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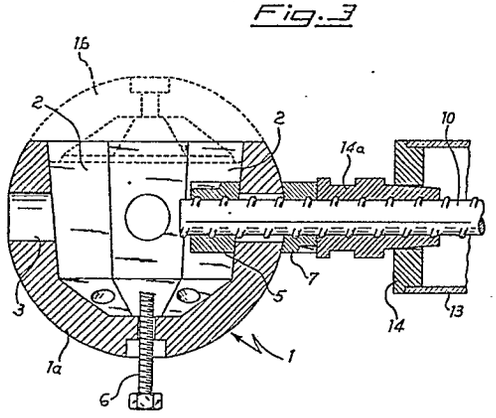
(54) Hollow nodal element for lattice spatial structures with ribbed profiled rods.

(57) A hollow nodal element (1) together with its principal fitting elements is described for a lattice spatial structure with ribbed rods (10), consisting in particular of special long pitch pseudo-threaded bars, in high resistance steel. The nodal element (1) is formed of a hollow sphere with internal polygonal walls nad, in any case, with inclined planes into which are provided through holes (3) for the insertion of stringers and diagonal rods. The completing cover (1b) of the sphere fixed by screwing with threaded edges or by means of small passing rods (6), can be a simple sphere section, or it can also have tapered internal planes and through holes for the connection and blocking of diagonal rods in the case of multi-layer links. Internal connecting nuts (5) are provided, of cylindrical shape with a self-blocking inclined plane for fixing the rods to the tapered internal planes of the hollow sphere and cylindrical external lock-nuts (7) on the spherical surface of the knot. There are possibly tubukar coverings (13) of the rods (10) with possible static functions in the case of compression stresses.

Fig. 3



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Description

HOLLOW NODAL ELEMENT FOR LATTICE SPATIAL STRUCTURES WITH RIBBED PROFILE RODS

This invention relates to a hollow nodal element for lattice spatial structures with ribbed profile rods, in particular of the special long pitch continuous pseudo-threaded type, as well as certain assembly elements for completing the structure.

It is known that currently there exist various solutions to the problem of obtaining three dimensional or spatial structures for covering medium/large areas, all based on the use of smooth profile rods which, for connections, must be subjected to various mechanical operations, which are sometimes somewhat complex.

Thus it was considered appropriate to use, as stringers and diagonal rods, high resistance steel bars with ribbed surfaces, which are already available on the market, and in particular, of the continuous special pitch pseudo-threaded type, known as high resistance "DYWIDAG" or "GEWI" rods, ready for use in any lenght through cutting from the stock in the warehouse. In this way, in addition to fewer mechanical operation, one obtains a reduction in the cross-sections, with consequent saving the weight of the structure and smaller diameters in the connecting elements and thus in the size of the knots.

The use of bars of this type is described in the European patent application N. 89830152.8 filed on the same date in the name of the same applicant, in combination with full nodal spheres between the hemispheres of which the continuous stringers are fixed, while requiring however the insertion of double threaded sleeves for connecting the cut diagonal bars. As a result of the crossed over positioning of the stringers, in that case a "virtual centre" of the knot occurs which must be considered when making the structural calculations. On the other hand it is not always so important, depending on the installation, to have the continuous stringers "crossing" the knot without interruptions.

Thus one of the objects of the present invention is that of providing a lattice spatial structure, and in particular its nodal elements, which can overcome the above-mentioned known drawbacks of the prior art by using ribbed rods available in any length by cutting to size and knots consisting of hollow spheres within which may be fitted sections of stringers and diagonal rods.

This is obtained with a hollow spherical nodal element characterised by the fact of including a truncated hollow sphere whose internal walls form the sides of a polyhedron, at least one of which sides is perforated radially for the insertion of a ribbed bar designed to constitute a stringer or diagonal rod of the structure, said perforated internal walls being inclined with respect to the axis of the corresponding hole, a spherical finishing cover also being provided for completing said truncated sphere with fixing devices on this latter and devices for blocking the ends of the rods joining the sphere.

In addition to having the simple function of covering, said spherical finishing cover can itself also be shaped at the inside with planes inclined as the sides of a polyhedral, radially perforated for the insertion and fixing of joining rods, should the knot concern multi-layer links.

According to a particular detail of this invention for fixing the ends of the rods to the sphere cylindrical internal nuts and external lock-nuts can be provided, both with inner pseudo-threading for joining with the ribbing of the rod, being supplied an a metalwork accessory to the road itself, the coupling being achieved thanks to the said inclination of the inner walls of the sphere, which can be of about 5° relative to the radial direction, thus coinciding with the taper required by the header press of the sphere to make extraction possible.

In addition the possibility of tubular coverings for the rods are planned, either simply for protection or to improve the aesthetic aspect, or even as a checking template for rod lenght at assembly, or as an actual static contribution to rods under compression stress. In this latter case the tubular coating of steel or aluminium will show a header flange at both ends with a tapered connecting sleeve, as described in the above mentioned European patent application N. 89830152.8, or an actual connecting cone between the end of the tubular element and the fixing lock-nut on the sphere, such as to replace flange and sleeve, which will be used as already described in the Italian application N. 22686 A/84, especially when in the hollow space between rod and external coaxial tube insulating materials such as ceramic wool are inserted with fire prevention functions.

Further objects and characteristics of the nodal element according to this invention and of the relative structure will become obvious to these skilled in the art from the following detailed description of one preferred embodiment thereof, given by way of a non-limiting example, with reference to the attached drawings, in which:

FIGURE 1 shows the top plan view of a truncated sphere used for the knot according to this invention, with two examples of coincident rods, of different diameters.

FIGURE 2 shows a cross-section through the diameter of the sphere, when complete with closing cover, in a plane perpendicular to that of Fig. 1 and with an example of a covered incident rod; and

FIGURE 3 shows a similar view to that of Fig. 2, with certain variations relative to the connection of the finishing cover and with the presence of a coaxial tubular reinforcing element.

With reference to the figures, the nodal element according to this invention consists of a hollow sphere 1 onto which converge, being blocked inside it, a certain number of rods 10, determined by structural requirements. The rods 10 will be of exclusively ribbed type and in particular with a special long pitch pseudo-threaded section, of the

type available on the market under the tradename of "DYWIDAG" or "GEWI", with the relative accessory equipment for assembly. In this way the particular pseudo-threaded continuous profile is used in correspondence with the nodal joints with no need for further mechanical operations and without the insertion of sleeves for threaded couplings.

Sphere 1 is composed of a hollow truncated sphere 1a, which extends over the diameter plane, and by a spherical finishing cover 1b. Part 1a at least has non-threaded radial through holes 3 for the insertion of the rods 10 which are then fixed inside by connecting nuts 5 and external lock-nuts 7. The truncated spheres 1a are obtained by hot pressing and have polygonal internal cavities with a number of sides at least equal to that of the radial holes, made in correspondence of their respective planes which, according to a detail of this invention, are inclined with respect to a normal plane to their axis, with a relative angle of about 5°, so as to form an angle of about 85° relative to the axis of hole 3, and thus to rod 10 and to the locking nut 5. In any case this angularity does not require any special operations since it is needed by the taper that the header press must have for its extraction and which is exploited to obtain the rest surface for the rod connecting nut, whose corresponding surface inclined of 5° allows a self-blocking, anti-rotation bolting system to be obtained. In this respect see, in particular, Fig. 2, where the same angle has also been given to the internal trapezoidal surfaces of the cover 1b. Naturally, this is required only when incoming rods are envisaged symmetrically on all the surface of the sphere, in particular for multi-layer structures. Otherwise cover 1b, when it is only for covering and completing the sphere, can have any type of international surface. However coupling means for parts 1a and 1b are provided, for example by screwing with peripheral threading 4 on the edges, as is shown in Figs. 1 and 2, while for non-perforated finishing covers, whose only function is to complete the sphere, small blocking rods 6 passing through holes at the poles are envisaged, as shown in Fig. 3. These small rods 6 can also have the function of anchoring for covering purlins (false ceilings and others) or hangers for sub-structural framing, but they can be fitted exclusively for these functions, independently from blocking the finishing cover which is, on the other hand, screwed on.

In Fig. 2 a rod 10 entering knot 1 has been shown with a tubular covering 12 which, in addition to having a protective function (anti-corrosion, protection from fire, etc.) and an aesthetic one by hiding the ribbing and possibly providing colour, can also constitute a reference to the lenghtof the rod during assembly, rather like a template. The coverings 12 can be in aluminium, rigid PVC and fibre cement or in any suitable material.

Referring to Fig. 3, a tubular element 13 is instead shown, coaxial with rod 10, preferably in steel or aluminium, which can have a function of static resistance to compression stresses and which is fitted with header flanges 14 and connecting sleeves 14a, as previously described for the co-pending European patent application N. 89830152.8. The hollow space between tubular element 13 and rod 10 can be filled with insulating material such as ceramic wool with fire prevention functions and in place of flange 14 and sleeve 14a a terminal connec ting cone can be provided for direct bearing onto the knot, as described and illustrated in Italian patent application N. 22686 A/84.

It should be noted that the hollow spheres according to this invention, obtained by hot pressing of steel or aluminium, provide high structural reliability and can be constructed with a diameter of up to 500 mm, with thicknesses of up to 100 mm with tapered internal surfaces of trapezoidal shape or, better, inclined relative to a plane perpendicular to a radial direction, simply by exploiting the cone shape of the header press so as to obtain, without any further operations or additional elements, self-blocking and anti-rotation bolting. This when requested, applies not only to the truncated sphere part 1a, but also to the finishing cover 1b. The number of internal trapezoidal surfaces will vary depending on the various lattice geometries required with triangular, square, rectangular, hexagonal, etc. links as long as it is compatible with the area required by the connecting nuts and it may be obtained by simply using a header of a different shape. For example a hexagonal header will be needed for triangular links, an octagonal header for square or rectangular links, and so on.

Finally it should be noted in this case, as for the co-pending European patent application N. 89830152.8, that the most statically stressed tetrahedrons and semioctahedrons can be divided into sub-pyramids, so that the structures are declassified to lower localised stresses, with the reduction of the free length of the rods, by using the specialised structural calculation which automatically solves the problem of the halving of the diagonal and stringer rods, with the added use of nodal spheres identical to those used in single structures, but under less stress than these.

Claims

1. Hollow nodal element for lattice spatial structures with ribbed rods having a special long pitch threaded profile, characterised by the fact of including a truncated hollow sphere (1a) whose internal walls form the trapezoidal sides (2) of a polyhedron, at least one of these sides (2) being radially perforated for the insertion of a ribbed bar (10) designed to constitute a stringer or diagonal rod of the structure, the perforated internal walls (2) being inclined with respect to the plane perpendicular to the axis of the corresponding hole (3), there also being provided a spherical cover (1b) for finishing sai truncated sphere (1a), with fixing means (4, 6) onto this latter and means for blocking (5, 7) the ends of the rods (10) impinging on the sphere.

2. The nodal element of claim 1, characterised by the fact that said spherical finishing cover (1b) of the sphere (1) also shows, as the truncated sphere (1a), perforated trapezoidal

walls.

3. The nodal element of claim 1, in which the said means of fixing the cover (1b) to the truncated cone (1a) are constituted by small rods (6) which pass across the diameter of the sphere through holes at its poles.

4. The nodal element of claim 1, in which the said means of fixing are provided by threads (4) at the peripheral edges of the truncated sphere (1a) and the cover (1b).

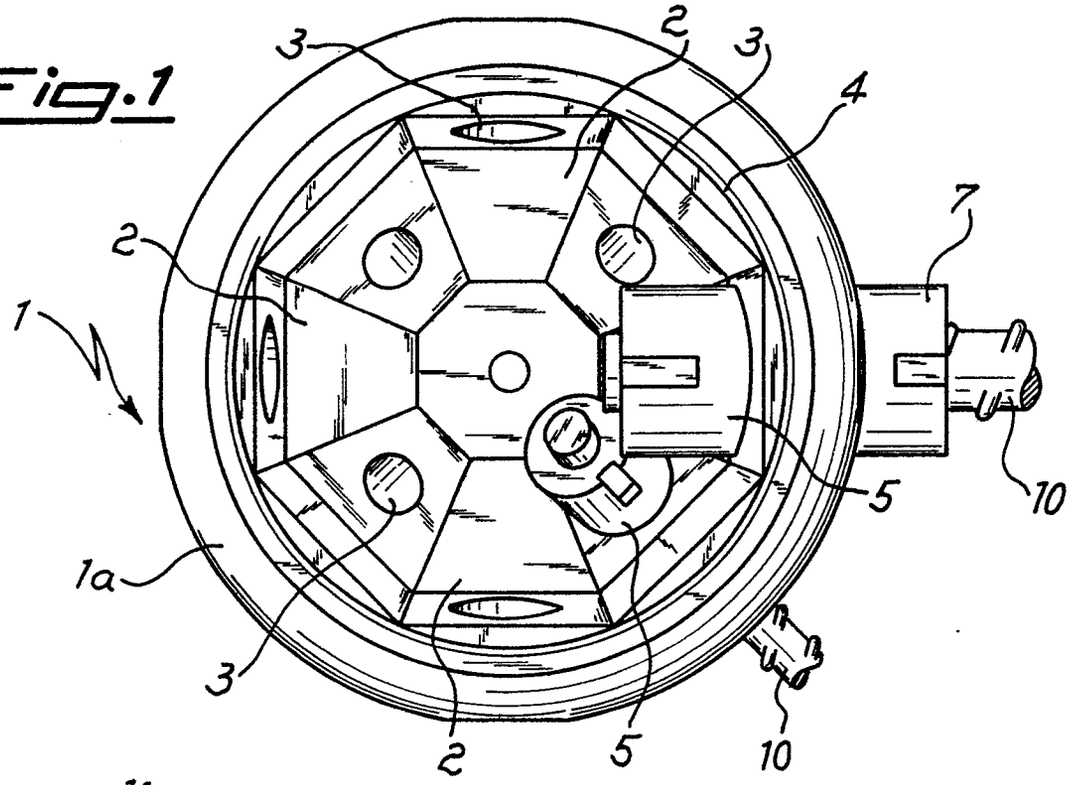
5. The nodal element of claim 1, in which said means of blocking the ends of the rods (10) impinging on the sphere (1) are formed of cylindrical nuts (5) which are self-locking onto a corresponding inner surface (2) and external anti-rotation lock-nuts (7) designed to lock against the surface of the sphere (1).

6. The nodal element of claim 5, in which said inclination of the internal sides (2) relative to the plane perpendicular to the axis of the hole (3) formed therein is about 5°.

7. Lattice spatial structure including stringers and diagonal rods formed of special long pitch pseudo-threaded ribbed bars and nodal elements according to any one of the preceding claims, characterised by the fact of also including tubular covering elements (12, 13), coaxialwith said rods (10).

8. The structure of claim 7, in which tubular elements (13), in aluminium or steel, are each fixed to a corresponding rod (10) by known header flange means (14) with connecting sleeve (14a) or by a terminal cone resting directly against the knot.

Fig.1



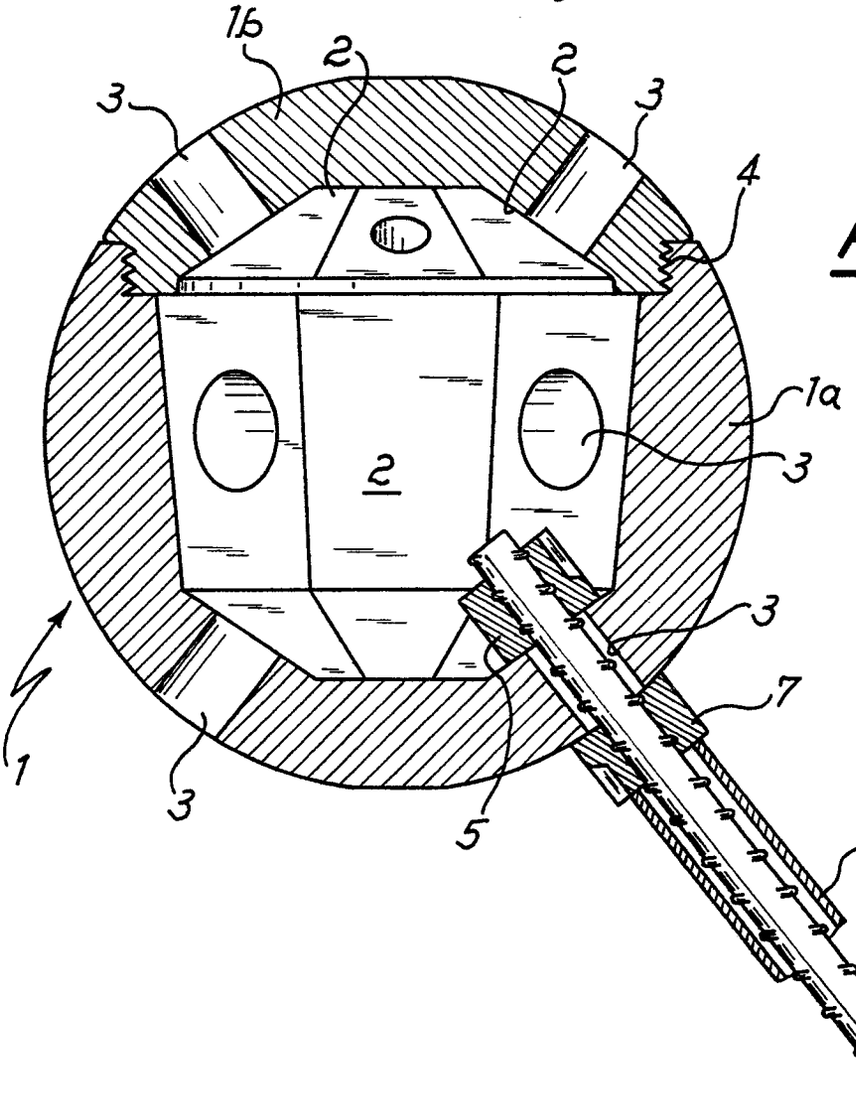
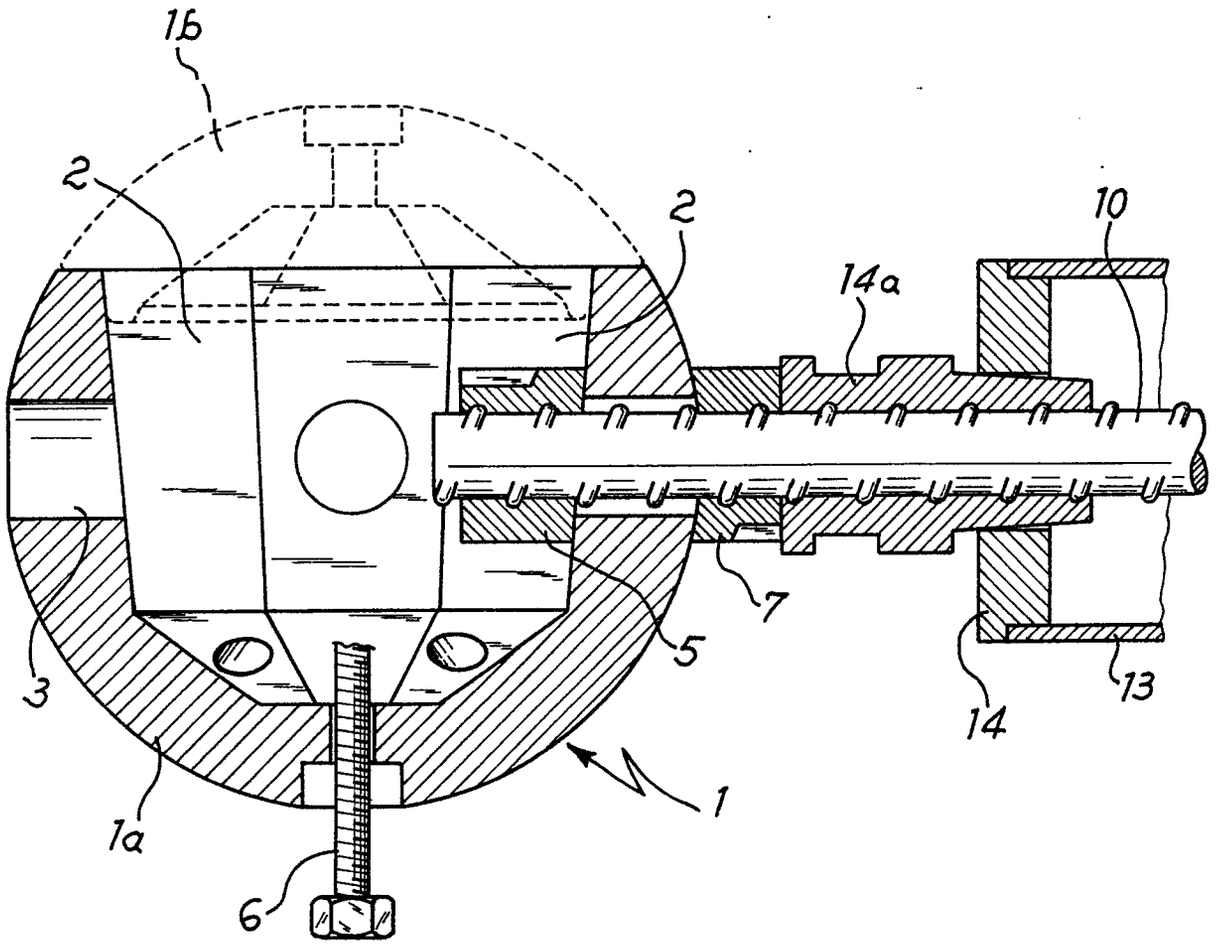


Fig.2

Fig.3



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EUROPEAN SEARCH REPORT

Application Number

EP 89 83 0153

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.4)
A	DE-A-3 133 946 (MÖBIUS) * Page 5, lines 15-33; page 6, lines 1-11; figures 2-4 *	1,4,5	E 04 B 1/19
A	US-A-3 882 650 (GUGLIOTTA) * Column 2, lines 32-68; column 3, lines 21-68; column 4, lines 1-46; column 6, lines 63-68; column 7, lines 1-11; figures 2,4 *	1,7	
A	FR-A-2 250 395 (S.A. L'ECLAIRAGE TECHNIQUE) * Page 2, lines 11-15,22-38; page 3, lines 1-9; figures 5-7 *	3	
A	US-A-3 864 049 (TAISABURO) * Column 3, lines 42-68; column 4, lines 1-28; figures 3-7 *	5,7,8	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4) E 04 B E 04 C F 16 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10-07-1989	BARBAS A.

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