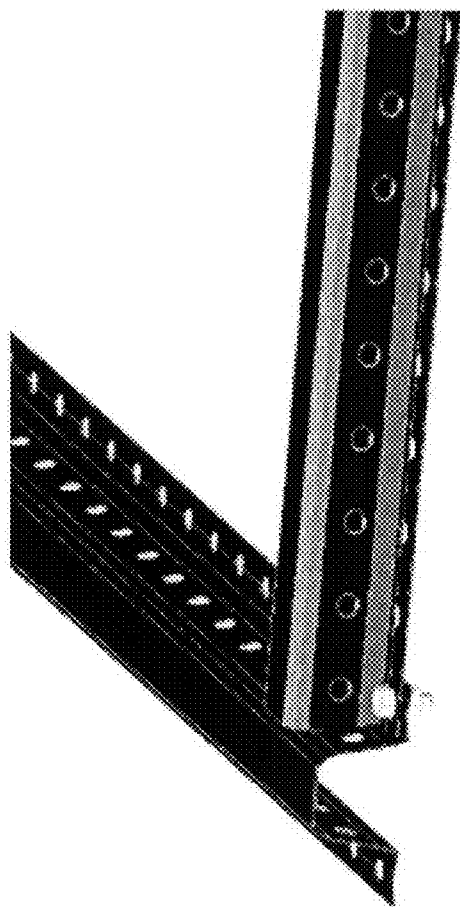


FIG.4

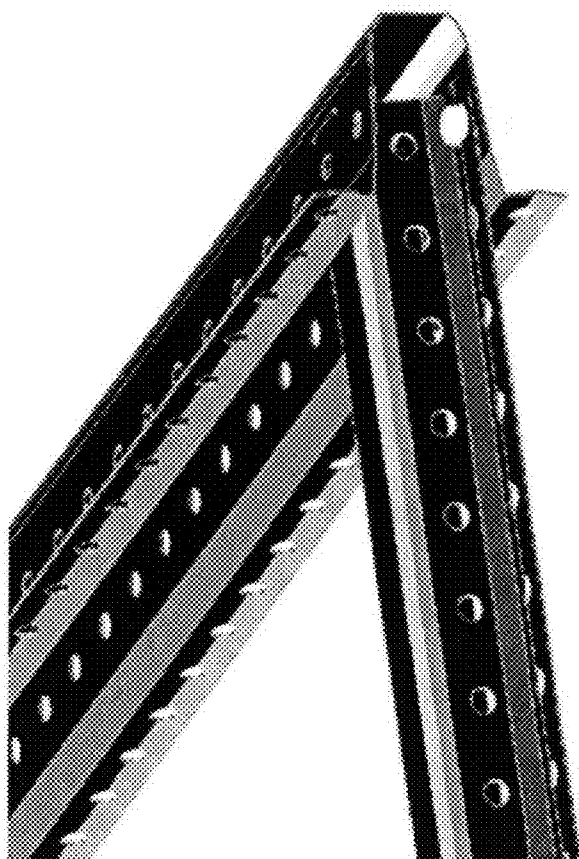


FIG.5

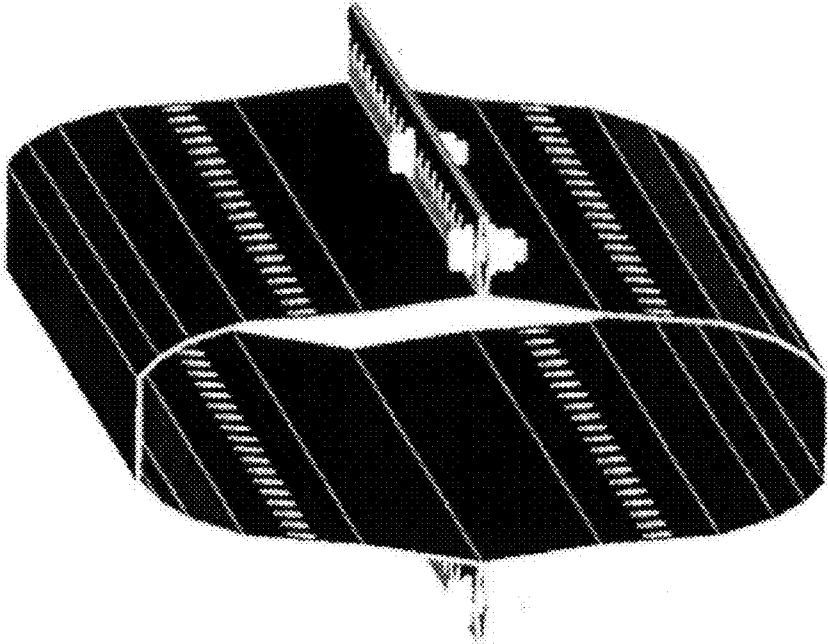


FIG.6

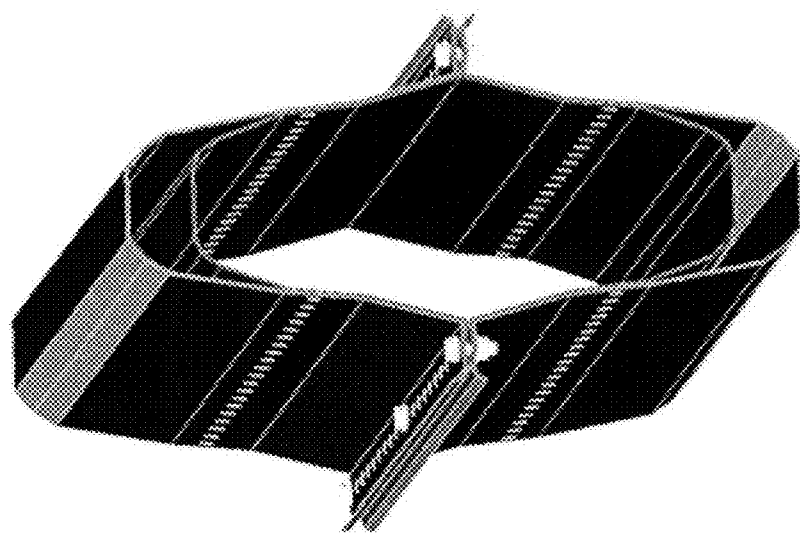


FIG.7



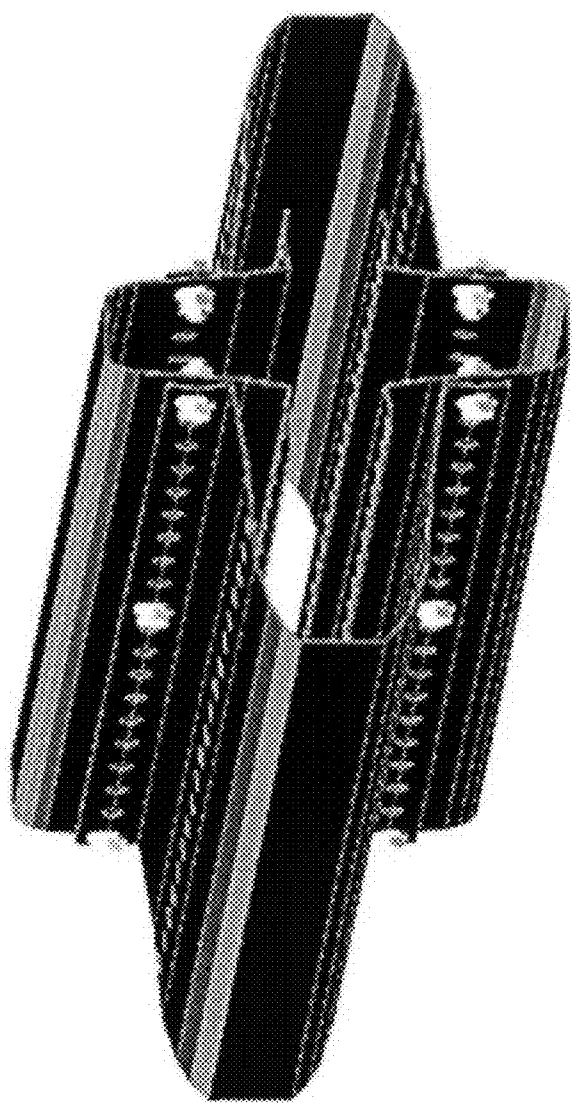


FIG.8

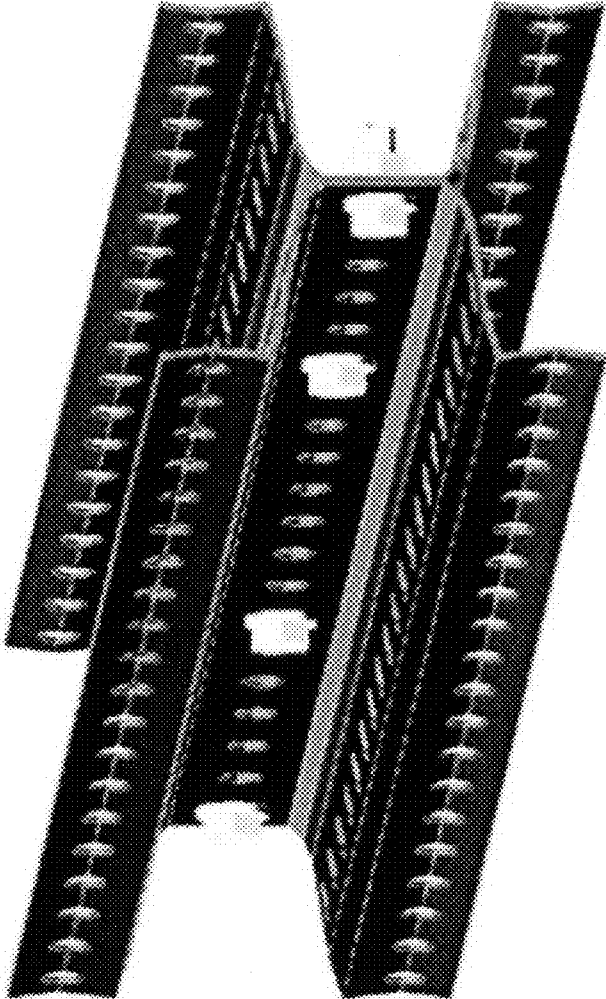


FIG.9

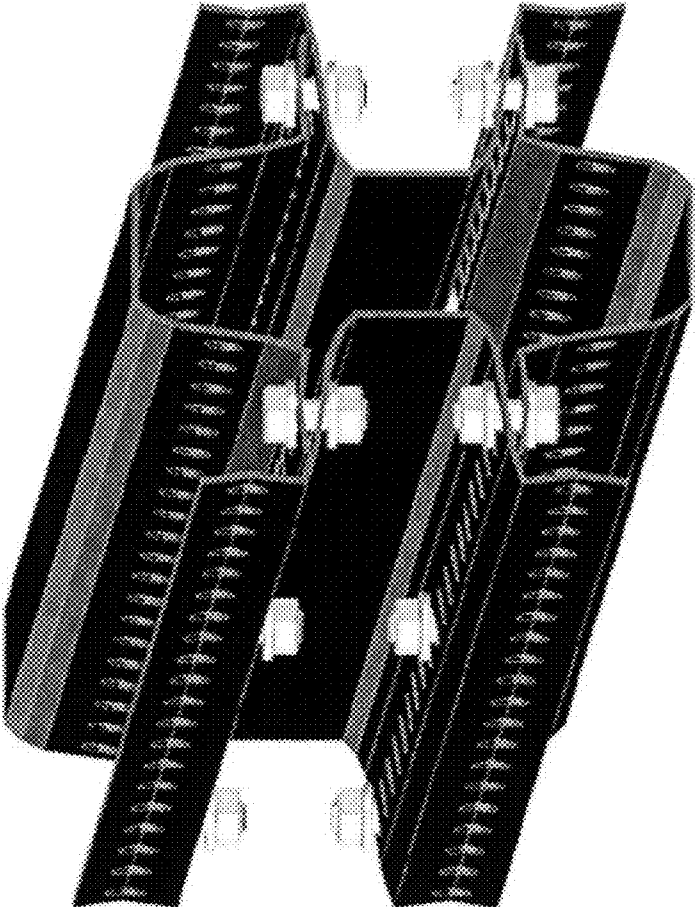


FIG.10

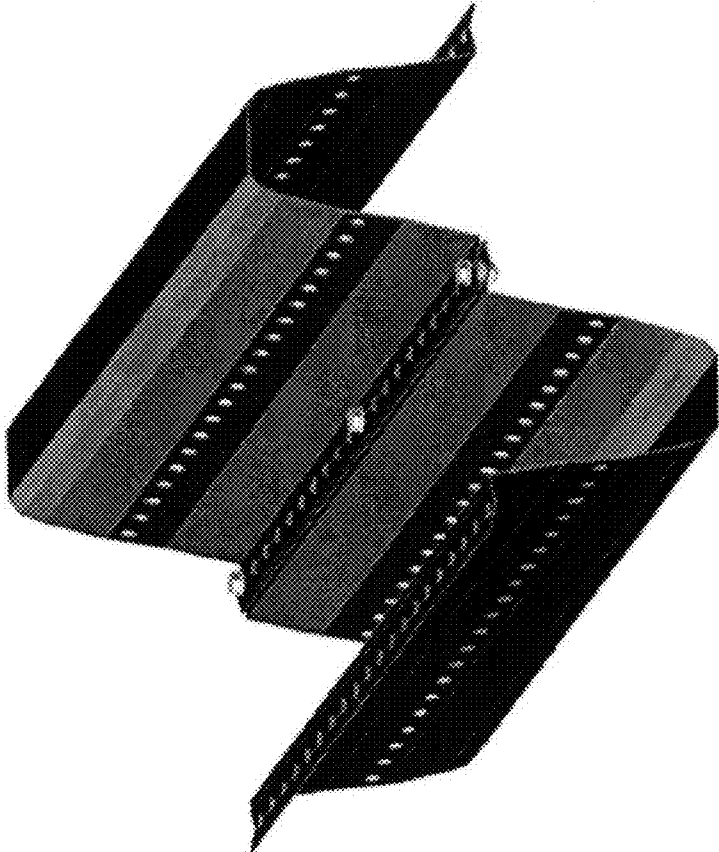


FIG.11

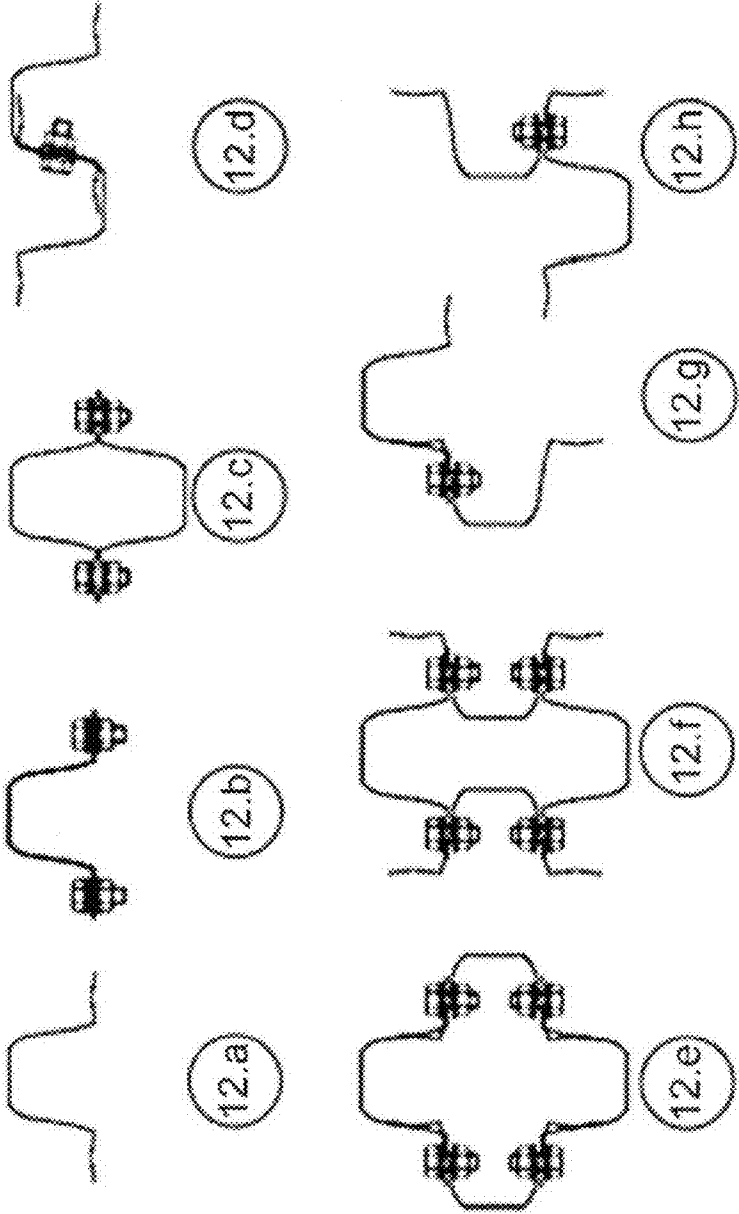


FIG.12

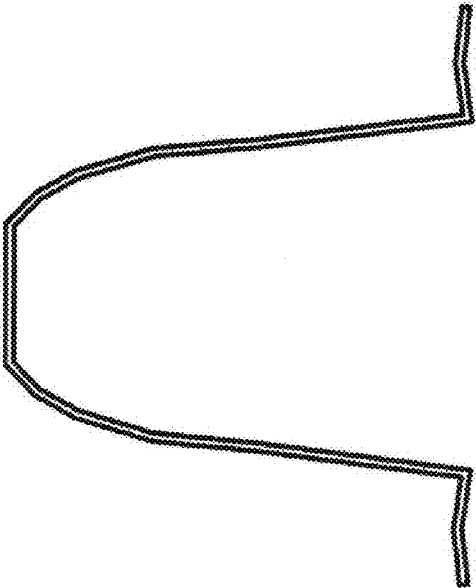


FIG.13

**MODULAR MULTIFUNCTIONAL  
MOTHER-BEAM**

**CROSS-REFERENCE TO RELATED  
APPLICATION**

**[0001]** This application is a national application and claims the benefit of the priority filing date of Portuguese patent application no. 105579 filed with the National Institute for Industrial Property (INPI) on Mar. 16, 2011 in the name of MODELING SOLUTIONS, UNIPESSOAL, LDA.

**FEDERALLY SPONSORED RESEARCH**

**[0002]** None

**SEQUENCE LISTING OR PROGRAM**

**[0003]** None

**STATEMENT REGARDING COPYRIGHTED  
MATERIAL**

**[0004]** Portions of the disclosure of this patent document contain material that is subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by anyone of the patent document or the patent disclosure as it appears in the Patent and Trademark Office file or records, but otherwise reserves all copyright rights whatsoever.

**BACKGROUND**

**[0005]** The present invention is a mother-beam which, through its configuration and holes, covers large spans. It also provides innovative features, enabling single or double pillars, overlapping in different angles, and connection through either of its parts.

**[0006]** By using just one module of a single type, the new modular mother-beam allows for building structures that, until now, was done in a slow way and required numerous different structural elements.

**[0007]** It can be connected in any angle from the back side, or fixed by the flanks or edges. The object of the modular mother-beam invention is to allow it to assume the role of a pillar, a beam, a trussed beam or a bar. It can also be reinforced, depending on the purpose of the construction.

**[0008]** Moreover, by allowing this kind of practically limitless connection, the mother-beam does not require any welding. This means that it would now be possible to build large structures without welding. It would be possible to build robust pillars, connect them to a beam structure, and build all kinds of trussed beams and reinforcements solely by modular connection. The mother-beams would be fixed to each other using a single type of screw.

**[0009]** Currently, all structural metal elements in buildings (e.g., houses, pavilions, industrial facilities, and greenhouses), coverings, and support structures (e.g., facades, sun farms, and parking lots) are implemented using parts designed in a project. This has the main drawback of requiring the development of specific parts in order to build a given metal structure, from very thick and heavy metal plates to a plurality of components with high dimensional control.

**[0010]** Moreover, such a system requires a great number of connecting parts, and in the constructive and assembly stage, it requires a great deal of welding, pickling and painting. The

workmanship is enormous and expensive. Furthermore, many large structures can only be lifted with the use of heavy cranes.

**[0011]** The construction of large industrial facilities has always met with a number of problems. Firstly, it is necessary to overcome large gaps between pillars. The traditional solution is to increase the number of pillars, which limits the amount of usable space. The existing solution is a longitudinal overlapping of beams and their juxtaposition with other perpendicular beams, at 90 degree angles.

**[0012]** The proposed invention seeks to go much further. The beam or mother-beam should have the following capabilities:

**[0013]** The ability to be longitudinally superimposed upon one another in order to overcome large spans, which solution is similar to other existing ones except that the invention also enables overlapping throughout the whole back side.

**[0014]** The ability to be superimposed upon one another in any angle, thus allowing an infinite variety of orientations of the mother-beams, which greatly enhances their use;

**[0015]** The ability to transform itself into a plain or reinforced pillar, serving a purpose it was not previously suited for;

**[0016]** The ability to connect both beam or mother-beam through the back side (in direct or reversed connection), as well as through the edges or flanks;

**[0017]** The ability to connect the back side with the flank or the edge, the flank with the flank, or the flank with the edge, thereby enabling practically all mounting solutions under normal circumstances when building a given structure;

**[0018]** The ability to cross over, to be juxtaposed, and to connect to beam-structures or trussed beams in any angle.

**[0019]** Essentially, the proposed invention increases the ability to overcome large spans with enormous reduction in the amount of material used by simplifying the assembly process and by allowing the addition of modular material, while providing multipurpose use as a beam, as a bar, as a trussed beam or as a solid pillar.

**[0020]** More elements (beams, pillars, trussed beam or bars) can be added at any time without the need for changing or moving structural elements in the construction.

**[0021]** On the other hand, the invention highly facilitates storage and transportation, it does not require any welding or any surface treatment to the structures, and it enables a faster execution.

**[0022]** The proposed invention starts off from a beam with the general appearance of a U-shaped profile, with multiple folds on the flanks and edges, which makes connecting, overlapping and fastening easier.

**[0023]** It is made out of structural steel and, in its most common version, the mother-beam is light and sturdy.

**[0024]** It has holes along its entire length, both on the back side, as well as on the flanks and edges, and it makes it possible to fasten, connect, and juxtapose several elements in different ways, thereby enabling the construction of pillars, bars and beams of various lengths, and the anchoring from any angle.

**[0025]** The configuration of the mother-beam is crucial to its multi-functionality. The positioning of the holes throughout the whole back side, flanks and edges, as well as its

U-shaped profile with a specially configured angled structure, enable a huge diversity of functions.

**[0026]** During the process of assembly or construction of pavilions and other large size areas, it would possible to build and assemble all structural elements using the same mother-beams (and not merely beams in longitudinal or perpendicular alignments) by simply choosing the anchorage angle according to the holes. This makes the process quicker and simpler.

**[0027]** The process, besides being simple, becomes much more economic. Not only is the process faster and requires less workmanship, it also uses only one kind of mother-beam that can perform all the functions performed by beams, bars, trussed beams, and pillars.

**[0028]** The use of profile beams made of lightweight material and with holes that allow their juxtaposition to overcome large spans is relatively recent. Known are beams with holes in the terminal area that enable longitudinal overlapping. In particular, there are beams, ones with a U-shaped profile, ones with holes on the ends, and ones which are able to connect longitudinally on the backside of each other and to overcome large spans.

**[0029]** However, the features of such beams are much more limited than the ones of the present invention. They do not allow overlapping in angles other than 90 degrees; they do not allow any other alignment than longitudinally, by aligning a beam with a corresponding one, back to back, in a straight line; they do not allow for the construction of pillars; they do not allow the crossing and juxtaposition of elements with different sections; and they do not allow for further modular increases in any direction.

#### SUMMARY

**[0030]** The present invention is a multifunctional modular mother-beam built in structural steel or in similar light, sturdy material, with a "U" configuration and provided with holes along its entire length, either on the back side (1 and 1-a), on the flanks (2 and 2-a) or on the edges (3 and 3-a), by which said mother-beams connect to one another either through their back sides, their flanks or their edges, in any angle. They are fastened with screws inserted into said holes, with no need for welding. The flanks and the edges are bended (2-b 3-b) in such a way as to facilitate the fitting and fastening of the mother-beams. The mother-beams may connect by overlapping their back sides, by joining their edges, by joining their flanks, by joining flanks with edges, and edges or flanks with the backside, either through direct or reversed connection. It has the ability to serve as a beam, pillar, trussed beam or bar, and is most desirable for the construction of large areas in pavilions or similar constructions.

#### FIGURES

**[0031]** FIG. 1 represents the mother-beam, highlighting the holes in the back side (1 and 1-a), the flank (2 and 2-a) and the edge (3 and 3-a);

**[0032]** FIG. 2 shows the more conventional crossing of two mother-beams, in mirror fashion and in a 90 degree angles, with screw fastening (4) in the holes of the edges (3-a);

**[0033]** FIG. 3 represents a crossing between two beams in a 45 degree angle, fastened by screws (4) in the same way as in the previous drawing;

**[0034]** FIG. 4 shows an external connection, in which the mother-beam is perpendicularly connected to one another through the holes on the edges (3-a);

**[0035]** FIG. 5 shows an internal connection, perpendicularly connecting the mother-beam to one another through the holes on the flanks and the edges (2-a and 3-a);

**[0036]** FIG. 6 shows a tubular connection between two mother-beams in mirror fashion, fixed through their edges (3), which is a particularly suited solution for pillars;

**[0037]** FIG. 7 shows a reinforced tubular connection, recommended for more robust pillars, in which two beams overlap in mirror fashion, fixed through their edges (3);

**[0038]** FIG. 8 shows a star structure, consisting of four mother-beams fastened together by connecting the edges (3) with the flanks (2), which is a suitable solution for reinforced pillars and beam-framework which allows several unions;

**[0039]** FIG. 9 shows an inverted tubular union in which the mother-beams are connected through the back side (1), a suitable solution for duplicating pillars and for beam-framework with multiple connections;

**[0040]** FIG. 10 shows an inverted star union, with connections through the flanks (2) and edges (3) with the use of four mother-beams, a recommended solution for the construction of pillars or reinforced beams with direct lateral assembly of other elements;

**[0041]** FIG. 11 shows a double inverted union, in which two mother-beams are connected by the edges (2), longitudinally in an asymmetric mirror fashion;

**[0042]** FIG. 12 shows some possible uses or placements arising from uniting or juxtaposing the mother-beam object of the invention, of which:

**[0043]** 12-a shows a cross-section of the mother-beam in a simple application;

**[0044]** 12-b shows a cross-section of the mother-beam in a double application (back-side overlapping);

**[0045]** 12-c shows a cross-section of the mother-beam in a tubular application;

**[0046]** 12-d shows a cross-section of the mother-beam in a double inverted connection, fastened through the holes on the flanks;

**[0047]** 12-e shows a cross-section of the mother-beam in a star assembly, by using four modules and by connecting edges and flanks;

**[0048]** 12-f shows a cross-section of the mother-beam in a star assembly, by using four modules and connecting edges to flanks;

**[0049]** 12-g shows a cross-section of the mother-beam assembled in an inner corner anchorage, by using two modules connected through the flank and the edge;

**[0050]** 12-h shows a cross-section of the mother-beam assembled in an outer corner anchorage, by using two modules connected through the flank and the edge.

**[0051]** FIG. 13 represents a profile cross-section of the mother-beam, showing in greater detail the bending of the flanks (2-b) and edges (3-b).

#### DETAILED DESCRIPTION

**[0052]** The invention starts-off from a mother-beam made of structural steel or a similar succedaneum light, sturdy material with a generally U-shaped configuration. This "U" shape is the result of successive folds from the back side to the edges. Specifically, such folds are present between the flanks (2-b) and the edges (3-b) along its entire length.



**[0053]** In fact, only the back side (1) has a flat surface, which facilitates coupling and modular fastening.

**[0054]** The flanks (2) have more or less pronounced folds (2-b) that award a certain convexity along the entire length of the mother-beam. The edges (3), on the other hand, have positive bending (3-b), also along the entire length of the mother-beam.

**[0055]** Such bending facilitates the coupling of the modules and provides strength to the anchorage. Accordingly, when connecting from edge to edge (FIG. 11, by way of example), or edge to flank (FIG. 5 and FIG. 8, as examples), the slight bending of the edge—present along its whole extension—provides increased tension and strength when tightening the screws (4). The same happens when coupling from flank to flank (FIG. 12-d, for example).

**[0056]** The mother-beam receives three types of holes throughout its entire length: On the back side (1-a), on the flanks (2-a), and on the edges (3-a). Such holes are all in longitudinal alignment.

**[0057]** The holes on the back side are used, namely, to overlap two beams or mother-beams in longitudinal alignment, allowing a variety of lengths, suitable to overcome spans of very different dimensions. For that purpose, it is enough to overlap one mother-beam over another, along any point of its length.

**[0058]** However, they can also be fastened through the back sides with reverse orientation (FIG. 9). As the holes are present along the entire length of the mother-beam, they allow juxtaposition or another type of longitudinal fastening with any intended length.

**[0059]** As they are made of lightweight and highly resistant material, mother-beams can be overlapped only on their borders, overcoming large spans, or may be overlapped along larger sections, for smaller spans.

**[0060]** Mother-beams can even be fully overlapped one upon another, in order to create stronger structures (FIG. 12-b).

**[0061]** If the mother-beams are reversed, by turning the two posterior faces in mirror fashion, they can be crossed at 90 degrees (FIG. 2), in its most current version, or with intended bending (FIG. 3), without the limitation of perpendicular orientation.

**[0062]** In fact, the above described possibility comes from the positioning of the holes. Thus, the holes along the entire length of the edges enable reversed placement and fixation of the mother-beams at any point (FIG. 2 and FIG. 3).

**[0063]** The configuration of the mother-beams also determines its exceptional functionality. Indeed, with the use of this new type of metal structure, the same element can be a bar, a beam or a trussed beam, or it may sometimes turn into a pillar.

**[0064]** Although it can take up the function of a beam in its most conventional application, simply by overlapping the backside of a mother-beam along another, the invention has many other possibilities which have already been duly tested.

**[0065]** Thus, with the same mother-beam, one can build a pillar, simply by connecting two mother-beams in mirror fashion by the edges (FIG. 6); while it is also possible to overlap the whole set with the same type of fastening by the edges, with the purpose of creating a more reinforced pillar (FIG. 7); or the star union of four mother-beams (FIG. 8), by joining the flanks of two of them (2) to the edges of the other two (3) with screws.

**[0066]** Besides its longitudinal juxtaposition, as stated above, the mother-beam enables an outer lateral fastening (FIG. 4) in which a mother-beam is connected perpendicularly to the other, fastening the top of an edge (3) to the other with screws (4) into the respective holes (3-a).

**[0067]** And the same would occur with an inner fastening perpendicularly between two mother-beams (FIG. 5), this time with the attachment being made between the edges of one and the flanks of the other through the respective holes (2-a).

**[0068]** FIGS. 9, 10 and 11 show us some possibilities of this versatile mother-beam. By choosing the holes and attaching the edges, flanks, or tops, it is possible to use mother-beam in multiple roles in the structural construction of large structures, such as pavilions, industrial facilities, warehouses, etc.

**[0069]** FIG. 12, which merely exemplifies the possibilities of juxtaposing or connecting mother-beams, shows us some solutions ranging from the use of a single mother-beam (12-a) or with back side overlapping (12-b), for beams or bars; to its connection for pillars (12-c, 12-d and 12-f) or other solutions (12-d, 12-g, and 12-h) with numerous connection possibilities.

**[0070]** The modules are always fastened with screws. These screws can be equally applied to the edges (for example, in FIG. 2, FIG. 3 and FIG. 11), or to the flanks (see for example FIG. 5, FIG. 8, FIG. 10 and FIG. 12-d), or to the back side.

**[0071]** In fact, the whole invention uses a single type of mother-beam and a single type of screw. Thus, the same mother-beam can take up the role of a beam, a bar, a trussed beam, or a pillar, and the same screw can be applied in every hole.

**[0072]** The construction is finished after everything is tightened with screws. There is no need for welding in any moment, and structural elements are built with a single type of beam.

**[0073]** As described above, construction, transportation, assembly and disassembly becomes faster, more economic and much simpler.

**[0074]** Construction is limited to a single type of modular mother-beam, which significantly decreases production costs. The screws are also of a single type.

**[0075]** Transportation becomes much simplified and economic, as it is possible to accommodate a single type of modular mother-beam, perfectly matching with one another and taking up less space.

**[0076]** Assembly is simple and takes up less workmanship. Modular mother-beams are lightweight, easy to handle and easily attachable, and can fasten together.

**[0077]** The same modular mother-beam can perform several functions in the structure to be built.

**[0078]** At any time, the structure can be expanded simply by connecting more modular beams.

**[0079]** Coupling can be internal or external, and so any section of the mother-beam can be connected to any section of another mother-beam.

**[0080]** Assembly can be made in any angle by two or more beams. It requires no welding.

**[0081]** It does not require the construction of structural elements according to a specified project.

**[0082]** Disassembly is simple because there are no welded elements. It is limited to loosening screws.

What is claimed:

1. A multifunctional modular mother-beam, comprising an overall "U" shaped configuration, made of structural steel or similar light, sturdy material, provided with holes along its entire length, on its back side (1 and 1-a), on its flanks (2 and 2-a) or on its edges (3 and 3-a), by which said mother-beam connects to another mother-beam, at any angle; said mother-beams are fastened together with a single type of screw (4) introduced into their holes; and said mother-beams are bended at the flanks (2-b) and edges (3-b).

2. The multifunctional modular mother-beam of claim 1, wherein only the back side (1) has a flat surface.

3. The multifunctional modular mother beam of claim 1 wherein the flanks and edges are bended along their entire length.

4. The multifunctional modular mother beam of claim 2, wherein the flanks and edges are bended along their entire length.

\* \* \* \* \*