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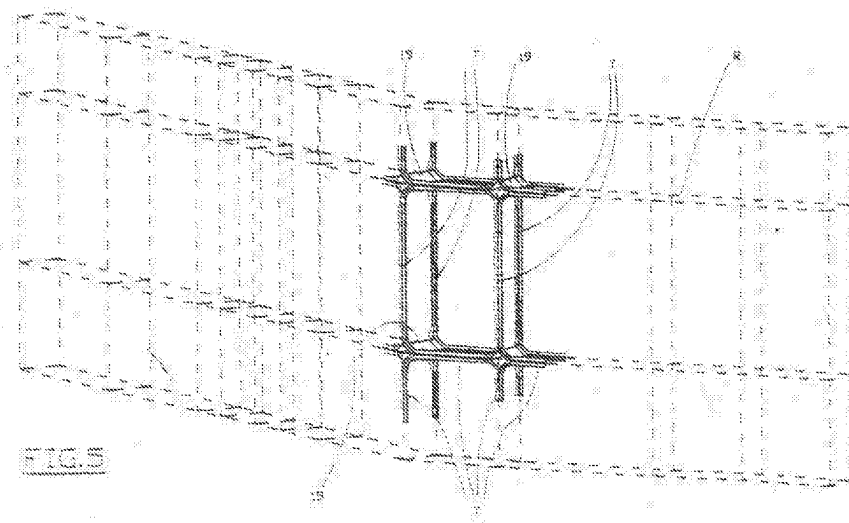
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(54) **Modular system and joint for the construction of extensive frameworks**

(57) System for the construction of a extensive framework joining a plurality of linear elements (T) by means of connecting joints of the ends of the linear elements (T), wherein at least the following components are used: shaped pieces (11) associated or to be associated to said linear elements (T) so as to project longitudinally from the ends of the same; in order to form each of said joints, a tubular core (1) with a polygonal section defining a completely free internal cavity and longitudinal corner edges, to be arranged so that the axes of the linear elements (T) converging in the joint substantially meet respective corner edges and the longitudinal axis

(X) of said core (1), one or more collars (2), which take the polygonal form of said core (1), to be tightened around the core and provided with substantially plate-shaped wings (21) projecting radially from respective corner edges, one for each of the linear elements (T) converging in the joint, and substantially C-shaped arms (3) to be arranged on the outside of the collars, each between two consecutive wings (21), with the concavity facing the outside, end segments (3a) of said arms being placed against respective wings (21) and engaged with the pieces (11) of the linear elements (T) and with the wings (21).



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Description

[0001] The present invention relates to the field of buildings. More particularly it refers to a new system and a connecting joint thereof, for the construction of general composite structures, namely frameworks with extensive texture, which can be used autonomously or in association with new or pre-existing masonry structures.

[0002] Metallic structures are known, which are designed for various applications that envisage the bi-dimensional or three-dimensional composition of linear elements or beams via nodal joints of various typologies. Traditionally, included among the requirements that these structure and nodal joints must satisfy, there are construction simplicity (possibly with a limited number of modular components) and the possibility to accomplish a certain range of different angles between the linear elements.

[0003] In the building field, these structures consists almost exclusively of lattices, and they are designed to construct massive surfaces or covers. None of them is expressly designed to be distributed in, and integrated with, masonry walls in order to extensively increase their structural ductility, or even statically replace them. on the other hand, it is precisely this distributed association that makes most important the satisfaction of the above mentioned requirements, and in particular the possibility of varying the angle between the beams. In fact, for the coupling between framework and masonry wall to be effective, the first must develop extensively over the second, that is to say the framework must extensively follow the development of the wall, both with regard to the planimetry and the altimetry and thickness, according to a dense and three-dimensional network texture.

[0004] Since it is precisely the versatility with which it can adapt to the most varying developments and conformations that is typical of masonry wall structures, a more effective result can clearly be achieved the greater the configuration freedom is with which the framework can develop three-dimensionally, both as a whole, and in every single mesh composing the net. A framework of this kind might then reconstitute a wall, following different depths (even locally) to simulate different thicknesses. In the same way, it might reconstitute a surface or a general figure, having also its own structural efficiency, which would be the one typical of load-bearing skeleton structures, with rigid connections between the elements. Such configuration freedom would obviously also remain usable for constructing composite lattice structures.

[0005] A more specific need of the above mentioned constructions, which is generally not met, concerns the possibility of maintaining the nodal joint, after installation, open to the possibility of joining new and additional beams onto it, to make the net-like structure, in its whole, subject to enlargements, modifications or integrations after the initial setup.

[0006] Also in case of integration with masonry struc-

tures, this possibility would enable the framework, in particular, to continue to be fit to the said structure when it undergoes changes in shape or use, or when it faces altered load conditions in relation to the original configuration. In general terms, then, the possibility of enlarging and reconfiguring a generally composite structure, at a later time and with the maximum flexibility, can have a positive influence on the costs of managing and reusing the constructions, so the very structure and the relative nodal joints must be particularly effective in this regard.

[0007] It is the object of the present invention to provide a structural system with extensive texture of the type that was generally referred to above, which, in particular thanks to a nodal joint with new characteristics, allows at least the following results to be reached at the same time and at the highest degree:

- a structure that is modular by repetition with a reduced number of components having reduced sizes;
- flexibility of use in various fields of use, as far as the structural configurations and shapes are concerned, and as for the spatial orientation of the beams;
- efficiency in relation to the multiple types of stress that the structure is called to bear, and which the nodal joints must transmit, both if the structure is designed to work autonomously and in association with masonry structures;
- modifiability of the structure and of the already installed nodal joint thereof, in terms of allowing the joints to withstand variations of the same structure guaranteeing continued service (that is without particular limitations of the effectiveness or use of the construction, and without making complex operations of disassembly necessary);
- easy installation and accessibility of the components of the structure also in the presence of masonry works;
- feasibility in metal materials by cold working, particularly cutting, curving, folding work and other basic workshop machining.

[0008] The present invention actually reaches the above mentioned results, with a system whose basic characteristics are defined in the first of the attached claims. A joint used in the system is essentially characterised by what is defined in claim 17.

[0009] The characteristics and advantages of the modular system and joint for constructing extensive frameworks according to the present invention will become clearer from the following description of its embodiments, which are given by way of example and not limiting, with reference to the accompanying drawings, wherein:

- figure 1 shows an axonometric view of a nodal joint

according to the invention;

- figure 2 is an exploded view of the joint in figure 1;
- figures 3 and 4 show a front view and an exploded, axonometric view of a nodal joint according to the invention, in a construction embodiment which is different compared to the one in figures 1 and 2;
- figure 5 schematically shows a portion of extensive texture, which reconstitutes a wall, and according to said texture a typical module of the framework according to the invention;
- figure 6 represents an exploded, axonometric view of a portion of the framework in figure 5, and in particular a relevant nodal joint that is basically referable to the one in figures 3 and 4;
- figure 7 represents a top view of a nodal joint of the framework in figure 6;
- figure 8 shows once again an axonometric view of a portion of the framework analogous to the one in the figures from 5 to 7, integrated into a masonry structure;
- figure 9 schematically represents an example of integration between a structure according to the previous figures and new or pre-existing masonry walls of a hypothetical building;
- figure 10 is a detail of a configuration similar to the one in figure 9, relating to the structure according to the invention in relation to an intervention of underpinning;
- figure 11 schematically represents a portion of a different framework, textured for the reconstruction of a vault with a certain thickness, based on a nodal joint according to the invention;
- figure 12 shows a further different texture related to a three-dimensional, net-like structure, with nodal joints referable to those shown in figures 1 and 2;
- figure 13 is, again, a portion of framework according to the previous figures, strengthened with the addition of further joints and beams;
- figures from 14 to 16 show - by means of schematic, axonometric representations - various additional structural solutions based on the nodal joint according to the invention, in particular in the embodiment of figures 3 and 4;
- figures 17 and 18 show further structural solutions again based on the use of a nodal joint according to the invention; and
- figures 19 and 20 are a front view and an enlarged, axonometric view, respectively, of a nodal joint according to the invention, in a still further embodiment.

[0010] With reference to figures 1 and 2, a first, generic example is provided of a joint according to the invention, which is intended, in the depicted configuration, for the connection between beams converging in the joint itself, in particular comprising four coplanar and mutually orthogonal beams (X axes), and four beams arranged according to the corner edges (Y axes) of an

imaginary straight pyramid with a quadrilateral base, with the apex on the joint and the height orthogonally arranged with respect to the plane of the previous four beams.

[0011] According to the invention, the joint is made by using three basic components: a core 1 consisting in a tubular body with a polygonal section, octagonal in the example as a function of the overall number of the beams, to be arranged so that the X, Y axes of the same beams each radially meets a corresponding corner edge of the core and the relative longitudinal axis (indicated at Z); dismountable collars 2 to be arranged coaxially with the tubular core 1 tightening it on the outside, which exhibit laminar wings 21 protruding radially from respective longitudinal corner edges, again whose number and angle correspond to that of the X, Y axes of the beams converging in the joint; and generally curved arms 3 (basically in a C that is relatively narrow depending on the requested angle of opening) arranged outside the collars 2, each for the mutual flexural connection between two consecutive beams converging in the joint, as will be discussed in greater detail hereafter.

[0012] Going into further detail, a collar 2 comprises a pair of semi-elements 4 each comprising a central gut-like portion 4a, congruent in relation to the external surface of the tubular core 1 onto which the semi-elements 4 are to be locked. The previously mentioned laminar wings 21 are defined by plates 4b, 4c, which extend integrally from the convex surface of the central portion 4a, in an intermediate position (plates 4b), and from the two ends (plates 4c) of it, respectively.

[0013] More precisely, the two end plates 4c of a semi-element 4 couple with corresponding end plates 4c of the other semi-element 4, possibly in a distanced relationship due to a spacer, to form cooperating two wings 21; in this example, two plates 4b are mutually coupled in the same way, but it is clear that one single intermediate plate 4b of a suitable thickness can constitute a wing 21 by itself. The connection between the end plates 4c of two different semi-elements is made by means of boltings (not represented), which are inserted into holes 5 formed near the junction with the central portion 4a.

[0014] In addition to the locking action determined by the mutual tightening of the two semi-elements 4, the collar is stabilized around the core 1 also with the cooperation of screwing elements, fixed radially into holes 6, 7 formed to the purpose, respectively, in the core and in the central portion 4a. In relation to the possible uses of the internal cavity defined by the core, which will discuss in further detail later on, the advancement position of said screwing elements can be adjusted thanks to a small slab 32 fixed on the outside of the same portion 4a, in turn provided with a threaded hole 32a. This adjustment aims to ensure that the cavity of the core can stay free from any obstruction.

[0015] As mentioned, the arms 3 have the function of ensuring the flexural connection in the common plane defined by two angularly consecutive beams (the refer-

ence is to an imaginary rotation movement on a normal plane at the axis of the tubular core 1, and centered on the same axis). An arm 3 is basically a linear member bent into a C with straight end segments 3a, which is arranged in the outer space defined by two consecutive wings 21 and by the central portion part 4a comprised between them; in fact, the arm 3 is set between two wings 21 with the convexity facing the collar, practically resting against the same. As in the example, the arm can be simply a tubular bar with circular cross-section.

[0016] When the arm 3 is mounted, the straight end segments 3a are arranged parallel to the wings 21, and can protrude slightly from them in a radial direction; however, they are not in contact with the wings 21, since they are distanced therefrom to some extent, as will be explained shortly. The connection between the arm and the beams is carried out via the aforesaid end segments 3a. In particular, the end segments 3a are to be inserted coaxially for a suitable length in respective hollow tubular pieces 11 of the beams, in this case having an open cross-section. Engaging with respective pieces 11, the straight end segments 3a will be distanced from the respective wings because of the interposition of a wall of the aforesaid pieces 11.

[0017] Small plaques 10 are welded outside the wings 21 near the relative central portions 4a of the semi-elements 4, to provide an abutment for the ends of the tubular pieces 11.

[0018] The fastening of the elements 3, 11, 21 is carried out simultaneously. In fact, thanks to holes 8, 9 formed respectively at least near the ends of the arms and/or in the end segments 3a as well as in a peripheral position on the wings 21, connecting bolts with nuts (not represented) are inserted via the same holes 8, 9, mutually connecting arms 3 and wings 21, thereby also establishing the continuity between the same arms and the pieces 11. In fact, the bolts are inserted at the same time in holes 12, which the pieces 11 exhibit in a suitable position near the end. So, as can be seen from the figures, the mutual alignment of the holes 8, 9 and 12 can allow the simultaneous fastening, in one single assembly, of a wing 21, of the pieces 11, and of two end segments 3a already inserted in the pieces and which are now stabilised, consequently securing respective arms 3 arranged on the two opposite faces of the wing.

[0019] In practice, thanks to the arms 3, at the same time as the fastening to each wing of the beam converging to it, it is also possible to set up the possible flexural cooperation of the collar 2 in the part included between each wing 21 and the adjacent wing 21.

[0020] The pieces 11 are clearly made available in a pair by each beam, and they can be an integral part of the beam itself, or be connected to it by means of a suitable connection system.

[0021] From this first example, it is already apparent that the configuration of the nodal joint can vary according to the number and arrangement of beams converging to the same joint. These variations will clearly affect

the various components, namely the polygonal section of the core 1, the number of the wings 21 as well as their angle to adapt to the angle of incidence of the beams. Consequently, the spatial orientation and opening angle of the arms 3 will vary, in accordance with the respective pieces 11 connected to them. For example, it should be noted how the collar 2 which is arranged in a lower position in the figures, which is designed for the connection with the Y axis beams non orthogonal to the axis of the core, has wings 21 with holes 9 and abutment plaques 10 distributed with a suitable configuration so as to be in accordance with an essentially diagonal orientation of the beams and relative pieces 11, in relation to the plates 4c. The wings 21 can also have an outline that is tapered or nonetheless shaped differently from the simple quadrilateral profile, to create the best adaptation possible to the specific mounting needs.

[0022] Now, with reference to figures 3 and 4, a joint according to the invention is represented in a different embodiment, and in a simplified configuration if compared to the joint in figures 1 and 2. The components, which are the same or correspond to those of the previously described joint, are designated by corresponding reference numerals, and will not be described again.

[0023] In this case, the joint is designed for joining four beams that converge in the same joint coplanarly, angled at 90° one in relation to the next. Therefore, one single collar 2 is used, consisting of two semi-elements 4, which altogether define four wings 21. With regard to these latter, it can be noted that each semi-element 4 defines two separate, intermediate plates 4b, which give the intermediate wing too a double, sandwich structure. In fact, spacers 13, in this case perforated and near the holes 9 (but they can be repeated also near the holes 5), are employed for spacing the two plates composing each wing 21.

[0024] On the outside of the central portions 4a of the semi-elements 4, also respective U-shaped brackets 14 are connected, in the space between two consecutive wings 21. The brackets 14 are arranged with their base resting on the relative semi-element and are provided with holes 15 on the side walls, for the connection, possibly articulated, of further diagonal rod members, not represented and the function of which will be discussed further on.

[0025] The brackets 14 can be connected to the semi-elements 4, as in the example, by locking elements 16, 17, which are suitably perforated. The same holes 5 used for the mutual connection of the end plates 4c are used for the anchorage of the locking elements 16, 17, along with holes 18 that are specifically formed in the intermediate plates 4b, the spacers 13 being as well suitably perforated. In this regard, it is clear that, once initially mounted the locking elements 17, the brackets 14 and the locking elements 16 can also be added later on.

[0026] Turning back to the tubular core 1, the cross-section thereof is in this case a quadrilateral rhomboidal

one, and the axial length reduced, as only one collar 2 need be supported. In figure 4 it can be seen that the core 1 is suitable for permitting the coaxial insertion of, and engagement with, a traverse, which is, in turn, preferably tubular, and nonetheless lockable, like the core, by means of a screw element (not represented here, but similar to an element 23 that will be mentioned shortly). The traverse can thus constitute a joining element between the joint itself and a second joint with a similar or comparable configuration.

[0027] In practice, thanks to a suitable axial extension, the tubular traverse, indicated at 19, can be shared by two coaxial joints, connecting them structurally. Despite keeping the possibility to receive a traverse 19, it can also be the core itself to act directly as a connecting traverse between two joints, thanks to a suitable extension. This second possibility will be used particularly if the two joints are installed at the same time, whilst the first option will clearly be preferred in case of a joint added after a pre-existing joint.

[0028] Now, with reference to the figures from 5 to 12, the advantageous characteristics of the above described joint according to the invention will be fully shown with particular reference to the construction of a structural system with frames arranged according to an extensive texture, fully satisfying the requirements mentioned in the introductory part.

[0029] Figure 5 represents a texture established in advance according to what is requested, depending on the structural configuration to be reconstituted, in this case a simple wall. The texture, basically a double net of generically rectangular meshes, one for each face of the wall, interconnected in correspondence to the vertices, is represented with dashed lines and indicated at R.

[0030] An extensive framework can therefore be developed, following the texture R, by repetition of single three-dimensional frames, wherein the beams, now indicated at T, and the tubular traverses 19 are mutually connected by nodal joints according to the invention. Therefore, this single frame is a sort of minimum unit or module by repetition of which the structure can increase itself. In fact, the figure represents a module adjacent to a corner of the wall. In addition to the beams T, the module comprises four joints for each face of the wall, respectively joined by traverses 19, all according to a configuration which, in the example, is basically parallelepiped with a trapezium base, in which the beams T define the faces of the wall, and the traverses 19 are arranged in the direction of the thickness.

[0031] The joints of the module in figure 5 basically correspond to the one in figures 3 and 4. Figure 6 represents in greater detail two joints mutually joined by a tubular traverse 19. However, in this case, according to an embodiment already envisaged, it is the traverse itself which defines the core of the joints, and the semi-elements 4, which compose the collars 2 of the same joints, are directly locked onto the traverse.

[0032] The previously mentioned various elements of

nuts and bolts are also partially represented in the same figure 6, amongst which, in particular, bolts 20 for fastening arms 3, pieces 11 and wings 21, and bolts 22 for the mutual connection of the two semi-elements 4 of the collars 2, now with interposed shaped spacers 13. Screws 23 are also visible, which prevent the reciprocal sliding between the same semi-elements 4 and the traverse 19, thanks to the holes 6 this time formed directly in the traverse.

[0033] The depth of the collars 2 and the connections with the screw elements 20 and 22 show that they can transmit flexural stresses to the traverse, and so in the various planes defined by the same traverse 19 with respective beams T. Therefore, further mutual rigid connections are developed between the various elements of the texture, the whole assembly being generally equivalent to a three-dimensional frame.

[0034] With simple constructive variations, the joint according to the invention may suit any type of angle between the beams. Figure 7 represents joints in a configuration similar to the one in figure 6, wherein it is possible to follow a corner edge such as the one determined by the texture in figure 5, thanks to a suitable shaping of the collars 2 and wings 21, and if necessary - and as represented here - of the ends of the tubular traverses 19.

[0035] The adaptability of the joint to the different angle between the beams and/or the traverses appears even more clearly if reference is made to figure 11, wherein the structure reconstitutes a portion of a circular vault with a given thickness, using joints that are referable to those previously represented in figure 7. It can be appreciated that in this case the section of the traverses 19 may not be constant, in other words it may taper moving from the outside towards the inside of the vault. Moreover, the joints can take on different configurations from one side to the other, in response to a variation of construction details, for example if rectilinear or curved beams are used.

[0036] By suitably adapting the opening angles of the various arms 3, regulating the shape of the collars on the terminals of the traverse, and again adjusting the angle of incidence of the wings 21 in relation to the central axis of the collars (on an axial plane and on a diametric plane), it is nonetheless possible to obtain corner edges with the most varied angles.

[0037] It is clear from the above that the framework according to the invention is particularly suitable for extensively following the conformation of practically generic masonry structures, and therefore for being used in association with them, not only in new buildings, but also in pre-existing structures.

[0038] In fact, with reference to figure 8, if a masonry wall P has to be consolidated, a particularly simple procedure permits to associate to the same wall P beams T arranged on the two faces of the wall according to a predetermined texture (possibly housed in grooves formed in the wall to this purpose), with the traverses 19

inserted in through holes F formed between the faces to join the beams extending on the surface. The result is immediately comprehensible from the same figure 9, in which the surface beams were then also hidden by a cover L.

[0039] This assembly mounting steps are assisted by the characteristics of the system according to the invention, in that the framework can easily adapt to wall structures of any shape and development, and with its reduced size, both with regard to the section of the beams and the dimensions of the nodal joints, it can be inserted in the wall without compromising its continuity and intrinsic stability. Moreover, the joints can also be assembled by working from the outside of the wall, with techniques that are compatible with the limitations determined by the presence of the wall itself.

[0040] As can be seen from the schematic example in figure 9, the succession of the framework modules, which are all the same or even different from one another, will enable the obtainment of extensive textures R having the most varied configurations, and consequently reproducing the development and the structure of the walls of a building E, whatever their thickness, planimetric or altimetric development. It is also clear that any textures used in basically similar ways provide for a dimensional consistency of the various components of the structure, including joints, which consequently can be generally and essentially repeated. Figure 10 also shows how the framework, along with the masonry wall, can easily relate to the ground or to other underpinning structures S, being concealed in them or leaning against them. The presence of the frame does not pose any particular obstacle to the realisation of these underpinning structures.

[0041] From the examples of level or angled walls discussed so far, basically making use of parallelepiped modules, or from the example of a vault structure, such as the one defined by the modules of the framework in figure 11, basically with a truncated pyramid shape (and nonetheless assembled on the basis of a joint analogous to the previous examples), it is clear that the framework can follow and reconstruct different configurations, which are defined by - and expand by way of - successive three-dimensional modules.

[0042] Even more generally speaking, the structure can be developed according to a surface that is essentially lacking in thickness (in other words without actual traverses, as previously shown with the examples in figures 3 and 4), with or without auxiliary panels, in all cases the shape of the structure itself being nonetheless the result of a succession of generic frame modules. Moreover, there is the possibility for some parts of the structure to shift from a bi-dimensional configuration to a three-dimensional one (by adjusting the length of the traverses and/or doubling the structure), for example in areas where the greatest stresses are generated, increasing the thickness of the structure locally and at will. In practice, part of the structure will be set up with a bi-

dimensional development via joints configured as in figure 3, and part three-dimensionally with a configuration such as the one in figure 6, all connected by beams and joints of a suitable construction.

[0043] On the other hand, the freedom and versatility with which it is possible to configure the structure according to the invention is practically total, as can be seen from figure 12, which shows how the structure, and in particular the joint, can easily copy a net-like texture R, typical of massive metal skeleton covers, via pyramidal modules with a square base, using joints configured as in the first example, that is the one in figures 1 and 2.

[0044] Now, with reference to the figures from 13 to 16, the nodal joint according to the invention makes it possible to extend and reconfigure the structure at a later time and always with maximum flexibility, both in general terms and in case of association with masonry walls. Besides the previously mentioned option of arranging rod members along a diagonal directions by using elements such as the brackets 14 or the like, it is noticeable from figure 13 that a framework previously formed can be extended in the direction of the axes of joints, by coaxially engaging in the traverses 19 (or cores 1) that are already installed, additional traverses 19 with a suitable section in relation with the available cavity. In this way - basically - the extension of the first traverse is prolonged, and a support is provided for mounting one (as in the example) or more supplementary levels of beams T.

[0045] Besides locally following subsequent thickenings of a wall, this last possibility can clearly be exploited both for enlargements and for strengthening, of a permanent or temporary nature. In any case, the subsequent intervention leaves the existing structure unaltered, and can be carried out without any kind of dismantling or demolition.

[0046] Other similar examples are shown in the figures from 14 to 16. In particular, figures 14 and 15 represent (in an exploded assembly and in the final configuration of installation, respectively) a temporary consolidation realised according to a modification to the original configuration of the skeleton. A tubular traverse 19 engages with, and becomes the connection between, three cores 1 of respective joints. These joints are thus arranged in close axial succession, and the various levels of beams T converging to the joints, overlap each other forming a structure which is tripled if compared with a hypothetical, original single structure (in the same way it is possible to increase the load bearing capacity of an existing skeleton). This original structure can also be dismantled without the whole construction losing its effectiveness, and it can subsequently be restored, for example with different texture or beams.

[0047] The doubled configuration in figure 16 is again basically similar to those just seen. However, it is possible to note how the pieces 11 are made available as pairs of terminal elements projecting axially from an actual beam T' with a quadrilateral section. Moreover, it is

possible to see that the joint allows enlargements, in other words extensions of the structure, also on the same planes over which it is already extended.

[0048] With reference then to figures 17 and 18, these illustrate other possibilities of development or useful employment of the framework, again made possible by the axially hollow shape of the core 1 and/or by the tubular traverse 19 of the joint. In figure 17, again on the basis of a joint similar to the one in the previous figures, in a structure associated with a masonry wall portion, it can be observed that the core 1 is equipped with a plug 24, that can be locked inside it by a fastening system similar to the screws 23 mentioned above (not represented here), defining seats 25 for inserting bars 26 that can be used as a support for setting up temporary scaffolding or as reference for auxiliary guide systems, e.g. for forming grooves or passages on the wall structure with which the framework can be coupled.

[0049] Figure 18 shows that the core of the joint can directly be made up in a composite form, if necessary with tubular portions, provided they ensure the presence of terminal cavities, so that there can be carried out the engagement techniques according to what is described above. It has to be stressed, in particular, that a generic traverse can be made up by means of two transversal elements 28, here with a tubular shape and triangular section, with axes out of alignment in relation to the joint.

[0050] The two aforesaid transversal elements 28 comprise terminal tails 27, whose axes are instead parallel to that of the joint. In this case, two more tails 27 are added in the joint itself so as to suitably fill the engagement section to be locked by the collar, and eventually a single tubular end portion is obtained from which two (or more) transversal elements 28 irradiate, obliquely in relation to the axis of the joint, with a variable inclination depending on the need (always with a view to adapting the framework to diverse structural needs).

[0051] From the same figure 18 and from the previous figure 17 it will be apparent that the cavity of the core 1 can receive plug elements with different configurations, for example in the shape of a cross (or other similar ones) also intended solely for purposes of stiffening. These integrations and reinforcements, even if limited to the core, and consequently to the interior of the joint, are possible at any time, fully reflecting the aims of modularity and modifiability of the joint itself and the structure. In a more general sense, but in the same way, it is possible to insert and connect projecting parts and beams of other structures or use the cavity for the passage of still different elements.

[0052] Thus, although the tubular shape is considered preferable for obvious reasons of lightness and productive economy, both the cores 1 and the traverses 19 can generally also have other structures, in other words be created integrally with plugs of various configurations and of a different nature, or be obtained in different ways and with different materials. For example, the traverses can have central regions similar to the reinforcement

frames for concrete.

[0053] From all of the above described examples, it is clear that the invention fully attains the stated objects, by providing a system which, with a relatively limited number of standardizable components, makes it possible to build load bearing frameworks, composing them module after module, the frameworks being capable of working both autonomously and in association with wall structures, nonetheless preserving the individual specific features of modifiability, with a versatility of use and an adaptability to the specific structural needs without comparisons in the prior art.

[0054] Even when the installation of the framework has been completed, also in the presence of masonry parts, the easy accessibility to the beams and the connections of the joints is guaranteed, since they remain nonetheless both arranged near the outside; that is, it is possible to work on the components, without operations of disassembly, with the object of achieving further expansions, consolidations and modifications of the framework, which can also be carried out without any substantial interruptions in the load bearing function, thanks of the previously described techniques for strengthening the structure.

[0055] The encumber and weight of the nodal elements and the beams is negligible and so, as previously mentioned, they do not hinder the execution of works simultaneous or subsequent to their first installation; also thanks to the above indicated operative possibilities and exploitations, it is therefore also easy to work in restrained spaces, and plan restoration in different ways, for example with extensive and progressive interventions or in areas to be rejoined successively, as well as with basically reversible methods.

[0056] Although the feasibility with relatively economic ordinary working, such as workshop cold working on commercial metal materials represents an advantageous possibility offered by the invention, it is clear that there is no limitation regarding the material and working techniques that can be used.

[0057] A multiplicity of variations, dictated by the flexibility and versatility guaranteed by the joint according to the invention can be applied beyond what is proposed in the previously described examples. For further exemplification, with reference to the figures 19 and 20, it is to be noted how, as in any case already stated, it is possible to satisfy the need to connect generically oriented beams (in this case coplanarly arranged) by opportunely shaping the cross section of the core 1, which can for example take on a generically irregular polygon configuration, such as those of the aforesaid figures.

[0058] In response to this, the shape of the collar 2, or the shape of the relative semi-element components 4 will undergo modifications, and with this the number and angle of the wings 21 - in this case six wings are used - and lastly the shape and angular opening of the arms 3. With regard to this last point, it is possible to see how the arms 3 that are sharper (in other words with a

more acute angle), have a composite structure rather than tubular, in particular formed by two parallel bands 30 joined by a series of transversal blocks 31. The end segments 3a are inserted into pieces 11 that are now tubular, but equivalent cavities for engagement with the end segments 3a can generally be provided by the beams with other structural devices.

[0059] Brackets 14 with various conformations can be seen, with holes 15 for connecting auxiliary diagonal bars, or for inserting pins 29 fixed with screws 33 or other similar ways. The pins 29, having a suitable thickness for providing an abutment to the arms 3, can assist in transmitting the rotation from the collars 2 to the core 1 and *vice versa*.

[0060] Finally, it can be deduced that no orthogonality or specific regularity is needed between the axis of the core and those of the beams, and nor are there any particular limits to their number. Furthermore, the great modularity and multiplicity of functions that the joint exhibits permit the very modifiability of the whole structure.

[0061] If a transmission of flexural stress is not required between two or more adjacent beams, the relevant arms 3 can be omitted, thus exploiting the fact that the joint is composed of different elements. In this regard, if *vice versa* resort is made to hollow end segments 3a of one same arm, and to open pieces 11 are, it will also be easy to insert one diagonal connection thereof afterwards, and consequently to strengthen the single arm 3.

[0062] By means of the spacers 13 it is possible to adapt wings and collars to the distance between the pieces 11 of a beam. The joint restores the continuity between the coplanar beams which converge there, so with appropriate texture and appropriate traverse sections, even when the structure is extended in the three dimensions, it can basically realise an overall grid of beams. The same structures can be realised and modified according to the most various needs, also and above all thanks to the adaptability of the joint according to the present invention.

[0063] The various proposed examples of modification, expansion or other, which refer to frame-like structures, can likewise be repeated in latticework, or even independently from a predetermined texture. The various constructive solutions can basically be combined with each other making the joint suitable at best for any particular circumstance of use. Finally, apart from being applied to the structures that have been referred to, with frames or lattices, the joint preserves its own characteristics and functionalities even if used in structures of another type, even not of a composite kind.

[0064] Other variations and/or modifications can be brought to the modular system and joint for the construction of extensive frameworks according to the present invention, without for this reason departing from the scope of the invention itself, as defined by the appended claims.

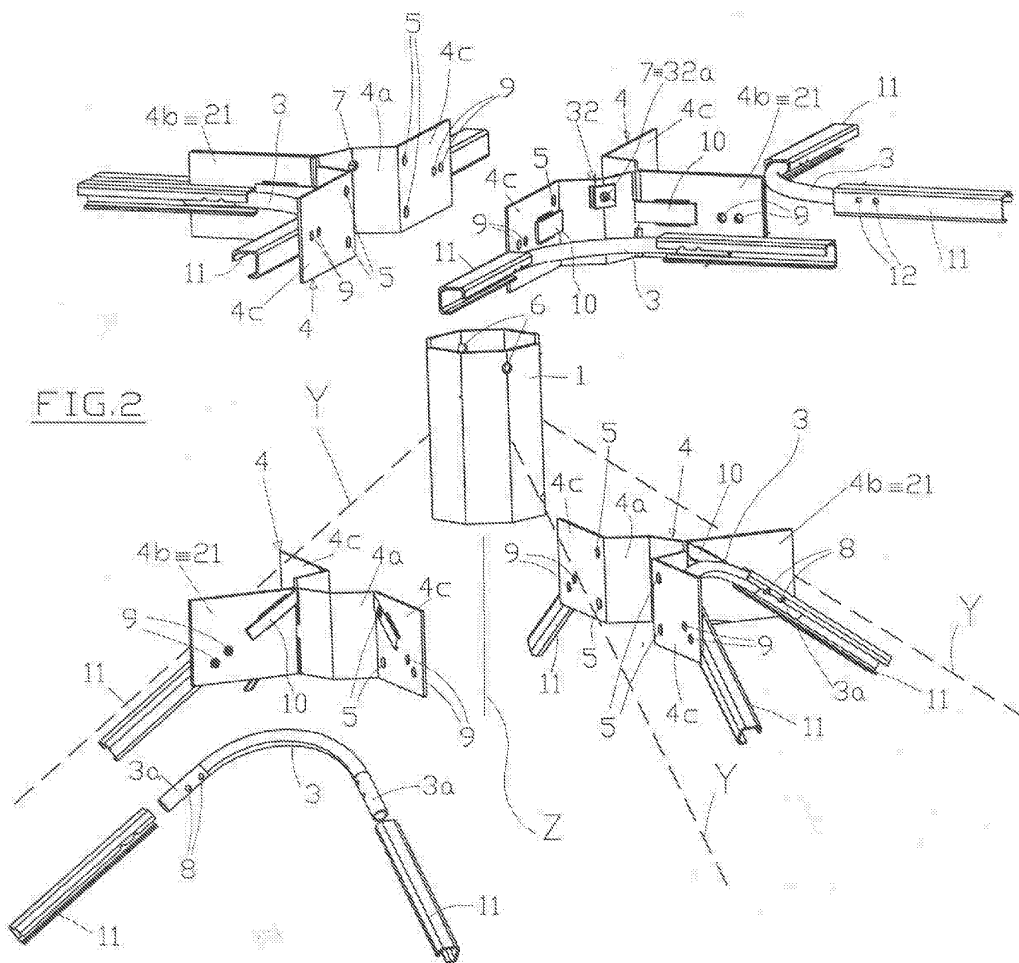
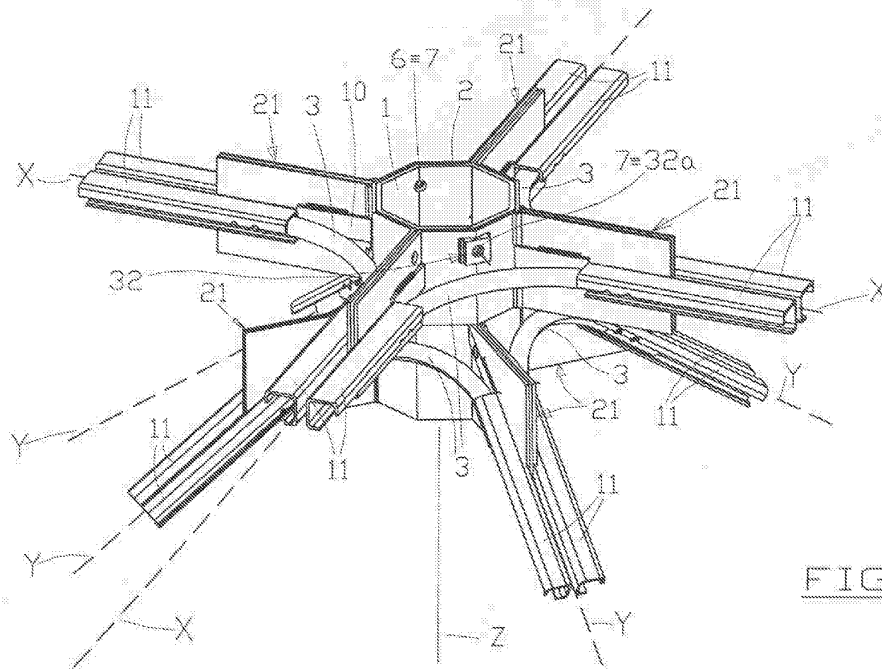
Claims

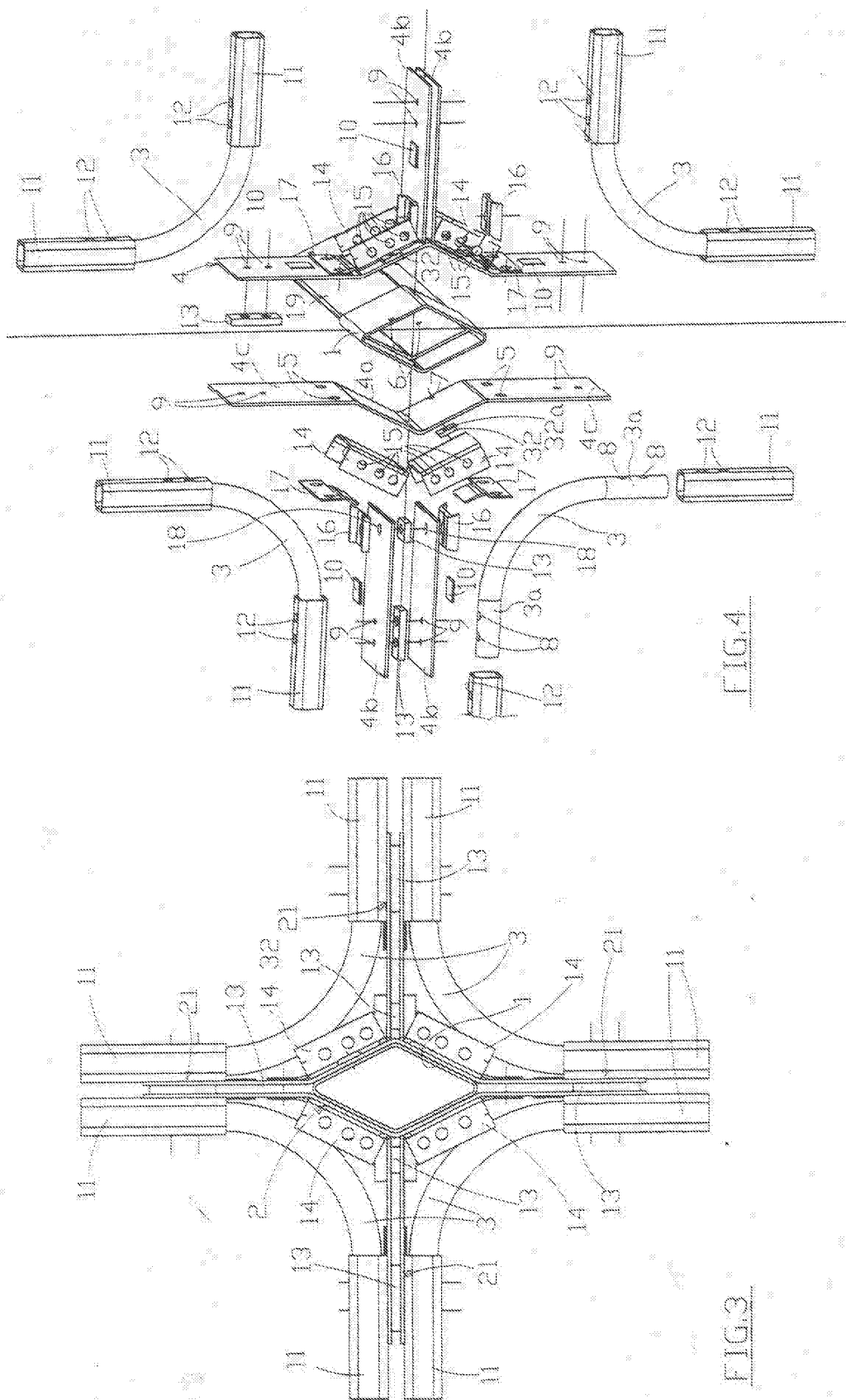
1. A system for the construction of a extensive framework joining a plurality of linear elements (T) by means of connecting joints of the ends of the linear elements (T), **characterised in that** at least the following components are used: shaped pieces (11) associated or to be associated to said linear elements (T) so as to project longitudinally from the ends of the same; in order to form each of said joints, a tubular core (1) with a polygonal section defining a completely free internal cavity and longitudinal corner edges, to be arranged so that the axes of the linear elements (T) converging in the joint substantially meet respective corner edges and the longitudinal axis (X) of said core (1), one or more collars (2), which take the polygonal form of said core (1), and thus with a corresponding number of longitudinal corner edges, to be tightened around the core and provided with substantially plate-shaped wings (21) projecting radially from respective corner edges, one for each of the linear elements (T) converging in the joint, and substantially C-shaped arms (3) to be arranged on the outside of said one or more collars, each between two consecutive wings (21), with the concavity facing the outside, end segments (3a) of said arms being placed against respective wings (21) and engaged with said pieces (11) of said linear elements (T) and with said wings (21).
2. The system according to claim 1, further comprising tubular traverses (19) with a polygonal section corresponding to that of said core (1), for coaxially joining a joint to one or more further joints, each of said traverses (19) being engaged coaxially in the tubular cores (1) of the joints or replacing said cores (1) so as to join, and be shared by, said joints.
3. The system according to claim 1 or 2, wherein cavities are defined by the ends of said pieces (11) for coaxially engaging the end segments (3a) of said arms (3).
4. The system according to any of the previous claims, wherein said collar (2) is composed of two semi-collar elements (4), which are mutually connected with screw means (20), so as to lock around said core (1).
5. The system according to claim 4, wherein said semi-collar elements (4) each comprise a central gut-like portion (4a), congruent in relation to the external surface of the tubular core (1) on which they are to be tightened, and plates (4b, 4c) protruding integrally in a substantially radial manner from said central portion (4a) in order to define said wings (21).

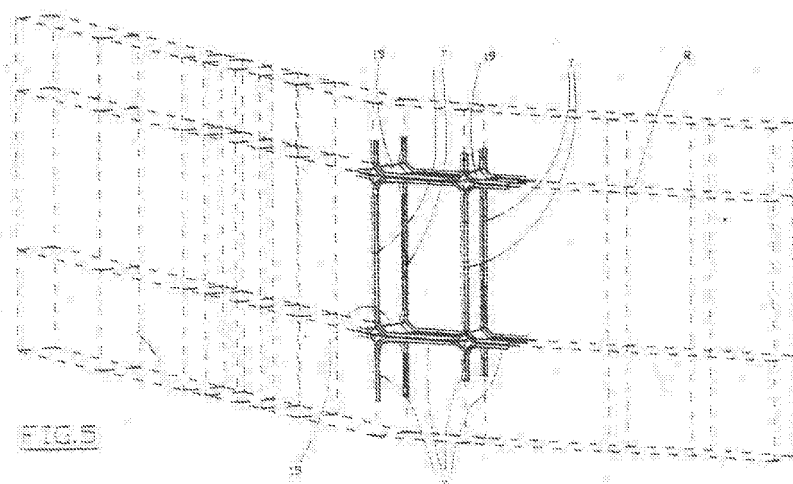
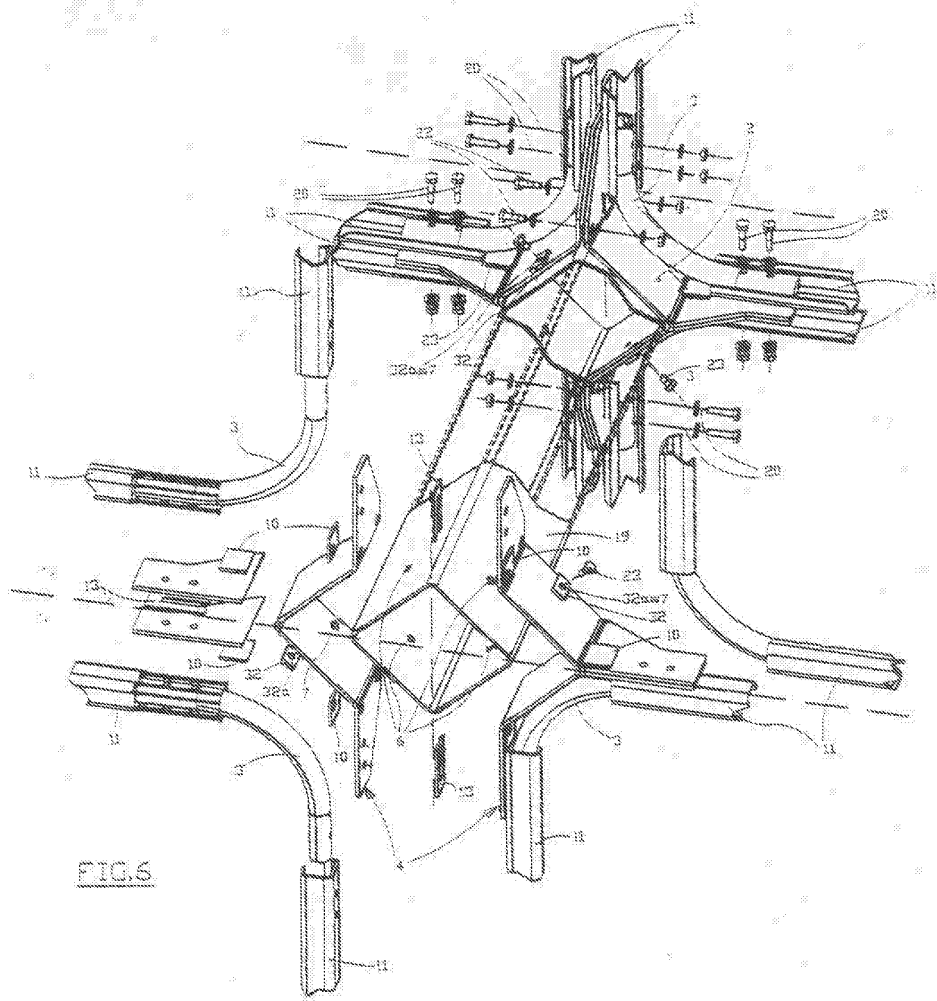
6. The system according to any of the previous claims, wherein said collar (2) is fastened onto said core (1) with screw means (23), radially inserted in holes (7, 6) formed to this purpose respectively in said collar (2) and in said core (1) and/or said traverse (19), external abutment slabs (32) for said screw means (23) also being arranged in correspondence with said holes (7), in order to avoid the protruding of said screw means (23) inside the internal cavity of said core (1) and/or of said traverse (19). 5
7. The system according to any of the previous claims, wherein screw elements (20) are used to secure said arms (3) to the assembly of said core (1) and said collar (2), and at the same time to said pieces (11) of said linear elements, said screw elements (20) being inserted through holes (8, 9, 12) formed in said arms (3), in said wings (21) of said collar (2), and in said pieces (11). 10
8. The system according to any of the previous claims, wherein stop plaques (10) are arranged on said wings (21) for stopping the ends of said pieces (11). 15
9. The system according to any of the previous claims, wherein said pieces (11) are integrally defined by said linear elements (T). 20
10. The system according to any of the previous claims, wherein said wings (21) are shaped and angled in relation to said collar (2) depending on the angle of incidence of said linear elements (T) on the joint. 25
11. The system according to any of the previous claims, further comprising U shaped brackets (14), for connection on the outside of said collar (2) in the space between two consecutive wings (21), holes (15) being formed in said brackets (14) for fixing additional rod members to the joint. 30
12. The system according to claim 11, wherein said holes (15) of said brackets accommodate abutment pins (29) for the abutment of said arms (3). 35
13. The system according to any of the claims from 2 to 12, further comprising plugs (24) to be locked in respective cores (1) or tubular traverses (19), said plugs defining seats (25) for inserting bars (26) or auxiliary supports. 40
14. The system according to any of the previous claims, wherein said traverses (19) comprise elements (28), whose axes are angled in relation to the axis of the joint, with terminal tails (27) to be inserted and locked in respective cores (1) or collars (2). 45
15. The system according to any of the claims from 2 to 14, wherein said extensive framework formed by said linear elements (T) and said joints is developed following a texture (R) that spreads over two opposite faces of a wall structure, said traverses (19) being arranged in the direction of the thickness of the wall. 50
16. The system according to any of the previous claims, wherein said arms (3) are formed by tubular structures with a circular or elliptic section. 55
17. Connecting joint for connecting the ends of linear elements (T), said linear elements (T) comprising shaped pieces (11) projecting longitudinally from said ends, **characterised in that** it comprises: a tubular core (1) with a polygonal section defining a completely free internal cavity and longitudinal corner edges, to be arranged so that the axes of the linear elements (T) converging in the joint substantially meet respective corner edges and the longitudinal axis (X) of said core (1), one or more collars (2), which take the polygonal form of said core (1), and thus with a corresponding number of longitudinal corner edges, to be tightened around the core and provided with substantially plate-shaped wings (21) projecting radially from respective corner edges, one for each of the linear elements (T) converging in the joint, and substantially C-shaped arms (3) to be arranged on the outside of said one or more collars, each between two consecutive wings (21), with the concavity facing the outside, end segments (3a) of said arms being placed against respective wings (21) and engaged with said pieces (11) of said linear elements (T) and with said wings (21).
18. The joint according to claim 17, wherein a tubular traverse (19) with a polygonal section corresponding to that of said core (1) replaces said core (1) or is engaged coaxially therewith, for coaxially joining a joint to one or more other joints.
19. The joint according to claim 17 or 18, wherein cavities are defined by the ends of said pieces (11) for coaxially engaging the end segments (3a) of said arms (3).
20. The joint according to any of the claims from 17 to 19, wherein said collar (2) is composed of two semi-collar elements (4), which are mutually connected with screw means (20), so as to lock around said core (1).
21. The joint according to claim 20, wherein said semi-collar elements (4) each comprise a central gut-like portion (4a), congruent in relation to the external surface of the tubular core (1) on which they are to be tightened, and plates (4b, 4c) protruding integrally in a substantially radial manner from said central portion (4a) in order to define said wings (21).

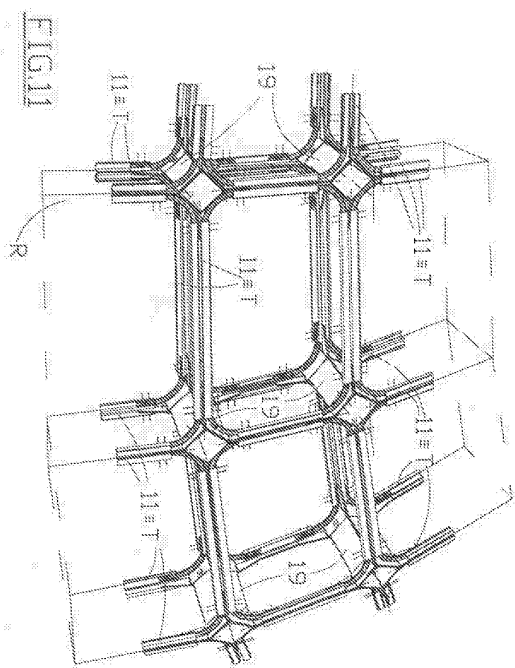
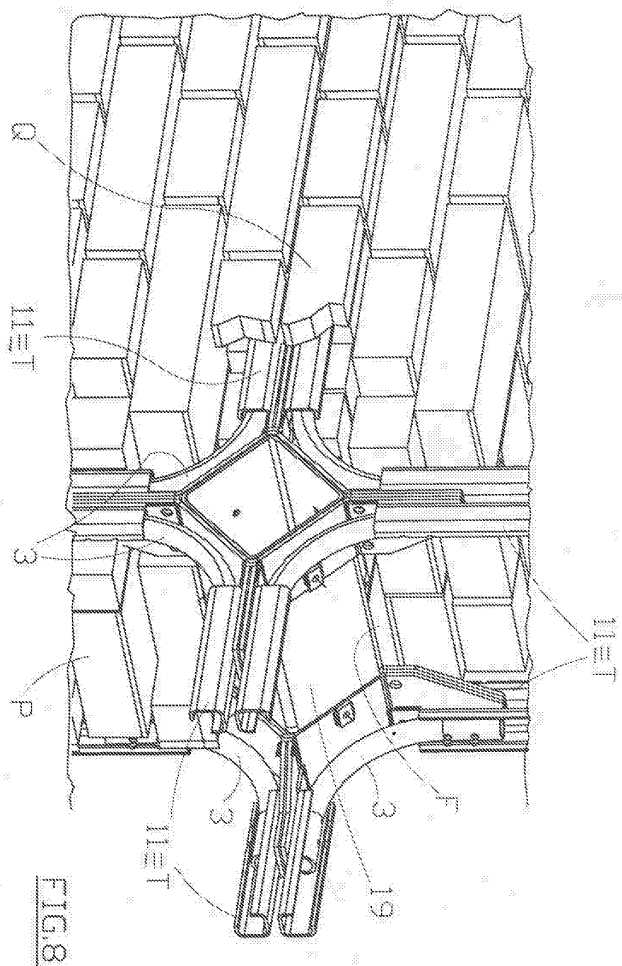
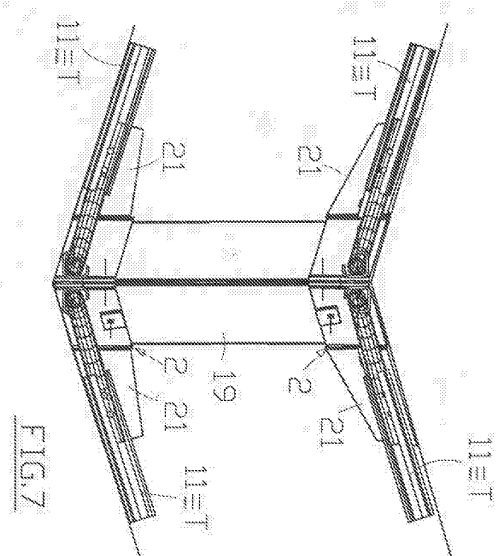
22. The joint according to any of the claims from 17 to 21, wherein said collar (2) is fastened onto said core (1) with screw means (23), radially inserted in holes (7, 6) formed to this purpose respectively in said collar (2) and in said core (1) and/or said traverse (19), external abutment slabs (32) for said screw means (23) also being arranged in correspondence with said holes (7), in order to avoid the protruding of said screw means (23) inside the internal cavity of said core (1) and/or of said traverse (19). 5 10
23. The joint according to any of the claims from 17 to 22, wherein screw elements (20) are used to secure said arms (3) to the assembly of said core (1) and said collar (2), and at the same time to said pieces (11) of said linear elements, said screw elements (20) being inserted through holes (8, 9, 12) formed in said arms (3), in said wings (21) of said collar (2), and in said pieces (11). 15 20
24. The joint according to any of the claims from 17 to 23, wherein stop plaques (10) are arranged on said wings (21) for stopping the ends of said pieces (11).
25. The joint according to any of the claims from 17 to 24, wherein said wings (21) are shaped and angled in relation to said collar (2) depending on the angle of incidence of said linear elements (T) on the joint. 25
26. The joint according to any of the claims from 17 to 25, further comprising U shaped brackets (14), for connection on the outside of said collar (2) in the space between two consecutive wings (21), holes (15) being formed in said brackets (14) for fixing additional rod members to the joint. 30 35
27. The joint according to claim 26, wherein said holes (15) of said brackets (14) accommodate abutment pins (29) for the abutment of said arms (3). 40
28. The joint according to any of the claims from 18 to 27, also comprising a plug (24) locked inside said core (1) and/or tubular traverse (19) and defining seats (25) for inserting bars (26) or auxiliary supports. 45
29. The joint according to any of the claims from 17 to 28, wherein said arms (3) are formed by tubular structures with a circular or elliptic section. 50

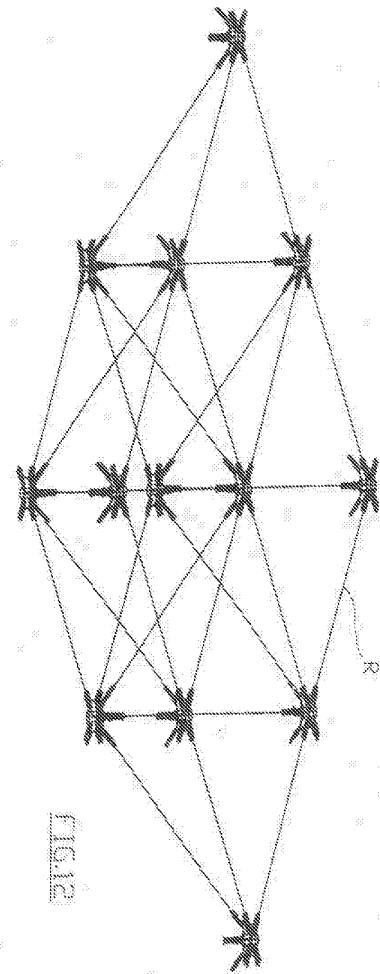
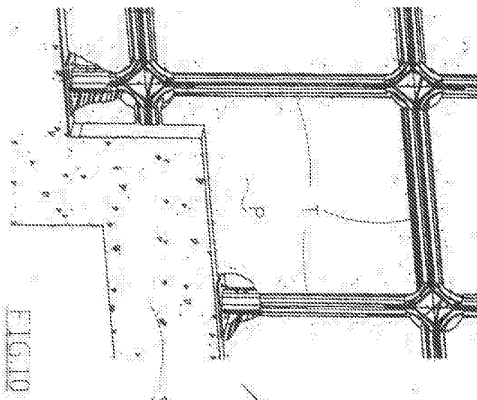
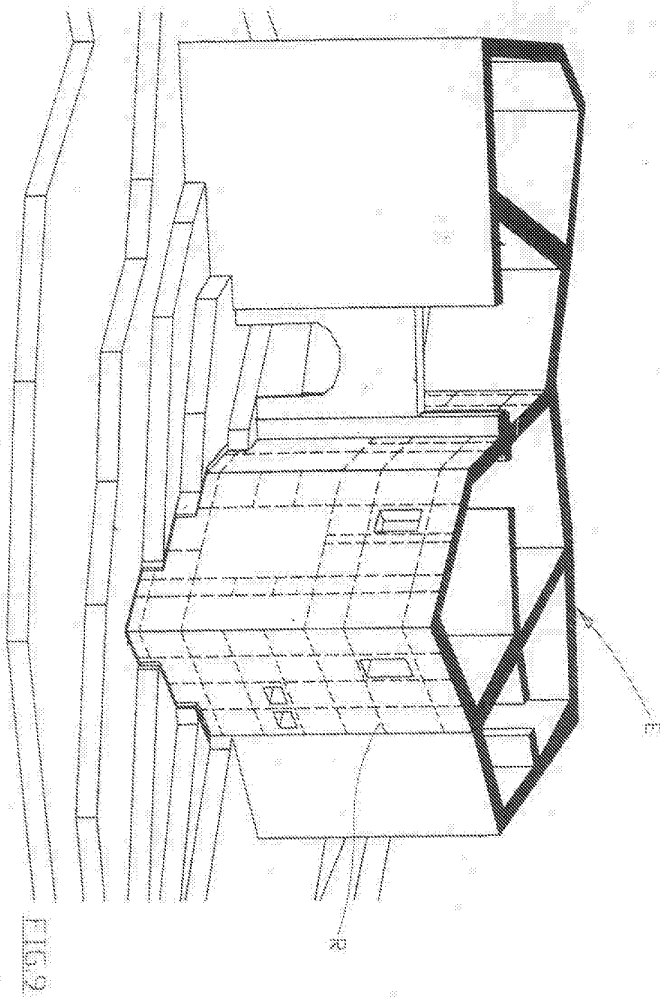
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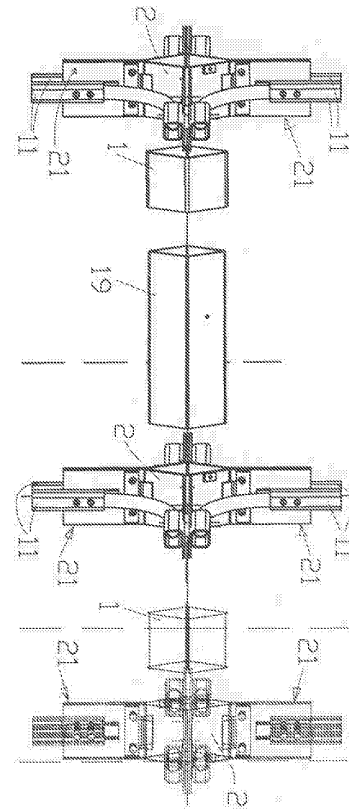


FIG. 14

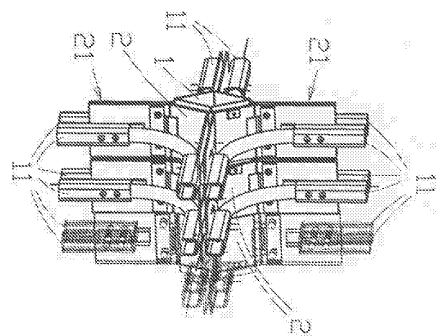


FIG. 15

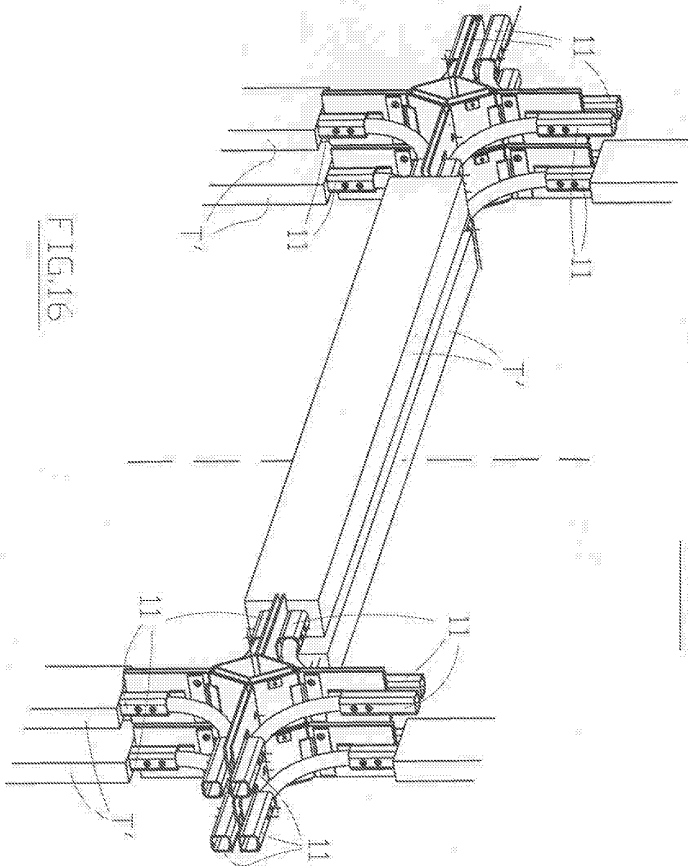


FIG. 16

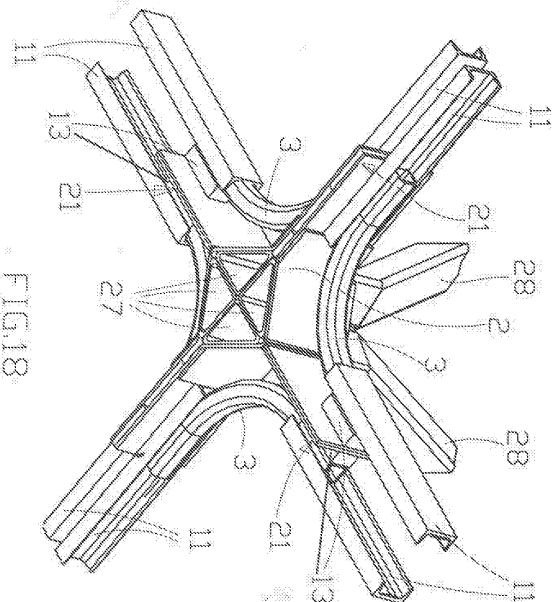
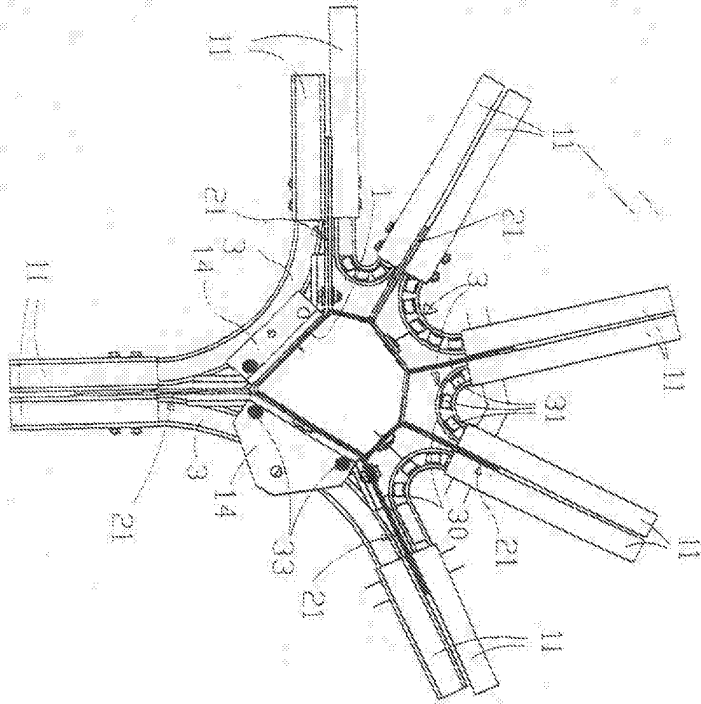
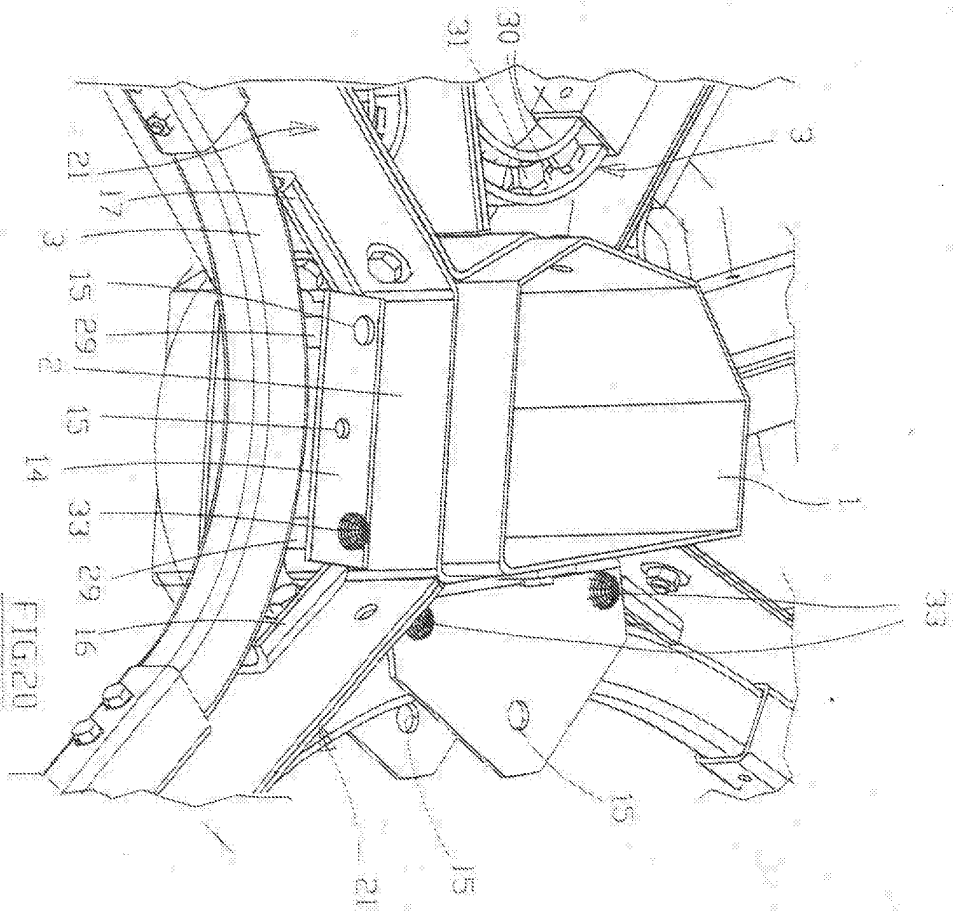


FIG. 18



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12345678910111213141516171819202122232425262728293031323334353637383940414243444546474849505152535455565758596061626364656667686970717273747576777879808182838485868788899091929394959697989910010110210310410510610710810911011111211311411511611711811912012112212312412512612712812913013113213313413513613713813914014114214314414514614714814915015115215315415515615715815916016116216316416516616716816917017117217317417517617717817918018118218318418518618718818919019119219319419519619719819920020120220320420520620720820921021121221321421521621721821922022122222322422522622722822923023123223323423523623723823924024124224324424524624724824925025125225325425525625725825926026126226326426526626726826927027127227327427527627727827928028128228328428528628728828929029129229329429529629729829930030130230330430530630730830931031131231331431531631731831932032132232332432532632732832933033133233333433533633733833934034134234334434534634734834935035135235335435535635735835936036136236336436536636736836937037137237337437537637737837938038138238338438538638738838939039139239339439539639739839940040140240340440540640740840941041141241341441541641741841942042142242342442542642742842943043143243343443543643743843944044144244344444544644744844945045145245345445545645745845946046146246346446546646746846947047147247347447547647747847948048148248348448548648748848949049149249349449549649749849950050150250350450550650750850951051151251351451551651751851952052152252352452552652752852953053153253353453553653753853954054154254354454554654754854955055155255355455555655755855956056156256356456556656756856957057157257357457557657757857958058158258358458558658758858959059159259359459559659759859960060160260360460560660760860961061161261361461561661761861962062162262362462562662762862963063163263363463563663763863964064164264364464564664764864965065165265365465565665765865966066166266366466566666766866967067167267367467567667767867968068168268368468568668768868969069169269369469569669769869970070170270370470570670770870971071171271371471571671771871972072172272372472572672772872973073173273373473573673773873974074174274374474574674774874975075175275375475575675775875976076176276376476576676776876977077177277377477577677777877978078178278378478578678778878979079179279379479579679779879980080180280380480580680780880981081181281381481581681781881982082182282382482582682782882983083183283383483583683783883984084184284384484584684784884985085185285385485585685785885986086186286386486586686786886987087187287387487587687787887988088188288388488588688788888989089189289389489589689789889990090190290390490590690790890991091191291391491591691791891992092192292392492592692792892993093193293393493593693793893994094194294394494594694794894995095195295395495595695795895996096196296396496596696796896997097197297397497597697797897998098198298398498598698798898999099199299399499599699799899910001001100210031004100510061007100810091010101110121013101410151016101710181019102010211022102310241025102610271028102910301031103210331034103510361037103810391040104110421043104410451046104710481049105010511052105310541055105610571058105910601061106210631064106510661067106810691070107110721073107410751076107710781079108010811082108310841085108610871088108910901091109210931094109510961097109810991100110111021103110411051106110711081109111011111112111311141115111611171118111911201121112211231124112511261127112811291130113111321133113411351136113711381139114011411142114311441145114611471148114911501151115211531154115511561157115811591160116111621163116411651166116711681169117011711172117311741175117611771178117911801181118211831184118511861187118811891190119111921193119411951196119711981199120012011202120312041205120612071208120912101211121212131214121512161217121812191220122112221223122412251226122712281229123012311232123312341235123612371238123912401241124212431244124512461247124812491250125112521253125412551256125712581259126012611262126312641265126612671268126912701271127212731274127512761277127812791280128112821283128412851286128712881289129012911292129312941295129612971298129913001

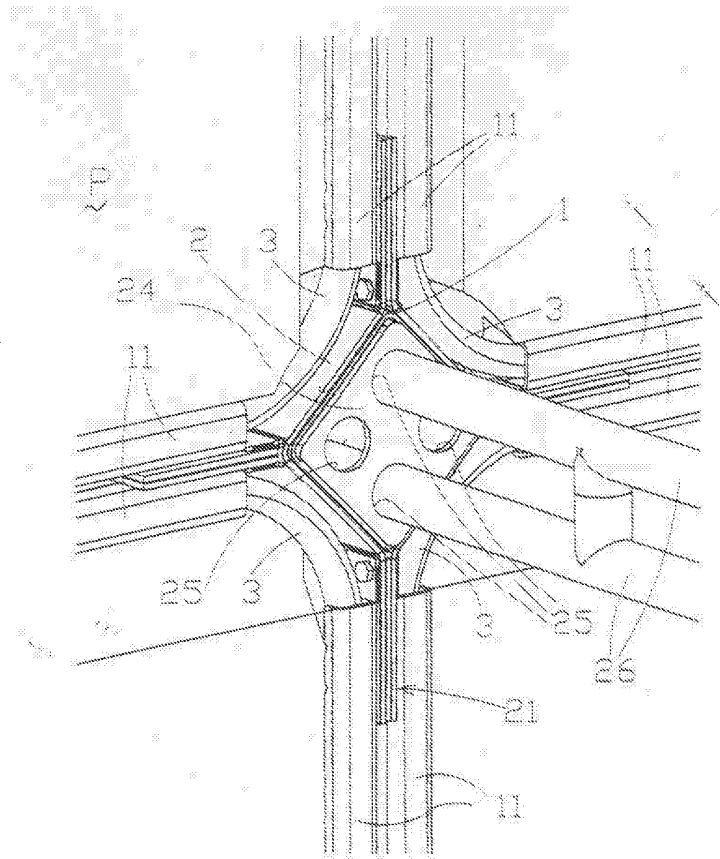


FIG. 17

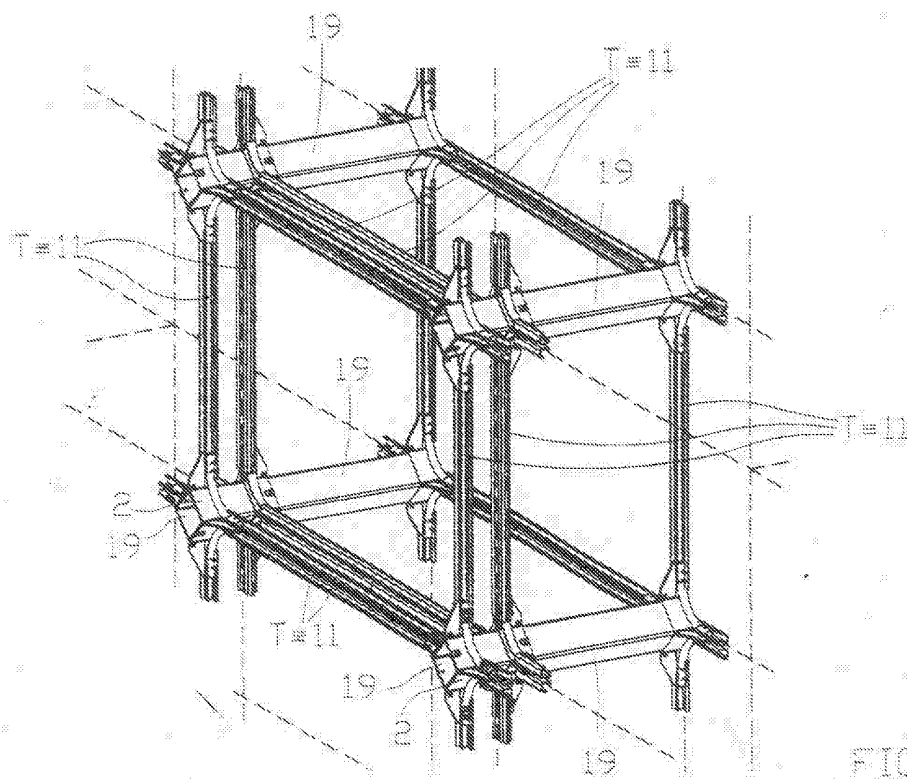


FIG. 13



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 10 4955

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 3 688 461 A (EBERHARD G. RENSCH) 5 September 1972 (1972-09-05) * the whole document *	1,17	E04B1/19
A	GB 832 306 A (F. FENTIMAN & SONS LIMITED) 6 April 1960 (1960-04-06) * the whole document *	1,17	
A	US 4 671 693 A (ROSSMAN ET AL) 9 June 1987 (1987-06-09) * the whole document *	1,17	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			E04B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		16 September 2005	Fordham, A
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)

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ON EUROPEAN PATENT APPLICATION NO.**

EP 05 10 4955

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16-09-2005

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3688461	A	05-09-1972	AT 328680 B 12-04-1976
			BE 750283 A1 16-10-1970
			CA 945728 A1 23-04-1974
			CH 514041 A 15-10-1971
			DE 1925262 A1 19-11-1970
			DE 1958878 A1 03-06-1971
			DE 2009252 A1 02-09-1971
			FR 2042712 A5 12-02-1971
			FR 2072286 A5 24-09-1971
			GB 1310595 A 21-03-1973
			IE 34169 B1 19-02-1975
			JP 52019004 B 25-05-1977
			NL 7007076 A 19-11-1970
GB 832306	A	06-04-1960	NONE
US 4671693	A	09-06-1987	NONE