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(72) Inventor: **von Timroth, Roland**
63225 Langen (DE)

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(74) Representative:
Eriksson, Svante Johan Christer et al
Oy Jalo Ant-Wuorinen Ab
Iso Roobertinkatu 4-6 A
00120 Helsinki (FI)

(71) Applicant: **RvT Messebau & Messedesign GmbH**
63225 Langen (DE)

(54) Node jointing system

(57) The present invention relates to a node jointing system comprising frame rods (1) and node elements (2) suitable for jointing said frame rods, whereby both ends of each frame rod (1) are provided with a hook-like clamp member (3) having a mouth of the clamp member arranged to open orthogonally sideways at the end of the frame rod (1), and said node element (2) being formed by a three-dimensional, hollow structure comprising shank rods (4) of equal length and circular cross section, which shank rods are connected to each other via corner pieces (5) of said node element and to which

shank rods (4) further the clamp members (3) of the frame rods can be lockably attached. The invention is characterized in that the node element (2) is formed into a 24-corner polyhedron in which the 48 equal-length edges are formed by said round shank rods (4) which are arranged into three pairs of octagonal parallel rings, each pair of rings being aligned to lay in a principal co-ordinate plane of its own and that said frame rod clamp member (3) has a locking pin (7) which is made spring-loadedly movable in the axial direction of the frame rod (1) so as to partially close the mouth opening (6) of the frame rod clamp member.

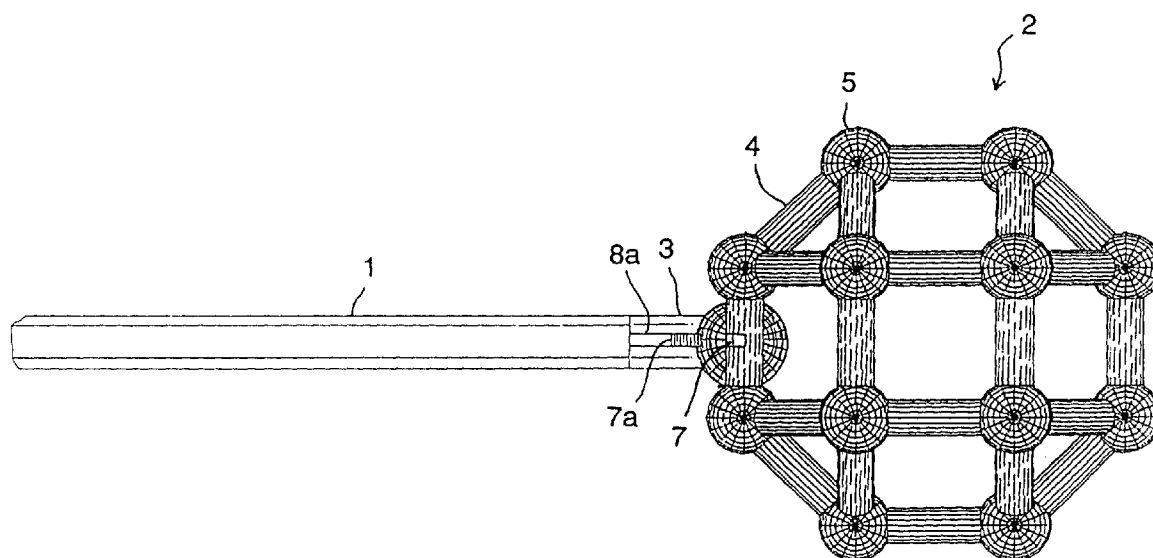


Fig. 3

Description

The present invention is related to a node jointing system comprising frame rods and node elements suitable for jointing said frame rods, whereby both ends of each frame rod are provided with a hook-like clamp member having the mouth of the clamp member arranged to open orthogonally sideways at the end of the frame rod, and said node element being formed by a three-dimensional, hollow structure comprising shank rods of equal length and circular cross section, which shank rods are connected to each other via corner pieces of said node element and to which shank rods further the clamp members of the frame rods can be lockably attached.

Such a node jointing system is known in the art from, e.g., patent publication EP 0,307,628 B1 in which the node element has a cubic shape and the secured connection of the frame rod to the shank rod of the node element is accomplished by means of a flexible spring-mounted cam included in the clamping part of the frame rod, or alternatively, such a locking function is achieved by placing a spring clip insertable in the mouth of the frame rod clamping part so as to close the clamp mouth.

While the above-described prior-art node jointing system is flexible enough for the assembly of a lot of frame rod structures, the cubic node element sets unnecessary limitations to the alignment and stabilization of the frame rods, whereby the locking means of the system have been found excessively clumsy or prone to damages in practical use.

It is an object of the present invention to overcome the disadvantages of the above-mentioned problems by virtue of a node jointing system characterized in that the node element is formed into a 24-corner polyhedron in which the 48 equal-length edges are formed by said round shank rods which are arranged into three pairs of octagonal parallel rings, each pair of rings being aligned to lay in a principal coordinate plane of its own and that the clamp member of the frame rod has a locking pin which is made spring-loadedly movable in the axial direction of the frame rod so as to partially close the mouth opening of the frame rod clamp member.

The node jointing system according to the invention with the 48-axis node elements and frame rods equipped with easy-to-use clamp members makes it possible to perform a rapid and simple erection of the most varied rigid frame-rod constructions of a curved and/or planar shape such as large cylindrical, spherical or cupole-like structures. In particular, by virtue of the quasi-spherical basic shape of the polyhedral node element, the shank rods of the node element can be used to realize stable structures of diverse shapes not feasible by means of prior-art embodiments. By virtue of the novel node element, the frame rods are automatically and easily locked to the multi-axis node elements simply by inserting the hook-like clamp member of the frame rod about any shank rod of the 48-axis node element.

Other specifications and benefits of the present invention will be evident from the detailed description of appended drawings in which

5 Figure 1 shows an exemplifying perspective view of a node element according to the invention;

10 Figure 2a shows a longitudinal section of an exemplifying embodiment of a frame rod clamp member according to the invention as viewed from one side of the member;

15 Figure 2b shows a longitudinal section of the frame rod clamp member as viewed from another side of the member;

20 Figure 2c shows an exemplifying embodiment of the frame rod clamp member as viewed from the rod axial direction of the member;

Figure 3 shows in detail the connection of the frame rod to the node element by means of the frame rod clamp member; and

25 Figure 4 shows a perspective view of one example of a node point of the node jointing system according to the invention.

30 Referring to drawings, the node jointing system according to the invention comprises a number of frame rods 1 and node elements 2 serving to joint said frame rods. Both ends of each frame rod 1 are provided with a forked clamping member 3 arranged to have its mouth to open orthogonally sideways with respect to the frame rod 1. The node element 2 is formed by a three-dimensional, hollow structure comprised of shank rods 4 of equal length and circular cross section and of corner pieces 5 serving to join said shank rods. According to the invention, the node element 2 is a 24-corner polyhedron in which the 48 equal-length edges are formed by said round shank rods 4, which are arranged into three pairs of octagonal parallel rings, each pair of rings being aligned to lay in a principal coordinate plane of its own. Thus, the first pair of shank rod rings is in the x-plane, the second pair of shank rod rings in the y-plane and the third pair of shank rod rings in the z-plane. The clamp members 3 of the frame rods 1 are suitable for providing a lockable grip on said shank rods 4. Hence, a maximum number of frame rods 1 connectable to each node element 2 is 48. For the locking of the clamp member 3 to the shank rod 4, the clamp member 3 is equipped with a locking pin 7 which is made spring-loadedly movable in the axial direction of the frame rod 1 so as to partially close the mouth opening 6 of the frame rod clamp member.

55 In a preferred embodiment of the invention, the frame rod clamp member 3 is formed by a shaft part 3a and a clamp part 3b. Then, the locking pin 7 is advan-

tageously adapted movable in a longitudinal channel 8, which is made into the shaft part 3a and is arranged to open into the mouth 6 of the frame rod clamp member, said channel having a slot 8a opening to the side of the shaft part 3a so as to accommodate a push-knob 7a of the locking pin 7. To the bottom of the channel 8 is advantageously adapted a compression spring 9 serving to push the locking pin 7 toward the mouth of the frame rod clamp member.

Under the force exerted by the compression spring 9, the locking pin 7 is advantageously arranged to slide substantially halfway across the mouth 6 of the frame rod clamp 3b, wherein the locking pin can effectively prevent the shank rod 4 of the node element 2 from coming loose from the frame rod clamp 3b. By shaping the locking pin 7 so as to have the tip part 7b of the pin slanted at its outer face, the locking pin 7 is automatically and readily pushed aside into the channel 8 when the frame rod clamp member 3 is hooked about any shank rod 4 of the 48-axis node element 2. Under the force exerted by the compression spring 9, the locking pin 7 is again pushed out into the clamp mouth 6 when said shank rod 4 has been pushed past the opening of the channel 8 at the mouth 6, whereby the shank rod 4 becomes efficiently locked to the clamp part of the frame rod clamp member 3.

When an assembled frame-rod construction is to be dismantled, the clamp members 3 of the frame rods 1 are easily detachable from the shank rods 4 of the node elements 2 by retracting the locking pin 7 into the channel 8 through pressing the push-knob 7a axially outward with respect to the node element simultaneously as the frame rod clamp member 3 is lifted away from about the shank rod 4 of the node element.

Advantageously, the frame rods 1 of the node jointing system are tubular, whereby the attachment of the frame rod clamp member 3 to the end of the frame rod 1 is easy to implement by inserting a certain length of the shaft part 3a of the frame rod clamp member into the hollow end of the frame rod 1 and then using, e.g., welding, glueing or possibly screws to attach the said shaft part to the frame rod.

A joint of maximum torsional stiffness between the frame rod 1 and the frame rod clamp member 3 attached thereto can be achieved if the cross sections of both the frame rod 1 and the shaft part 3a of the frame rod clamp member 3 are made polygonal as is clearly illustrated in Fig. 2c. In a preferred embodiment, the cross section of the shaft part 3a along the length of the shaft part close to the clamp part 3b is made equal to the outer cross section of the frame rod 1, and approximately at the mid-length of the shaft part 3a, the cross section of the shaft part is reduced at a circumferential shoulder 10 to a size corresponding to the inner cross section of the hollow frame rod 1. This design gives the frame rods 1 of the node connector system a smooth outer surface up to the tip of the clamp part 3b of the frame rod clamp members 3.

As is evident from Fig. 1, the corner pieces 5 of the node element 2 advantageously have a spherical shape. Also the basic shape of the clamp part 3b of the frame rod clamp member 3 is advantageously made spherical, whereby its diameter is essentially equal to the free distance of two adjacent corner pieces 5 of the node element 2. The basic shape of the frame rod clamp part 3b may also be cylindrical or ellipsoidal, and its width may be made equal to the free distance between two adjacent corner pieces 5 of the node element, or alternatively, half said free distance if two frame rods 1 are desired to be connected to the same shank rod 4.

The frame rod clamp members 3 are advantageously assembled from two mirrored pieces, which after the insertion of the locking pin 7 and the compression spring 9 are joined together by means of peg or screw joints 11, or simply, by glueing.

According to a preferred embodiment of the invention, the frame rod clamp member 3 and the frame rod itself are made from the same material, which can be aluminium, for instance.

Claims

1. A node jointing system comprising frame rods (1) and node elements (2) suitable for jointing said frame rods, whereby both ends of each frame rod (1) are provided with a hook-like clamp member (3) having a mouth of the clamp member arranged to open orthogonally sideways at the end of the frame rod (1), and said node element (2) being formed by a three-dimensional, hollow structure comprising shank rods (4) of equal length and circular cross section, which shank rods are connected to each other via corner pieces (5) of said node element and to which shank rods (4) further the clamp members (3) of the frame rods can be lockably attached, **characterized** in that the node element (2) is formed into a 24-corner polyhedron in which the 48 equal-length edges are formed by said round shank rods (4) which are arranged into three pairs of octagonal parallel rings, each pair of rings being aligned to lay in a principal coordinate plane of its own and that said frame rod clamp member (3) has a locking pin (7) which is made spring-loadedly movable in the axial direction of the frame rod (1) so as to partially close the mouth opening (6) of the frame rod clamp member.
2. A node jointing system as defined in claim 1, **characterized** in that said frame rod clamp member (3) is formed by a shaft part (3a) and a clamp part (3b).
3. A node jointing system as defined in claim 2, **characterized** in that the locking pin (7) is advantageously adapted movable in a longitudinal channel (8), which is made into the shaft part (3a) and is ar-

ranged to open into the mouth (6) of the frame rod clamp member, said channel having a slot (8a) opening to the side of the shaft part (3a) so as to accommodate a push-knob (7a) of the locking pin.

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4. A node jointing system as defined in any of claims 1 - 3, **characterized** in that a compression spring (9) is adapted to push the locking pin (7) essentially halfway across the mouth (6) of the frame rod clamp part (3b).

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5. A node jointing system as defined in claim 4, **characterized** in that the tip part (7b) of the locking pin (7) entering into the mouth (6) of the clamp member, is slanted at its outer face.

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6. A node jointing system as defined in claim 2, **characterized** in that the frame rod (1) is tubular and the shaft part (3a) of the clamp member is partially inserted therein.

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7. A node jointing system as defined in claim 6, **characterized** in that both the frame rod (1) and the shaft part (3a) of the clamp member have a polygonal cross section.

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8. A node jointing system as defined in claim 7, **characterized** in that the cross section of the shaft part (3a) along the length of the shaft part close to the clamp part (3b) is equal to the outer cross section of the frame rod (1), and approximately at the mid-length of the shaft part (3a), the cross section of the shaft part is reduced at a circumferential shoulder (10) to a size corresponding to the inner cross section of the hollow frame rod (1).

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9. A node jointing system as defined in any previous claim, **characterized** in that the basic shape of the corner pieces (5) of the node element (2) is spherical.

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10. A node jointing system as defined in any previous claim, **characterized** in that the basic shape of the clamp part (3b) is spherical, whereby its diameter is essentially equal to the free distance of two adjacent corner pieces (5) of the node element (2).

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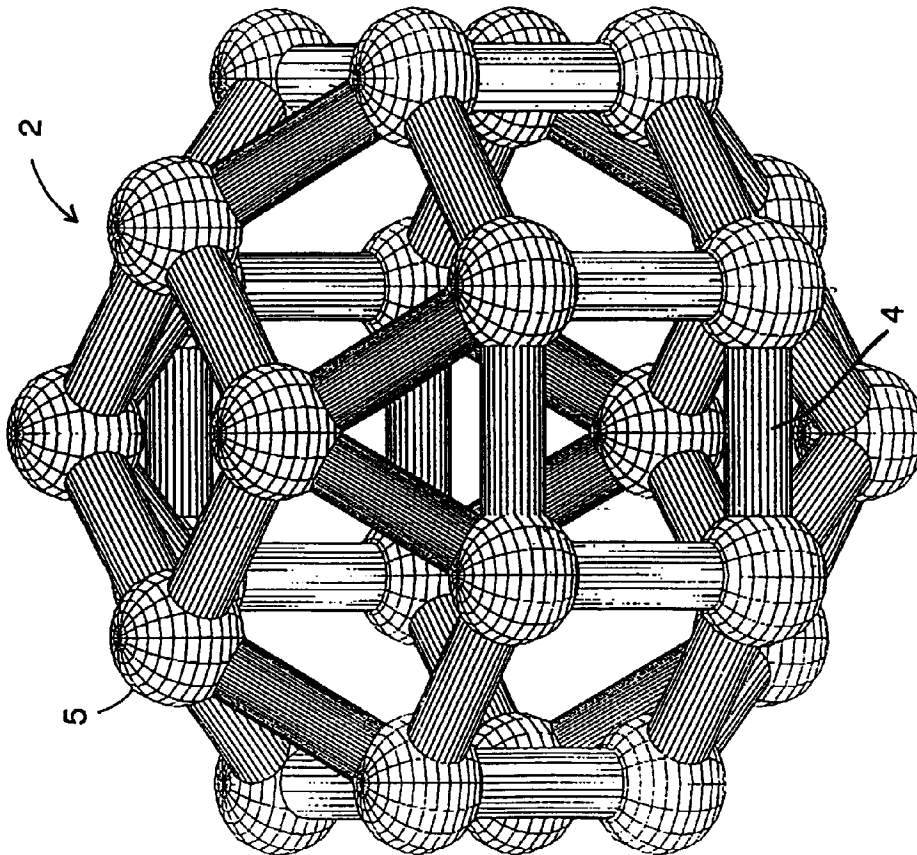


Fig. 1

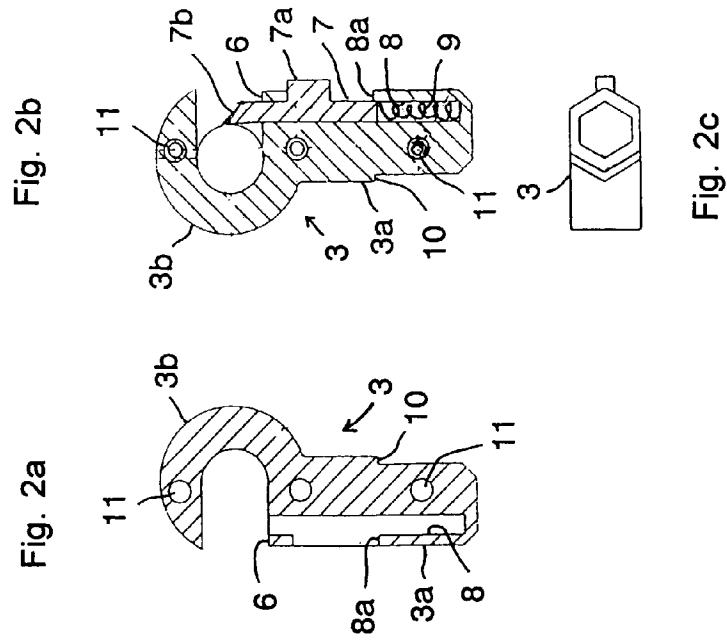


Fig. 2b

Fig. 2a

Fig. 2c

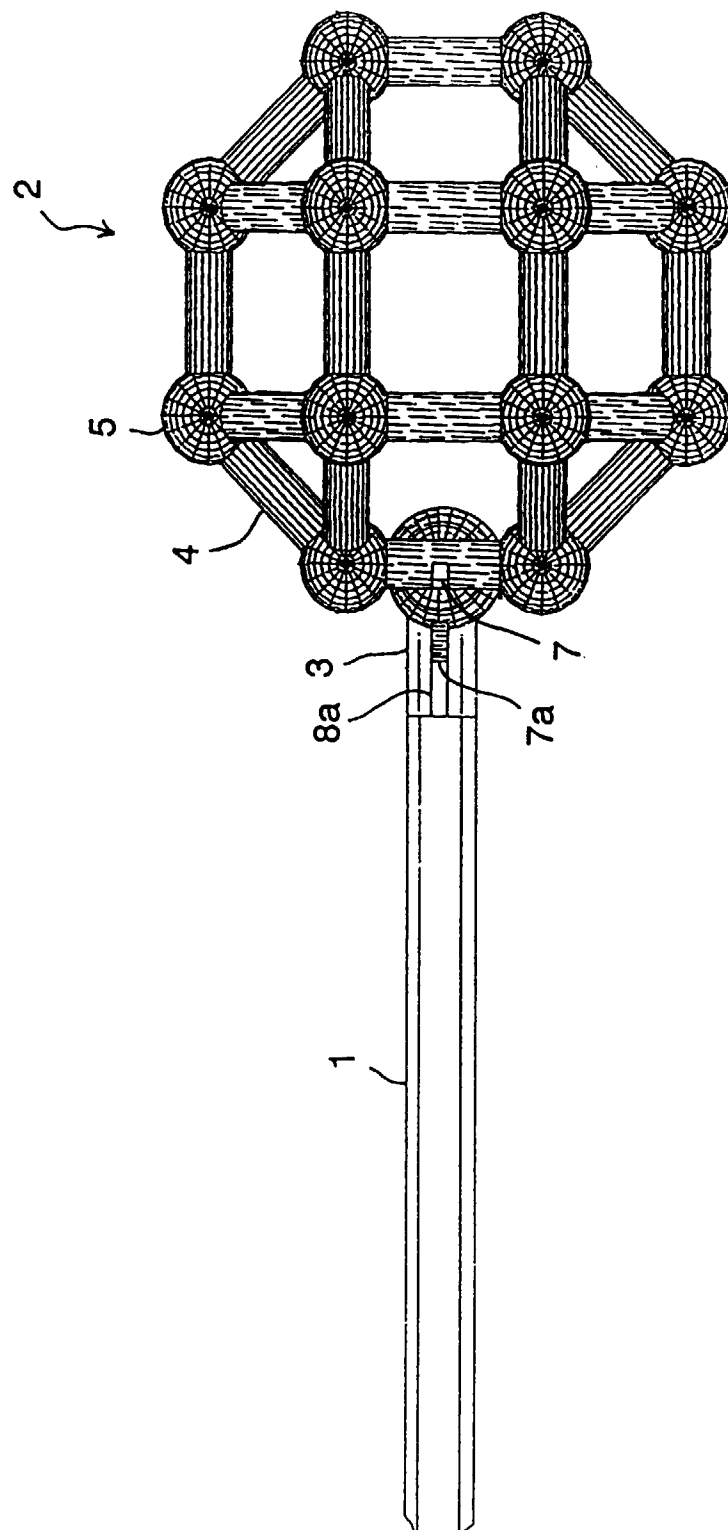


Fig. 3

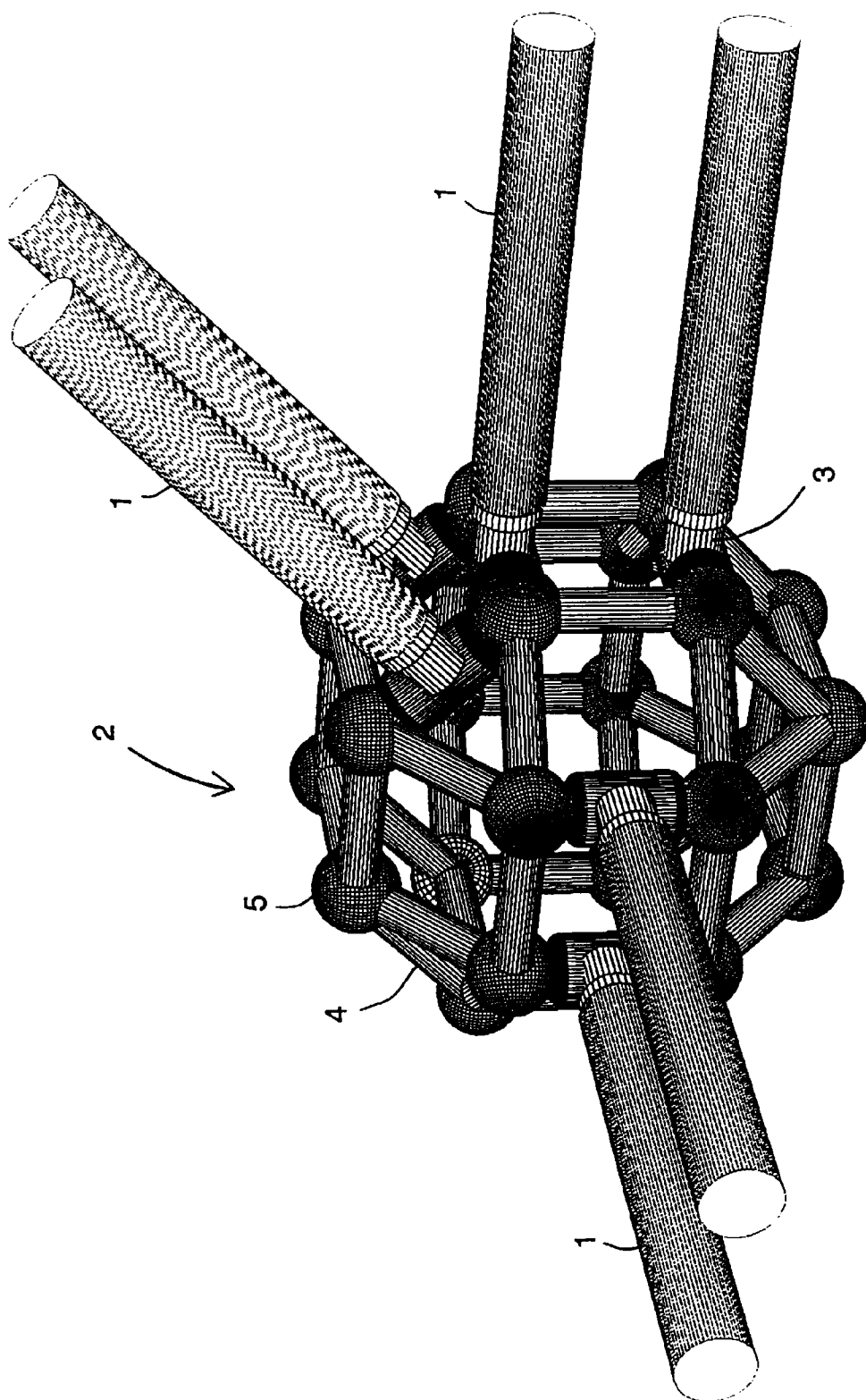


Fig. 4