



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 1 522 639 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.04.2005 Bulletin 2005/15

(51) Int Cl.7: **E04B 1/19**

(21) Application number: **03380223.2**

(22) Date of filing: **07.10.2003**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PT RO SE SI SK TR**
Designated Extension States:
AL LT LV MK

(72) Inventors:
• **Hevia Corte, Jose Antonio**
33394 Gijon (Asturias) (ES)
• **Fernandez Rico, Miguel**
33209 Gijon (Asturias) (ES)

(71) Applicant: **Ideas en Metal, S.A.**
33211 Tremanes - Gijon (Asturias) (ES)

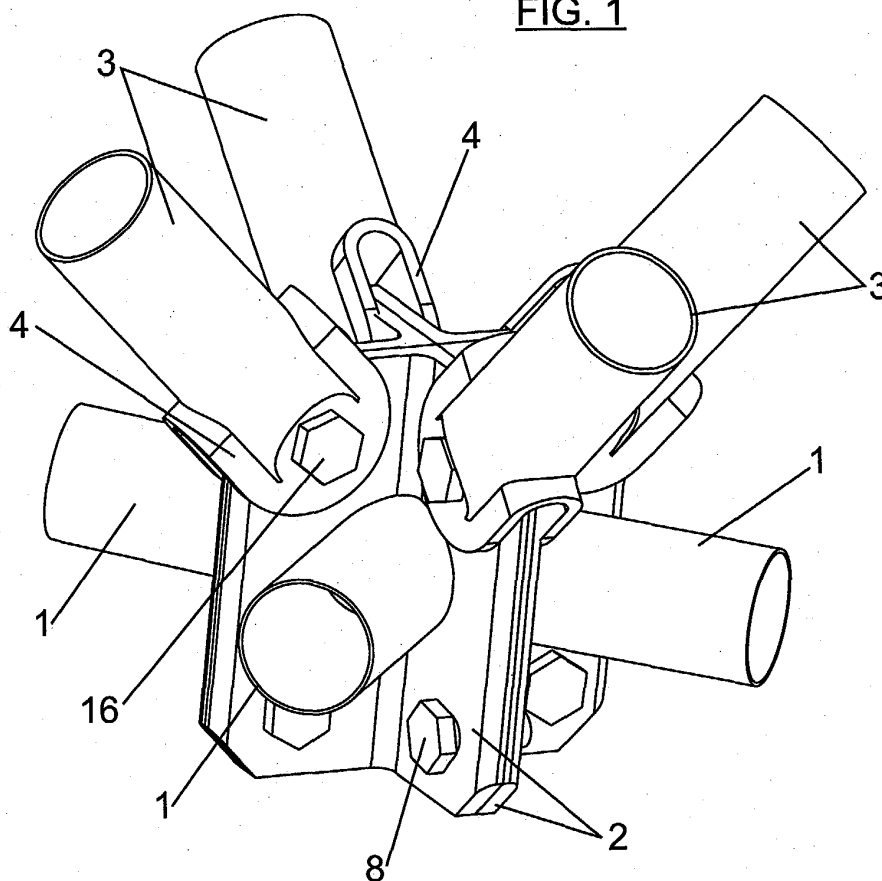
(74) Representative: **Davila Baz, Angel et al**
c/o Clarke, Modet & Co.,
Goya, 11
28001 Madrid (ES)

(54) **Connection system between bars of space frames**

(57) A connection system between bars of space frames, which bars (1-3) concur at points in which the theoretical axes thereof are cut and are provided on their ends with mutual coupling means (2-4) which are fixed

together by means of screws (8-16). The coupling means (2) of a first group of bars (1) constitute a node on which the coupling means (6) of a second group of bars (2) are fixed.

FIG. 1



EP 1 522 639 A1

Description

[0001] The present invention refers to a connection system between bars of space frames, particularly applicable in space frames composed of tubular bars.

[0002] As is known, one of the conventional constructive systems for the support of roofs of buildings and the like is constituted of space frames in mesh or lattice form, which are generally supported by columns.

[0003] For constructing this type of structures, steel tubular bars of different sections are generally used, although solid bars and bars of other materials, such as aluminum, concrete, wood, reinforced plastics, etc., can also be used.

[0004] The use of tubular bars in this type of structures has a better mechanical behavior against pure compression and pulling forces than solid bars. Furthermore, tubular bars are more suitable for achieving a better frame appearance.

[0005] The bars which constitute the frame concur at points in which said bars are connected by means of welding, pins, screws, auxiliary parts, etc.

[0006] The currently used connection systems between bars can be divided into three major groups:

A first group which is composed of the connections based on nodes, in which the nodes are constituted of independent parts, in the shape of hollow or solid spheres, in the shape of polyhedra, etc., to which the ends of the bars concurring at said node are connected. These systems generally use auxiliary, intermediate connecting parts between bars and nodes, being it possible to mention, for example, those known as the Mero system, in which the intermediate part is conically shaped, and the Nodus system, which uses ribbed parts. Auxiliary intermediate parts are dispensed with in other systems and they resort to the modification of the ends of the tubular bars, for example by means of crushing, folding, etc., as occurs in the Triodetic system. Generally, the node-based connection system requires the use of the part constituting the node which, due to its function, acting as a connection element between bars, requires special resistance features. In a second system, the connections are carried out by using continuous chords, as occurs in the Harley, Mai Sky or Catres systems. In this type of connections, eccentricities occasionally occur in the transmission of forces.

A third connection system is the one using premanufactured modules for the connections between bars. The best-known basic modular unit is the quadrangular regular pyramid. Although with this system, onsite assembly operations are reduced, transporting costs increase, and during assembly, it is necessary to handle the generally bulky and heavy modular units. An example of these systems are those known with the names Unibat, Space

Deck and ABBA Dekspace.

[0007] The object of the present invention is to eliminate the drawbacks set forth by means of a connection system which requires no independent parts for the connection between bars, eliminating the risk that eccentricities occur in the transmission of forces, and which provides no drawbacks in the transport and assembly.

[0008] Another object of the invention is to simplify the connection system between bars, such that production and assembly costs with regard to conventional systems can be reduced.

[0009] Therefore, the present invention develops a connection system which, although assimilable to said first group, is different from it in that there are no independent parts of the bars constituting the node. In the system of the invention, the bars are provided on their ends with their own means for connection with the remaining bars concurring at each meeting point, thus eliminating the independent part constituting the node and which is usually the most complicated and expensive part in the different connection systems.

[0010] Thus, the system of the invention implies a considerable innovation in the core and more important part of the great majority of connection systems of bars in space frames, such as the meeting points of the bars, where the connection thereof must be carried out so as to permit the balance of stress and the transmission thereof with sufficient rigidity.

[0011] In summary, the system of the invention has considerable advantages with regard to traditional systems, due both to the production costs ratio and to weight reduction and assembly facility and safety, the system of the invention benefiting from the available new production technologies, such as precise and automatic laser cutting of steel pipes and plates without changing tools, robotic welding, etc.

[0012] The system of the invention is characterized by the absence of parts independent of the bars for the connection thereof.

[0013] According to the present invention, the bars are provided on their ends with mutual coupling means, which are fixed together with the collaboration of screws. In a first group of bars, said coupling means form a node on which the coupling means of a second group of bars are coupled and fixed.

[0014] The coupling means of the first group of bars consist of plates having dimensions larger than the diameter of the bars. These plates are connected to the ends of the bars by welding, the plates defining an angle coincident with the one that said bars form together. Thus, when the first group of bars includes four coplanar bars, concurring together forming right angles, the plates will adopt the shape of right dihedra. In the event that the first group of bars includes three coplanar bars forming a 120° angle with one another, the plates will form a 120° dihedral angle. In the event that the first group of bars is composed only of two bars concurring

in alignment, the plates will be flat.

[0015] In all cases, the ends of the bars will be shaped in the same convex angle as the plates for their coupling and connection to the concave surface of said plates, remaining, with regard thereto, in a centered position and in a direction perpendicular to the edge of the plate. Obviously, if the plate is flat, the bars will fall in a direction perpendicular to said plate.

[0016] The plates of this first group of bars are backed against one another in a coincident position at their convex surface for their connection by means of screws insertable through facing holes in said plates, in coincident position, around the area of connection with the bars.

[0017] With regard to the coupling means of the second group of bars, they consist of U-shaped semi-clamps, preferably having parallel branches and an arcuate bottom, which are connected to the ends of these bars by welding, through the convex surface of their central branch. The ends of the bars will be shaped with two diametrically opposed notches having a contour coinciding with the outer contour of the semi-clamps for their coupling and welding thereon. The semi-clamps are provided with facing holes on the end portions of their side branches. The semi-clamps will be dimensioned such that they can be coupled on the edge of pairs of plates backed against each other belonging to said first group of bars, with the holes of their end portions in coincidence with holes of said plates, for passing of the lockscrews.

[0018] Part of the plates constituting the coupling means of the first group can have a transverse partition provided with one or more holes attached on one of their edges, in a direction perpendicular to the edge of the angle formed by said plates, for support and connection to the head of support columns or purlins of the roof.

[0019] Said first group of bars can be intended for shaping both the upper and lower chords of the three-dimensional lattices, whereas the second type of bars can be those which form the diagonals or backing profiles.

[0020] The plates connected to the ends of the first group of bars can be obtained by means of bent plates, which allows them to adopt different shapes and to form different angles, coinciding with those angles that the bars of the first group form with one another. Furthermore, the plates can adopt contours of any shape. These plates can also be obtained from commercial laminated profiles, for example when they form right dihedral angles. With regard to the hairpins connected to the ends of the bars of the second group, they can be obtained from a plate of a suitable thickness by die-cutting plus a subsequent bending.

[0021] The fundamental advantage of the system of the invention is derived from the inexistence of anchoring elements not pertaining to the actual bars forming the frames, except the necessary lockscrews. This means that all the operations to be carried out for adding

the parts to the ends of the bars can be carried out in a workshop, with the subsequent reduction in costs and time with regard to onsite assemblies, independence from climatic conditions, dimensional control, improvement in welding quality, etc.

[0022] All the features and advantages set forth will be better understood with the following description made in reference to the attached drawings, which show a nonlimiting embodiment.

[0023] In the drawings:

Figure 1 shows a perspective view of a meeting and connection point of bars of a space lattice or frame, constituted according to the invention.

Figure 2 shows a perspective view of the end portion of a tubular bar of a first group of bars concurring in the meeting point of figure 1.

Figure 3 shows a perspective view of the plate connected to the end of the tubular bar of figure 1, for constituting the coupling means between the first group of bars.

Figure 4 shows a perspective view of the end portion of the tubular bar of figure 2 coupled and connected to the plate of figure 3.

Figure 5 shows a perspective view of the end portion of a tubular bar forming part of the second group of bars concurring at the meeting point of figure 1.

Figure 6 shows a perspective view of a U-shaped semi-clamp, constituting the connection means for connecting the bars of the second group.

Figure 7 shows a perspective view of the end portion of the tubular bar of figure 5 coupled and connected to the semi-clamp of figure 6.

Figure 8 shows a perspective view of a plate similar to the one of figure 3, provided with means for support thereof on the head of a column or the like.

[0024] Figure 1 shows a meeting point of tubular bars belonging to a space frame, constituted according to the invention. At this meeting point, a first group of bars concurs, which are given reference number 1 and which are provided on their ends with mutual coupling means, given reference number 2, and a second type of bars, given reference number 3, which are provided on their ends with coupling means 4 for coupling on means 2 of bars 1.

[0025] In the example shown in figure 1, four bars from the first group, referenced with 1, concur, which bars are coplanar and consecutively form 90° angles with one another.

[0026] The coupling means 2 are constituted by plates forming an angle coinciding with the one formed between every two consecutive bars 1 of said first group of bars. In the example shown in figure 1, the bars 1 form 90° angles with one another, therefore the plates constituting the coupling means 2 form a right dihedral angle, as can be seen in figure 3. The tubular bars 1 are connected to the plates 2 by the concave side thereof, whereby the end of the bars is shaped, as can be seen

in figure 2, by means of two beveled edges 5 forming a 90° convex angle with one another, for being coupled to the concave surface of the plate 2, as can be seen in figure 4.

[0027] Plate 2 shown in figure 3 can be obtained by means of plate bending or from commercial laminated profiles.

[0028] In the event that a number of bars 1 other than those shown concur at the node of figure 1, forming a different angle with one another, the plate 2 will form the same dihedral angle.

[0029] Thus, if three bars forming a 120° with one another concur, the plate 2 will form a 120° dihedral angle, and in the event that only two bars 1 aligned in opposition concur at the node, the plates 2 would form a 180° angle, i.e. they would be flat. If the number of bars 1 concurring is greater than 4, the dihedral angle of the plates 2 will be less than 90°.

[0030] In any case, the bars 1 fall on the concave side of the plates 2 in a direction perpendicular to the edge 6 of the dihedral angle. Furthermore, the plates 2 have a contour larger than the diameter of the tubular bars 1 and have, in the areas around the bar 1, holes 7 located in coincident positions on all the plates.

[0031] With said constitution for the formation of the meeting point of figure 1, the plates 2 of all the bars 1 concurring at the meeting point are backed against one another at the convex surface, such that the holes 7 of consecutive plates are in coincident position for receiving lockscrews 8, thus configuring a node composed of the plates 2 forming part of the bars 1.

[0032] In the event that the plates 2 form an angle of less than 180° and in the angle, at the concave side, they have a welding rib or bead 9, the end of the bars 1 will have the angle formed by the beveled edges 5 finished off with notches 10, which can be coupled on the rib or bead 9.

[0033] With regard to the coupling means 4 of the second group of bars 3, as can be best seen in figure 6, they consist of U-shaped semi-clamps whose side branches 11 are flat and parallel, whereas the central branch 12 has a curved contour, for example of a semi-cylindrical shape. The end of the bars 2 is machined, as can be seen in figure 5, with two arcuated notches 13 located in position diametrically opposed and with a curvature coinciding with the outer curvature of the central branch 12 of the semi-clamp 4, such that it can be coupled on the outer surface of said semi-clamp, as can be seen in figure 7, for its connection thereto by means of welding. The side branches 11 of the semi-clamps 4 will be provided with aligned holes 14. If necessary, the end of the bars 3 will also be provided with auxiliary notches 15 to pass over the holes 14, as can be seen in figure 7.

[0034] The side branches 11 of the semi-clamps 4 will remain separated from one another by a distance approximately equal to or slightly greater than the thickness of every two plates 2 backed against one another for their coupling thereon, clamping them, as can be

seen in figure 1, the holes 14 being in alignment with holes 7 of the plates 2 for receiving lockscrews 16.

[0035] As can be seen in figure 8, the plates 2 can have a partition 17 provided with a hole 18 attached on one of their edges, in a position perpendicular to the edge 6, for support and attachment to the head of support columns or purlins of the roof.

[0036] In summary, in the system of the invention, all the bars 1 and 3 concurring at one meeting point are provided on their ends with mutual coupling means 2 and 4, which are fixed to one another with the collaboration of screws 8 and 16, the coupling means 2 and 4 being connected to the ends of the bars by means of welding.

[0037] By means of the described shaping of the ends of the bars 1 and 3, a perfect and tight fit thereof to the coupling means 2 and 4 is achieved, which allows achieving a solid fixing of these elements by means of welding, with a relative position between components which prevents the occurrence of secondary bending forces.

[0038] The bars 1 can form part of the upper and lower chords of three-dimensional lattices, whereas the bars 3 can constitute diagonals or backing profiles of the frame.

[0039] With the system of the invention, once a space frame is designed, the bars forming part thereof, with the corresponding coupling means, can leave the workshop perfectly finished, such that only the onsite positioning of the bars will be necessary for carrying out their fixing by means of screwing between the corresponding coupling means thereof.

Claims

1. A connection system between bars of space frames, in which frames the bars concur at meeting points in which the theoretical axes thereof are cut, **characterized in that** said bars (1-3) are provided on their ends with mutual coupling means (2-4) which are fixed together directly with the collaboration of screws (8-16), a node constituting the coupling means (2) of a first group of bars (1), on which node the coupling means (4) of a second group of bars (3) are coupled and fixed.
2. A system according to claim 1, **characterized in that** the coupling means of the first group of bars consist of plates (2) with dimensions greater than the diameter of the bars (1), which are connected to the ends of said bars by welding; which plates define an angle coinciding with the angle which said bars form with one another, the ends of these bars being shaped with the same convex angle (5) for their coupling and connection to the concave surface of the plates (2), in a centered position and in a direction perpendicular to the edge (6) of the angle

of said plate; the plates (2) of all the bars (1) being backed against one another in coincident position by their convex surface for their connection by means of screws (8) insertable through holes (7) provided on said plates, in coincident position, 5
around the area of connection with the bars.

3. A system according to claim 1, **characterized in that** the coupling means of the second group of bars (3) consists of U-shaped semi-clamps (4), which 10
are connected to the ends of these bars by welding, each one of said ends being shaped with two diametrically opposed notches (13), having a contour coinciding with the outer contour of the central branch (12) of the semi-clamps (4), for their coupling and 15
connection to the outer surface of said central branch by welding, said semi-clamps being provided on their end portions with facing holes (14) and being dimensioned for coupling on the edge of pairs of backing plates (2), with the holes (14) of their end 20
portions in coincidence with holes (7) of said plates, for the passage of the lockscrews (16).
4. A system according to claim 1, **characterized in that** at least part of the plates (2) shaping the cou- 25
pling means of the first group of bars have a transversal partition (17), provided with one or more holes (18), attached on one of their edges, in a direction perpendicular to the edge (6) of the angle 30
formed by said plates, for support and connection to the head of support columns or purlins of the roof.

35

40

45

50

55

FIG. 1

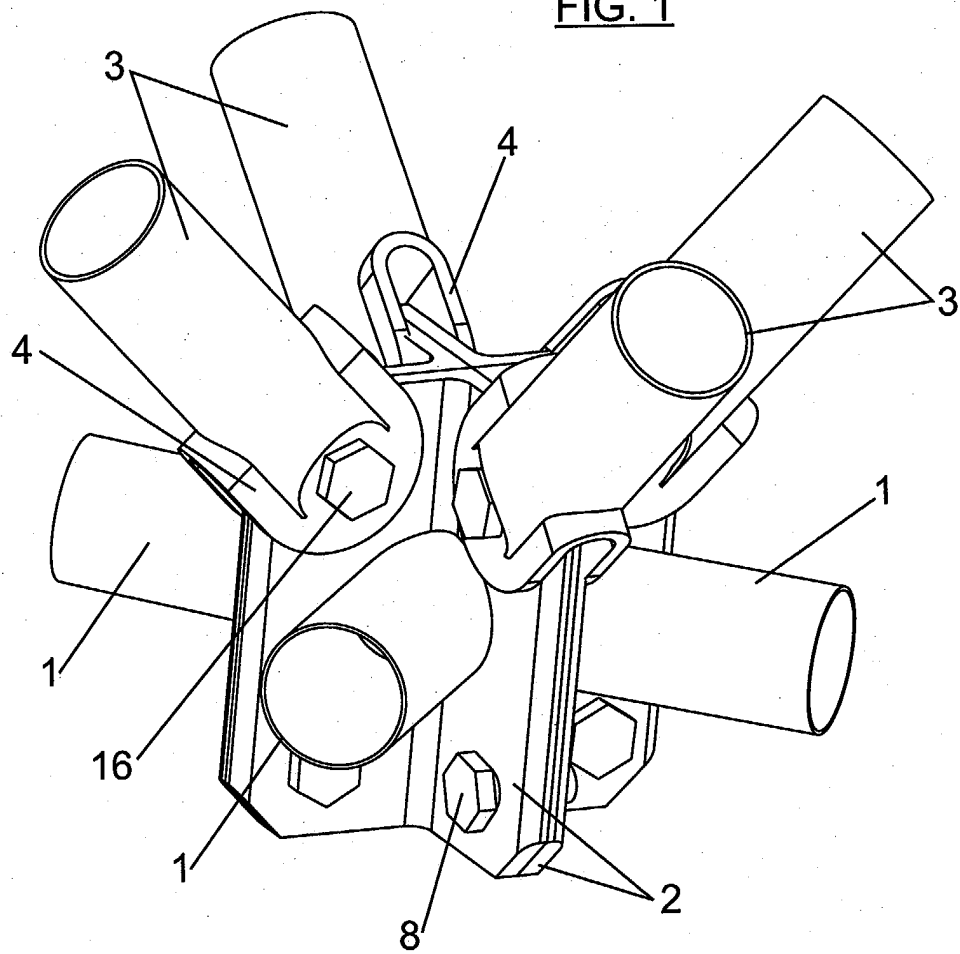


FIG. 2

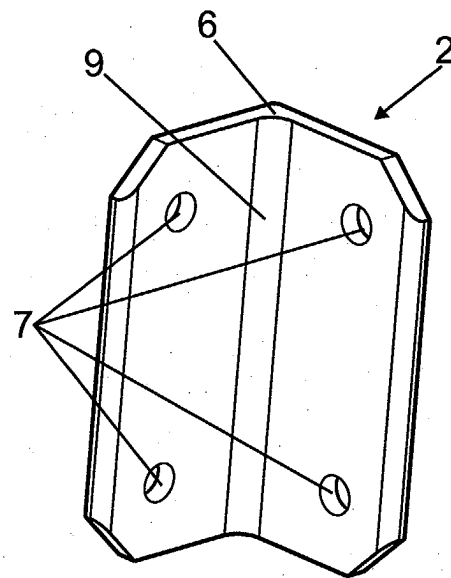
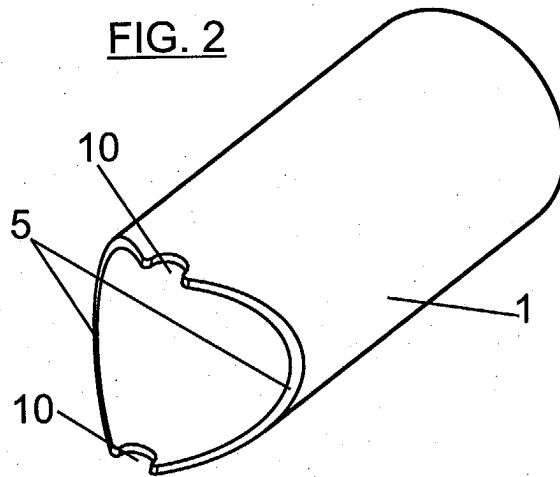


FIG. 3

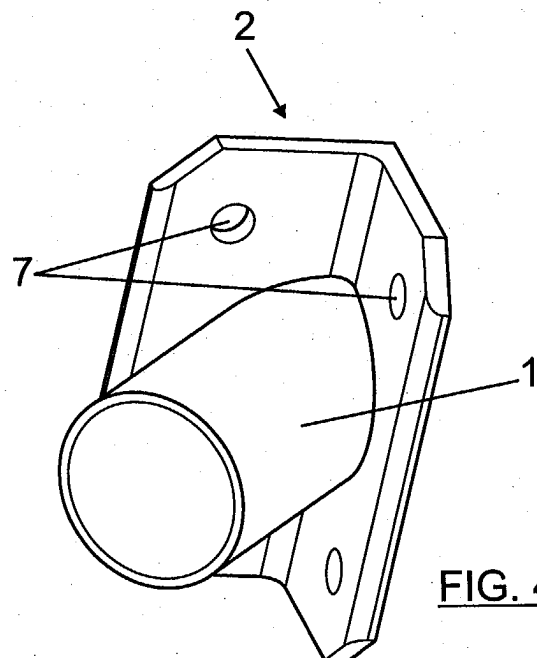


FIG. 4

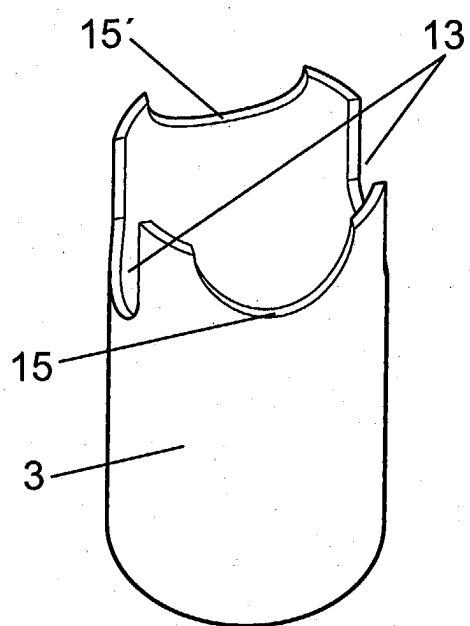


FIG. 5

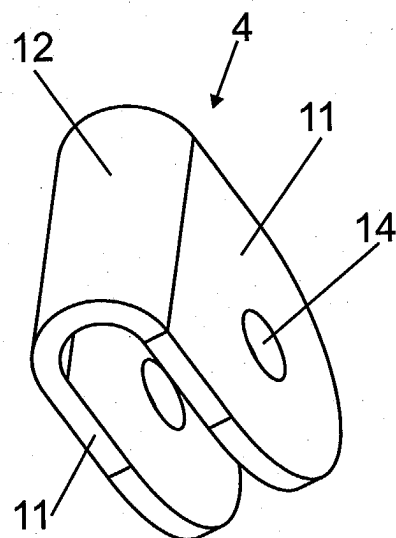


FIG. 6

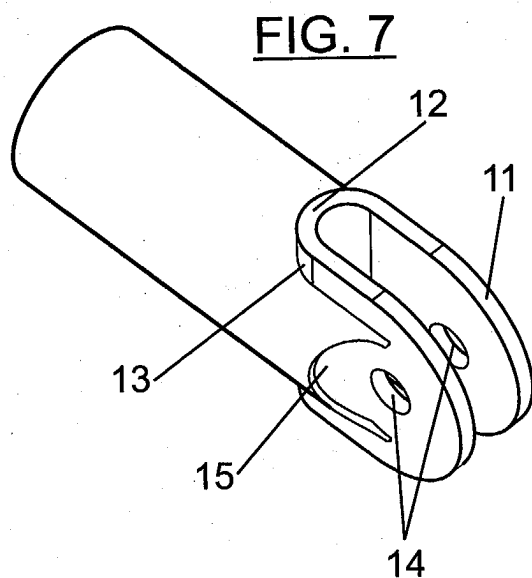


FIG. 7

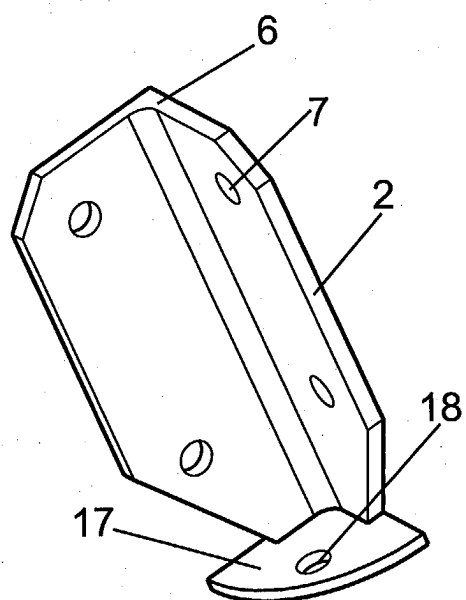


FIG. 8



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 38 0223

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)
X	FR 2 143 644 A (LAMPSON SERGE) 9 February 1973 (1973-02-09)	1	E04B1/19
A	* the whole document *	2,3	

X	WO 93 00490 A (GEISEN JOHANNES) 7 January 1993 (1993-01-07)	1	
A	* page 17, paragraph 1; figure 12 *	2,3	

A	FR 2 601 981 A (NASI CESARINO) 29 January 1988 (1988-01-29) * page 6, line 31 - page 7, line 2; figures *	1,2	

X	FR 2 221 035 A (COMETUBE) 4 October 1974 (1974-10-04)	1,4	
A	* the whole document *	2	

X	FR 1 450 635 A (TUBEWRIGHTS LTD) 24 June 1966 (1966-06-24)	1,4	
A	* page 4, column 1, paragraph 3 - page 5, column 1, paragraph 3; figures 5-8 *	2	

X	EP 0 031 804 A (UTEMA TRAVHYDRO S A EN ABREGE) 8 July 1981 (1981-07-08)	1	E04B
A	* the whole document *	2	

The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		16 February 2004	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			

1

EPO FORM 1503 03.82 (P04C01)

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

EP 03 38 0223

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

16-02-2004

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
FR 2143644	A	09-02-1973	FR	2143644 A1	09-02-1973
WO 9300490	A	07-01-1993	AU	2013692 A	25-01-1993
			WO	9300490 A1	07-01-1993
FR 2601981	A	29-01-1988	IT	1197003 B	25-11-1988
			CH	670468 A5	15-06-1989
			FR	2601981 A1	29-01-1988
FR 2221035	A	04-10-1974	FR	2221035 A5	04-10-1974
FR 1450635	A	24-06-1966	BE	666115 A	18-10-1965
			LU	48944 A	31-08-1965
			NL	6508364 A	30-12-1965
EP 0031804	A	08-07-1981	BE	880894 A1	16-04-1980
			DE	3070682 D1	27-06-1985
			EP	0031804 A2	08-07-1981