

DESCRIPTION
IMPROVEMENTS RELATING TO SPACE FRAMES

The invention relates to a space frame of the kind,
5 hereinafter referred to as of the kind described,
comprising a plurality of nodes, each provided with a
plurality of screw threaded sockets; and a plurality of
elongate struts for linking respective pairs of nodes.
Each end of each strut is provided with a longitudinally
10 extending bolt which is freely rotatable relatively to a
strut body and which has a shank with a screw threaded
portion extending from the end of the strut body for
engagement of the screw threaded portion with a respective
node socket, whereby rotation of the bolt draws the end of
15 the strut body towards the node. Each shank is surrounded
by a collar having a non-circular external surface to which
a turning tool can be applied, the collar and the shank
each having one a key and the other a complementary
longitudinal keyway whereby the shank is constrained to
20 rotate with the collar but is movable axially therethrough
and the collar is gripped between the end of the strut body
and the node when the bolt has been fully tightened.

A space frame of this kind is disclosed for example is
EP-B-0044057, and in GB-B-2002482. In 0044057, the
25 complementary key and keyway are provided by a pin which
extends diametrically through, and is fixed in, the bolt,
the ends of the pin engaging in axial slots through the
collar. This is costly to produce and the exposed slots in
the collar are unsightly and may accumulate dirt. In
30 2002482 the key and keyway are provided by a hexagonal
section of the bolt shank, and a surrounding
complementarily shaped inner surface of a hub of the
collar. Although this connection is concealed, it is again
expensive to produce.

35 In accordance with the present invention, in a strut
for a space frame of the kind described, the key and key
way are provided by a ball partly nesting in a recess in

the bolt shank, and a complementary groove extending axially along the inner surface of the collar. This is a very simple arrangement both to produce and assemble. To assist assembly the groove in the collar will normally be
5 open at the end of the collar nearer to the strut body, and closed at its other end.

An additional problem with space frames of the kind described, is that when two nodes are rigidly positioned relatively to one another, as a result of complete, or near
10 complete, assembly of the frame, it is difficult to insert or replace a strut between the two nodes which are at a fixed distance from one another. This is because it is necessary for the screw threaded ends of the bolt shanks to extend from the strut collars, so that they can engage the
15 screw threads in the node sockets, upon rotation of the collars and bolts. However, if the shanks extend, even marginally, from the ends of the strut collars, the strut body, with the collars at its ends, cannot be inserted between two nodes which are spaced by no more than the
20 total length of the strut body and collars. Consequently, some clearance to accommodate the projecting bolt shank, is necessary between the end of each collar and the respective node, so that when the bolts are subsequently tightened into the node sockets, either the collars will not be drawn
25 up closely against the nodes, or the frame will be deflected and stressed by drawing of the nodes towards one another.

In order to overcome this problem, each bolt may be retractable against a spring within the strut body to a
30 position _____

in which the tip of the shank is flush with the outer end of the respective collar, whereby a strut body with collars at each end can be inserted between two fixed nodes having a spacing substantially equal to the combined length of the
 5 strut body and two collars whereupon the springs will extend the bolt shanks so that the screw threaded portions will be pushed into the entrances to the respective node sockets ready for engagement with the socket screw threads when the bolts are turned by a torque applied to the
 10 collars. This solution is the subject of divisional application No. 9116983.9, (GB2248901A).

In one construction each strut body is provided by a tube, each end of which receives a reduced diameter portion of a member which houses the head of the bolt and, behind
 15 the bolt an abutment for a compression spring which is located between the abutment and bolt head.

An example of a space frame constructed in accordance with the present invention is illustrated in the accompanying drawings, in which:-

20 Figure 1 is a side elevation of the end of one strut;
 Figure 2 is a section taken on the line II-II in Figure 1;

Figure 3 is a perspective view of a strut bolt;
 Figure 4 is a perspective view of a strut collar; and,
 25 Figure 5 is a perspective view of a node.

Each strut comprises a body in the form of a steel tube 6, each end of which receives as a force fit a reduced diameter end portion of a tapered housing 7. Captive by its head 8 within the housing is a bolt having a shank 9,
 30 which extends out of the housing and is provided at its end with a screw threaded portion 10. The shank is closely surrounded by a collar 11 having a hexagonal tool engaging portion 12. The bolt is urged out of the housing 7 by a helically coiled compression spring, which abuts _____

at one end a washer 14, engaging the head 8, and at its other end, a washer 15, which is held in position by a circlip 16. The clearance within the housing 7 is such that the bolt can be retracted against the action of the spring 13 until the tip of the screw threaded portion 10 is flush with the outer end of the collar 11. This feature is the subject of divisional application no.

The shank 9 of the bolt is provided with a hemispherical recess 17, in which is seated a steel ball, the ball being slidable within a complementary groove 18 within the interior of the collar 11.

In addition to a number of the struts, the frame comprises a number of nodes, such as that shown in Figure 5. Each node comprises a generally spherical body 19 formed with a symmetrical array of internally screw threaded sockets 20, each complementary to the screw threaded portion 10 of a strut bolt.

A strut may be assembled between two fixed nodes by retracting the bolts within the housing 7 and collars 11, inserting the strut between the nodes, in alignment with two of the sockets 20, whereupon the springs 13 will advance the bolts so that the screw threaded portions 10 of the bolts are urged into the respective sockets 20. Rotation of respective collars 11, by application of a spanner or similar tool to the portions 12, will then screw the bolts into the respective sockets, until the collars 11 are clamped between the ends of the strut body and the nodes. This results from each ball, acting between a respective recess 17 and groove 18, transmitting the rotation of the respective collar 11 to the respective bolt, whilst allowing axial movement of the bolt through the collar. As shown in Figure 2, each groove 18 opens at the strut body end of the respected collars, so that the collar can be assembled on to the bolt shank over the screw threaded portion 10.

CLAIMS

1. A strut for a space frame of the kind comprising a plurality of nodes, each provided with a plurality of screw threaded sockets; and a plurality of elongate struts for linking respective pairs of nodes; the strut having, at each end, a longitudinally extending bolt which is freely rotatable relatively to a strut body and which has a shank with a screw threaded portion extending from the end of the strut body for engagement of the screw threaded portion, in use, with a respective node socket, whereby rotation of the bolt draws the end of the strut body towards the node; each shank being surrounded by a collar having a non-circular external surface to which a turning tool can be applied, the collar and shank each having one a key and the other a complementary longitudinal keyway whereby the shank is constrained to rotate with the collar but is movable axially therethrough and the collar is gripped between the end of the strut body and the node when the bolt has been fully tightened; wherein the key and keyway are provided by a ball partly nesting in a recess in the bolt shank, and a complementary groove extending axially along the inner surface of the collar.
2. A strut according to claim 1, wherein the groove in the collar is open at the end of the collar nearer to the strut body, and closed at its other end.
3. A strut according to claim 1 or claim 2, wherein each bolt is retractable against a spring within the strut body to a position in which the tip of the shank is flush with the outer end of the respective collar, whereby a strut body with collars at each end can, in use, be inserted between two fixed nodes having a spacing substantially equal to the combined length of the strut body and two collars whereupon the springs will extend the bolt shanks so that the screw threaded portions will be pushed into the



entrances to the respective node sockets ready for engagement with the socket screw threads when the bolts are turned by a torque applied to the collars.

- 5 4. A strut according to claim 3, wherein each strut body is provided by a tube, each end of which receives a reduced diameter portion of a member which houses the head of the bolt and, behind the bolt, an abutment for a compression spring which is located between the abutment and bolt head.
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5. A space frame, comprising a plurality of nodes, each provided with a plurality of screw threaded sockets; and a plurality of elongate struts, each according to any one of the preceding claims, for linking respective pairs of
- 15 nodes.
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