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(54) A structural node joint, especially for use in grid structures, and a hollow connecting member and a screw for use in such a joint.

(57) In a structural node joint of the kind comprising

a) a hollow connecting member (1), in the wall (2) of which a number of through-going attachment holes (3,4) are formed,

b) the adjacent ends of a number of rod-shaped or tubular elements (5,6),

c) a number of attachment screws (7,8), the heads (9) abut against the inside of the wall (2), and the shafts (10) of which extend outwardly through the attachment holes (3,4) and are screwed into said ends of the elements (4,6), and

d) an access opening (11) formed in the wall (2) of the connecting member (1), said access opening (11) being sufficiently large to allow the introduction of the screws (7,8) and possibly associated washers (19) through the opening into the internal cavity of the connecting member (1), said access opening being closable by means of a releasably secured closure member (12), the features consist in

e) that the access opening (11) is not substantially larger than what is necessary to allow the heads (9) of the screws (7,8) and possibly associated washers (19) to be introduced through it, and

f) that a thread (14) is formed in the access opening (11).

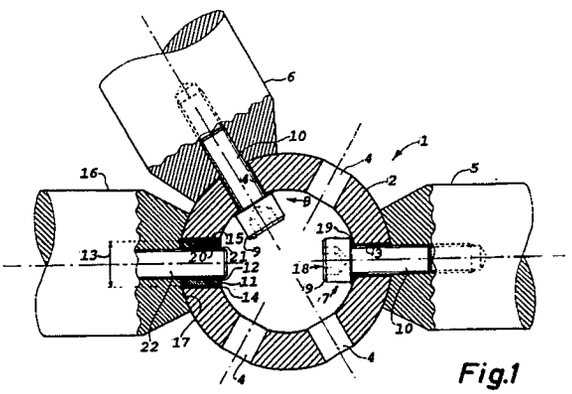

Fig.1

EP 0 386 606 A1

A STRUCTURAL NODE JOINT, ESPECIALLY FOR USE IN GRID STRUCTURES, AND A HOLLOW CONNECTING MEMBER AND A SCREW FOR USE IN SUCH A JOINT

The present invention relates to a structural node joint of the kind set forth in the preamble of claim 1.

Such a structural node joinT is known inter alia from US Patent Specification No. 4.353.662. In the joint thus known, the access opening has a substantial size in relation to the hollow connecting member as a whole, and is closed by a relatively large cap-shaped cover, which is secured to the remainder of the connecting member by means of a through-going bolt. The substantial size of the access opening results in a considerably reduction in the mechanical strength of the connecting member, and hence of the mechanical strength of the complete joint comprising this connecting member.

It is on this background the object of the present invention to provide a structural node joint of the kind referred to initially, in which the hollow connecting member and thus also the joint as a whole exhibits a substantially greater mechanical strength than in the known joints, and this is achieved in a structural node joint, according to the invention exhibiting the features set forth in the characterizing clause of claim 1. The feature mentioned in item e) of claim 1 ensures that the access opening does not weaken the connection member more than necessary to allow the screws to be introduced into the connecting member, and the feature set forth in this claim's item f) makes it possible to close the access opening by merely screwing a plug or the like into it.

The embodiment set forth in claim 2 makes it possible to use also the closure member for attaching a rod-shaped or tubular element included in the joint. This element may e.g. be provided with or end in a threaded stub, that may be screwed into a corresponding threaded bore in the closure member. At this stage it should be noted, that while all those rod-shaped or tubular elements, that are attached to the hollow connecting member by means of the attachment screws, the heads of which abut against the inside of the connecting member, may be attached to the connecting member without being turned, as only the attachment screws are to be turned, it is on the other hand necessary to turn that threaded stub, with which the further rod-shaped or tubular element is to be attached to the closure member, relatively to the latter, and if the threaded stub is secured to or constitutes a part of the element in question, it is possible to avoid problems when assembling each joint by taking care that the access opening faces in such a direction, that a screwing-in of the element in question does not cause problems.

The embodiment set forth in claim 3 makes it possible to introduce some attachment screws, that otherwise would be difficult to place in position. Because of the small size of the access opening in relation to the connecting member as a whole, even two or more such openings will only cause a relatively insignificant reduction of the mechanical strength of the connecting member and hence of the joint.

The embodiment set forth in claim 4 makes it possible that at least those attachment screws being placed in the attachment holes in question may relatively easily be introduced and tightened by using a tool introduced through the access opening in question. For tightening the remaining attachment screws it will in some cases be necessary to use articulated spanners or the like.

The embodiment set forth in claim 5 makes it possible to keep the costs at a reasonably level, since in this case standard screws are used, which are available on the market at a moderate cost.

The embodiment set forth in claim 6 makes it possible to give all those members, with which the various rod-shaped or tubular elements are attached to the connecting member, identical shape, as when used with the attachment holes, the screw heads function in the normal manner as abutment means, whilst the screw heads securing elements facing the access openings are screwed into the threads in these openings.

The present invention also relates to a hollow connecting member for a structural node joint according to the invention. This connecting member is of the kind set forth in the preamble of claim 7, and according to the present invention, it exhibits the features set forth in the characterizing clause of claim 6.

Further embodiments, the effects of which are explained in more detail in the following detailed portion of the present specification, are set forth in claims 8 and 9.

In the following, the present invention is to be explained in more detail with reference to exemplary embodiments of structural node joints according to the invention, shown partly in section in the drawing, in which

Figure 1 shows a first exemplary embodiment, and

Figure 2 show a second exemplary embodiment.

The structural node joint shown in Figure 1 comprises a hollow connecting member 1, which in the example shown is spherical, but generally may have any shape suitable for the particular applica-

tion in question. In the wall 2 of the connecting member 1 there are a number of through-going attachment holes 3 and 4, whereas an attachement screw 7 and 8 has been inserted in the hole 3 and one of the holes 4 respectively, the heads 9 of said attachment screws being tightened up against the inside of the wall 2, their shafts 10 being screwed into the ends of two structural rod elements 5 and 6 respectively, of which only the ends are shown.

The structural rod elements 5 and 6 may be contructed in any manner and from any material being suitable to the particular application in question, but they will not be described in more detail in the present application, since their construction and shape have no direct bearing upon the present invention, with the exception of what is required for the cooperation with the connecting member 1.

Apart from the attachment holes 3 and 4, the wall 2 has an access opening 11, which is somewhat larger than the attachment holes 3, viz. just large enough to make its clear diameter 13 a trifle larger than the largest diameter of the screwheads 9 and their associated washers 19, so that all those attachment screws 7 and 8, that are to be used for attaching the rod elements 5 and 6, may be introduced through the access opening 11 and be placed in the attachment holes 3 and 4 and screwed into the ends of the rod elements 5 and 6 respectively using suitable tools (not shown).

If no structural rod element or other member is to be attached to the side of the connecting member 1 having the access opening 11, the latter may be closed by a threaded plug (not shown), that is screwed into the thread 14 in the opening 11, but in the exemplary embodiment shown in Figure 1 the access opening 11 has screwed into it a closure bushing 12 with an external thread 15 corresponding to the thread 14 in the opening 11. The ball in the closure bushing 12 has a thread 20 cooperating with a corresponding thread 21 on a threaded stub 22, the latter constituting part of or being secured to a further structural rod element 16. The optimal strength of this part of the joint is achieved if the threaded stub 22 is non-rotatably secured to or constitutes a part of the rod element 16, but in that case it is necessary to turn the latter when the threaded stub 22 is to be screwed into the closure bush 12 until an abutment surface 17 on the end of the rod element 16 abuts against the outside of the connecting member 1. With sensible planning of the way, in which the grid structure or space grid structure is to be assembled, this will, however, not cause any problems, as the hollow connecting member 1 is placed in each joint with access opening 11 facing in a direction away from the rod elements already attached.

What has previously been said with regard to the structural rod elements 5 and 6 and their construction and material will, of course, apply to a corresponding extent for the further structural rod element 16.

The attachment screws 7 and 8 shown in Figure 1 have hexagonal recesses 18 for cooperation with a correspondingly hexagonal spanner. The screws may e.g. be of the kind marketed under the trade mark "Unbrako", and the use of these or other standard screws results in the advantage that the joint may be based on the use of ready-made, possibly heat-treated and/or corrosion-protected screws, that would be relatively costly to produce in small numbers, with the exception of the possible attachment of a further structural rod element 16 to one ore more closure bushes 12.

In order to distribute the abutment force between the screw heads 9 and the inside of the wall 2, spherical washers 19 are placed between these parts in a manner known per se.

The attachment screw 7 extending through the attachment hole 4 to the right in Figure 1 may be introduced through the access opening 11 relatively easily, before this opening is closed by the closure bushing 12, e.g. by using a straight hexagonal spanner, which can also be used for tightening the screw. When further attachment screws, e.g. the screw 8, that are not to be aligned with any access opening, are to be placed, the introduction of each screw may require the use of special tools (not shown), while the tightening in many cases may be achieved by introducing a straight hexagonal spanner through an oppositely situated attachment hole. In other cases it will be necessary to use a hexagonal spanner with an articulated shaft when tightening the attachment screws.

For the sake of good order it should be noted, that apart from the attachment holes 3 and 4 and the access opening 11 shown, all being intersected by the sectional plane of the drawing, the connecting member 1 may comprise further attachment holes and possibly also one or more further access openings in front and behind the sectional plane.

As material for the connecting member 1 proper, steel of a strength suited to the particular application may suitably be used. Before the last opening -normally the access opening 11 - is closed completely, a suitable rust-protecting agent may be introduced or injected into the cavity in the connecting member 1.

The exemplary embodiment shown in Figure 2 has many features in common with the embodiment shown in Figure 1, for which reason only those features, by which the former differs from the latter, will be mentioned below with reference to Figure 2.

In the structural node joint in Figure 2, all structural rod elements 5, 6 and 16 are attached to the connecting member 1 by means of uniformly

shaped attachment screws 23, 24 and 25 respectively, the heads 27 of which have an external thread 27 able to fit with the internal thread 14 in the access opening 11. Even if the external diameter 28 on the heads 26 is larger than the clear diameter 13 in the opening 11, it is therefor possible to introduce the screws in the connecting member, as they may be introduced into the opening 11 with their shafts directed inwardly, whereupon the heads 26 are simply screwed through the opening 11 until they are screwed free on the inside and may be placed in the attachment hole 3 or 4 in question and screwed into the rod elements 5 or 6, the screws for this purpose being provided with a hexagonal head 29 or - in an embodiment not shown -with a hexagonal recess of a kind similar to the recess 18 shown in Figure 1.

The screw 25 securing the rod element 16 may in the manner shown be provided with an annular spacer 30, that ensures that the thread engagement between the head 26 and the opening 11 is situated suitably far into the latter. The rod element 16 is attached by simply first screwing the screw 25 into the rod, preferably with the annular spacer 30 in place as shown in Figure 2, whereupon the unit consisting of the rod element 16 and the screw 25 and possibly the spacer 30 is screwed into the opening 11 until the abutment surface 17 abuts against the outside of the wall 2.

In cases where the dimensioning will permit, central ducts my be formed in the rod elements 5, 6 and 16 and in the attachment screws 7 and 8 or 23-25, said ducts making it possible to blow dry air through the grid structure and/or to draw e.g. electrical wires for lamps, loudspeakers and the like, which are suspended in or secured to the grid structure.

Claims

1. A structural node joint of the kind comprising

a) a hollow connecting member (1), in the wall (2) of which a number on through-going attachment holes (3,4) are formed,

b) the adjacent ends on a number of rod-shaped or tubular elements (5,6),

c) a number of attachment screws (7,8;23-25), the heads (9;26) of which abut against the inside of the wall (2), and the shafts (10) of which extend outwardly through the attachment holes (3,4) and are screwed into said ends of the elements (4,6), and

d) an access opening (11) formed in the wall (2) of the connecting member (1), said access opening (11) being sufficiently large to allow the introduction of the screws (7,8) and possibly associated washers (19) through the opening into the internal cavity of the connecting member (1), said access opening being closable by means of a releasably secured closure member (12;26), characterized in

e) that the access opening (11) is not substantially larger than what is necessary to allow the heads (9;26) of the screws (7,8;23-25) and possibly associated washers (19) to be introduced through it, and

f) that a thread (14) is formed in the access opening (11).

2. A joint according to claim 1, characterized in

a) that the closure member (12;26) has a thread (15;27) corresponding to the thread (14) in the access opening (11),

b) that the closure member (12;26) constitutes a part of or is secured to or adapted to be secured to the adjacent end of a further rod-shaped or tubular element (16) and

c) that on the closure member (12;26) or said element (16) there is shaped an abutment surface, which abuts against the outside of the wa11 (2) of the connecting member (1), when the threaded connection between the closure member (12;26) or the element (16) and the connecting member (1) is tightened.

3. A joint according to claim 1 or 2, characterized in that there are two ore more access openings with associated closure members.

4. A joint according to any one or any of the claims 1-3, characterized in that each access opening generally aligns with an attachment hole in the opposite part of the wall of the connecting member.

5. A joint according to any one or any of the claims 2-4, characterized in that the screws (7,8) are of the kind comprising generally circularly cylindrical heads (9), in which there in the end face facing away from the shaft (10) of the screw is formed a non-circular, e.g. hexagonal recess (18), adapted to the be engaged by a correspondingly shaped spanner.

6. A joint according to any one or any of the claims 2-4, characterized in

a) that the heads (26) of the attachment screws (23-25) are provided with a thread (27) adapted to cooperate with the thread (14) formed in the access opening (11), and

b) that that attachment screw (25) being screwed into an element (16) facing the access opening (11) is screwed into the thread (14) in the opening (11) with its head (26).

7. A hollow connecting member (1) for a structural node joint according to any one or any of the claims 1-5 and of the kind, in which there in the wall (2) of the connecting member (1) are formed a number of attachment holes (3,4) for attachment screws (7,8;23-25) extending outwardly through the wall (2), as well as at least one access opening (11)

sufficiently large to allow the screws and any associated washers (19) to be moved through it, said opening being closable by means of a releasably secured closures member (12;26), characterized in

a) that the access opening (11) is not substantially larger than what is necessary to allow the heads (9;26) of the screws (7,8;23-25) and possibly associated washers (19) to be introduced through it, and

b) that a thread (14) is formed in the access opening (11).

8. A connecting member according to claim 7, characterized in

a) that the closure member (12;26) has a thread (15;27) corresponding to the thread (14) in the access opening (11), and

b) that the closure member (12;26) is adapted to be secured to the adjacent end of a further rod-shaped or tubular element (16).

9. A connecting member according to claim 8, characterized in that the closure member comprises an abutment surface adapted to abut against the outside of the wall of the connecting member, when the threaded connection between the closure member and the connecting member is tightened.

10. A screw (23-25) for use in a structural node joint according to claim 7 and with a threaded shaft (10) and a head (26), characterized in that the head (26) is provided with a thread (27) capable of cooperating with the thread (14) in an access opening (11) formed in a hollow connecting member (1).

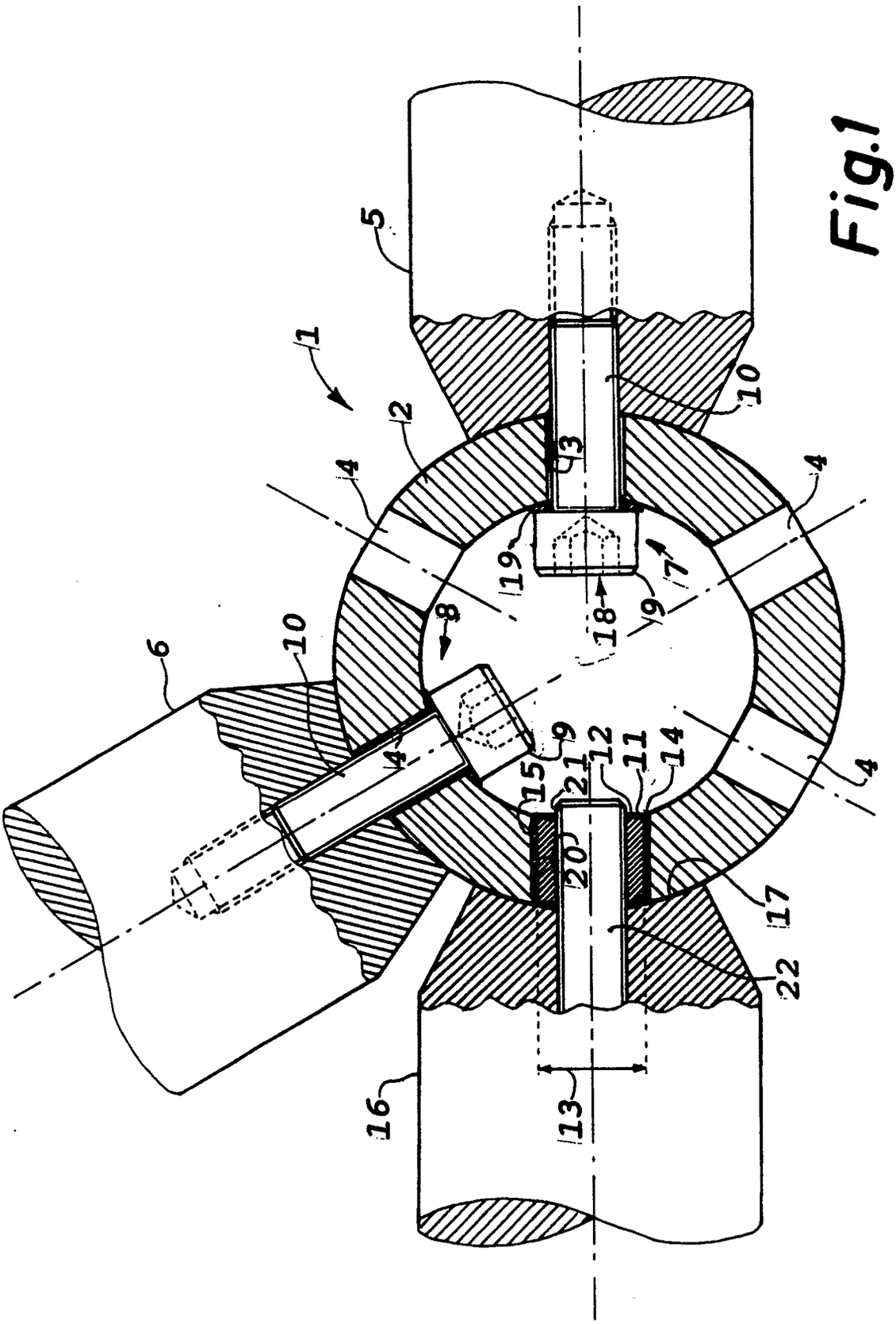

Fig.1

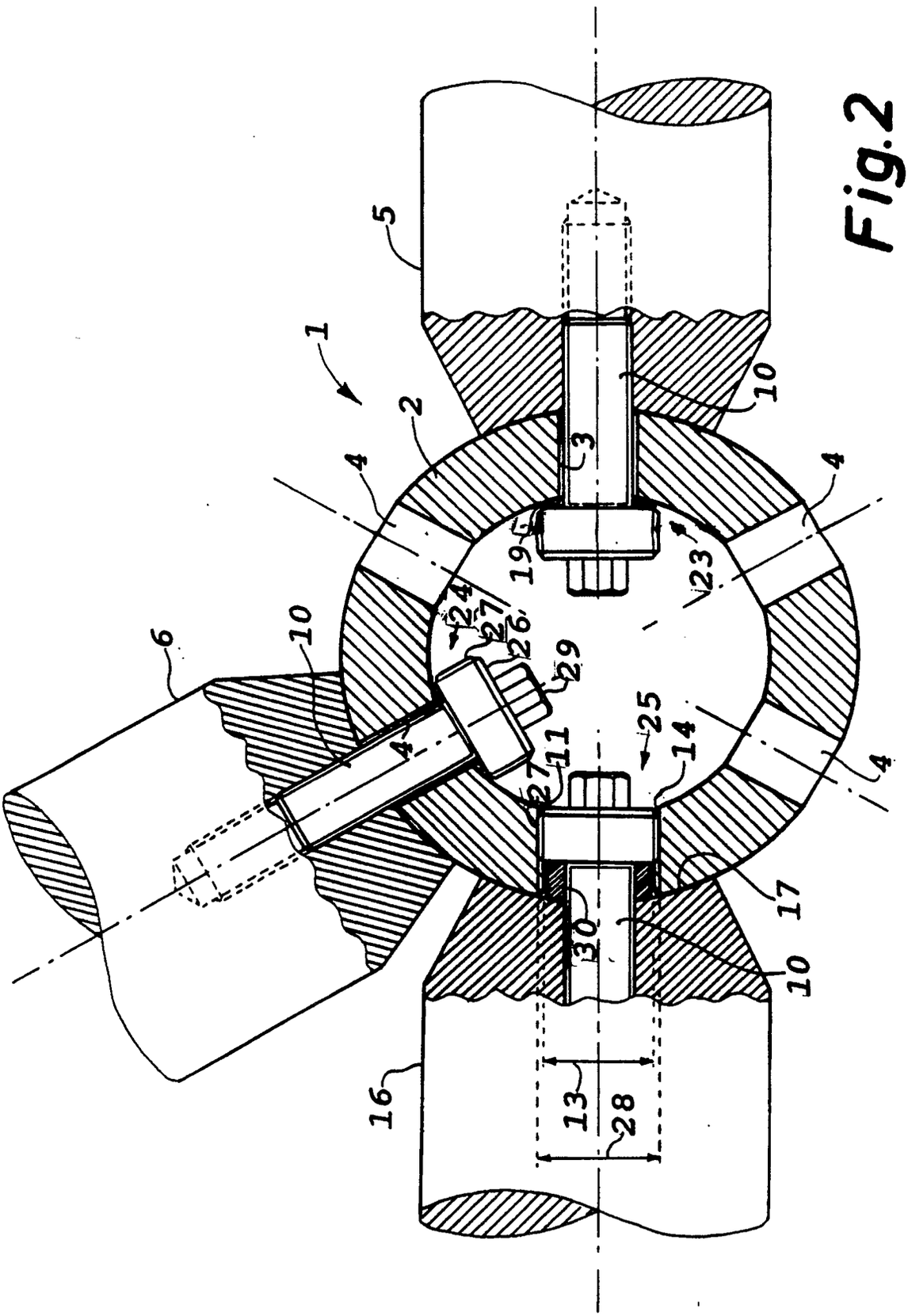

Fig.2

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 90103898.4

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.)
A	GB - A - 2 192 965 (TAN EE PING) * Abstract; fig. 4,5,6 *	1,2,3, 4,5,6, 7,8	F 16 B 7/00 E 04 B 1/38
A	DD - A - 55 868 (SPEER) * Fig. 1,2 *	1,2,3, 6,7,8	
D,A	US - A - 4 353 662 (DU CHATEAU) * Totality *	1,2,3, 4,5,6, 7,8	

TECHNICAL FIELDS SEARCHED (Int. Cl.)

E 04 B 1/00
E 04 G 1/00
E 04 G 7/00
F 16 B 2/00
F 16 B 7/00
F 16 B 9/00
F 16 B 12/00
F 16 B 23/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	27-04-1990	RIEMANN

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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