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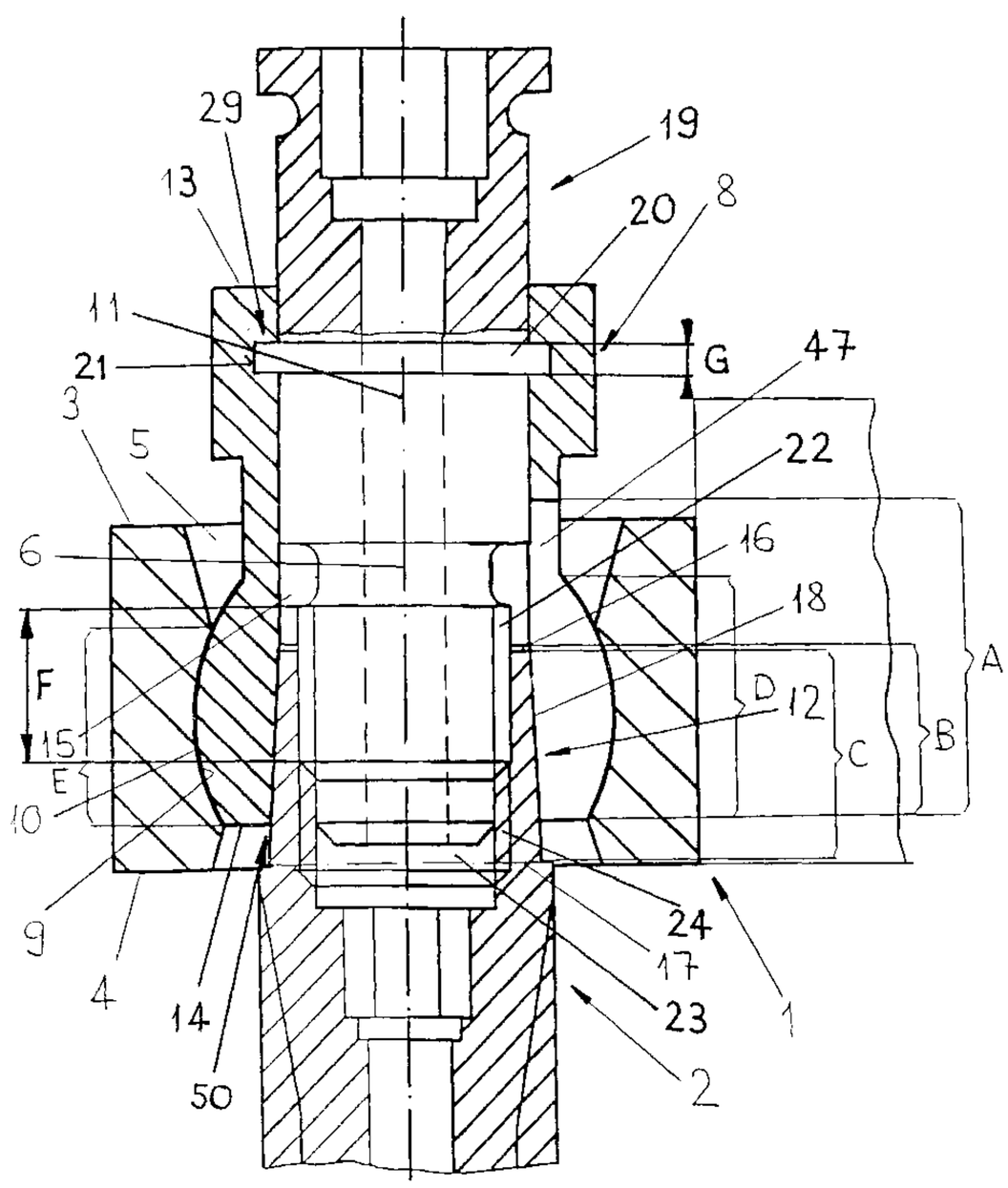

(57) Abrégé/Abstract:
The invention relates to a device for the articulated connection of two bodies. Said device comprises A) a first body (1) which contains a hollow chamber (5) that is positioned coaxially in relation to a central axis (6); B) a clamping element (8) comprising a longitudinal axis (11) and a coaxial bore (15) with at least one opening (50) that adjoins said bore, whereby the clamping element (8) is configured in such a way that it can be elastically deformed in a complementary manner in relation to the hollow chamber (5) and perpendicular to the longitudinal axis (11); C) at least one tensioning element (12) which can be introduced into the opening (50) coaxially in relation to the longitudinal axis (11) and which can extend in an axial direction; D) a second body (2), which can be detachably connected to the first body (1) using the tensioning element(s) (12) and the clamping element (8);

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(57) Abrégé(suite)/Abstract(continued):
E) a drive element (19) which can be used to displace the tensioning element(s) (12) axially in relation to the opening (50), whereby F) the drive element (19) is connected axially to both the clamping element (8) and the tensioning element(s) (12) in a positive fit and in such a way that it can be rotated about the longitudinal axis (11).

Abstract

A device permitting a joint-like connection of two bodies, including

A) a first body (1) which comprises a cavity (5) extending coaxially to a central axis (6);

B) a clamping member (8) having a longitudinal axis (11) and a coaxial bore (15) with at least one contiguous aperture (50), the clamping member (8) being complementary to the cavity (5) and resiliently deformable in a direction vertical to the longitudinal axis (11);

C) at least one tension member (12) insertable coaxially to the longitudinal axis (11) into the bore (50) and widening axially;

D) a second body (2) which is releasably connectable to the first body (1) by means of the at least one tension member (12) and the clamping member (8);

E) a driving member (19) by means of which the at least one tension member (12) is axially displaceable relative to the aperture (50),

F) the driving member (19) being connected to both the clamping member (8) and the at least one tension member (12) in such a way as to be axially in positive engagement while rotatable about the longitudinal axis (11).

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English translation of the International Patent Application No. PCT/CH00/00224 "Device permitting a joint-like connection of two bodies" in the name of Synthes AG Chur

Device permitting a joint-like connection of two bodies

The invention relates to a device permitting a joint-like connection of two bodies as claimed in the precharacterising part of a claim 1.

In the case of various surgical implants such as articulatedly connected, multipart bone plates and osteosynthetic vertebral column fixation devices where for example a longitudinal carrier extending approximately parallel to the vertebral column has to be attached by means of a number of bone screws, the joint-like connections must be releasably lockable. For this purpose, resilient tension members, such as collet chucks, are used. The locking of such joint-like connections is realised by means of an expansion of these resilient tension members within a corresponding cavity with fixed dimensions. This expansion process of resilient tension members is preferably achieved by means of clamping cones or clamping wedges.

An osteosynthetic fixation device including a bone screw to be anchored in a bone, a longitudinal carrier, and a connection member by means of which the bone screw is attachable to the longitudinal carrier is known from WO 94/00066 SCHLÄPFER. This known fixation device comprises a resilient clamping member shaped in the form of a

spherical segment contained between two parallel circles which has a conical bore, and a bone screw having a male taper corresponding to the conical bore of the clamping member and a screw thread arranged in the end portion located opposite to the bone. In the connecting member, a spherical cavity for receiving the clamping member is provided which is adequately dimensioned so as to permit the spherical segment of the clamping member to be pivotably received therein. A second bore serves for receiving the longitudinal carrier. The tightening of a nut screwed over the screw thread formed in said end portion of the bone screw and supported by the clamping member causes the taper formed in the bone screw to be pulled into the inner cone of the clamping member, thus spreading said clamping member apart and pressing it firmly against the wall of the spherical cavity, whereby the connecting member and the bone screw are kept in place relative to each other.

A disadvantage common to all these connections realised by means of clamping cones consists in the difficulties encountered in releasing said connections, which often necessitates heavy hammer blows to be struck on the bone screw or the connecting member or which requires the aid of special instruments.

The invention is intended to provide a remedy for this. It is accordingly an object of the invention to create a clamping connection based on a cone mechanism or wedge mechanism which is apt to be locked and released again by means of a screw driver.

According to the invention, this object is achieved by means of a device permitting a joint-like connection of two bodies which shows the features of claim 1.

The device of the invention permitting a joint-like connection of two bodies comprises a first body with a cavity extending coaxially to a central axis and containing the joint pan, a clamping member with a longitudinal axis and a coaxial bore, the clamping member having a shape complementary to that of the cavity and being resiliently deformable in a direction vertical to the longitudinal axis, at least one tension member insertable coaxially to the longitudinal axis into the bore and widening axially, so that an axial displacement of the at least one tension member within the bore may cause the clamping member to be expanded and releasably locked within the cavity, a second body which is releasably connectable to the first body by means of the at least one tension member and the clamping member, and a driving member by means of which the at least one tension member is axially displaceable relative to the bore. The driving member is connected with both the clamping member and the at least one tension member in such a way as to be axially in positive engagement while rotatable about the longitudinal axis.

Version A:

In a preferred embodiment of the device according to the invention, the axially positive connection rotatable about the longitudinal axis existing between the driving member and the clamping member is realised by means of an annular shoulder formed in the driving member and of a complementary, annular groove formed in the clamping member, whereas the axially positive connection rotatable

about the longitudinal axis existing between the driving member and the tension member is realised by means of a threaded connection.

Version B:

In another embodiment of the device according to the invention, the configurations of the axially positive connections rotatable about the longitudinal axis are inversed. The axially positive connection rotatable about the longitudinal axis existing between the driving member and the clamping member is realised by means of a threaded connection, whereas the axially positive connection rotatable about the longitudinal axis existing between the driving member and the tension member is realised by means of an annular shoulder formed in the driving member and of a complementary, annular groove formed in the tension member.

Version C:

In another embodiment of the device according to the invention, both of the axially positive connections rotatable about the longitudinal axis, the one between the driving member and the clamping member and the one between the driving member and the tension member, are realised in the form of threaded connections. Preferably, one of the two threaded connections is provided with left-hand threads and the other of the two threaded connections is provided with right-hand threads. The thread pitches of the two threaded connections may be of the same amount or of different amounts.

The advantages of the versions A and B reside in their simplicity of manipulation, whereas version C, due to the

two threaded connections, permits a rapid releasing and tightening and, in addition, is easy to manufacture.

The configuration of the cavity formed in the first body and of the clamping member, on which depends the type of joint-like connection to be realised, may be cylindrical or spherical, depending on the application, and is preferably shaped in the form of a spherical segment contained between two parallel circles. In the case of a cylindrical configuration, the clamping member is rotatable only about the central axis of the cavity, whereas in the case of a configuration of the cavity in the shape of a spherical segment between two parallel circles, the clamping member is rotatable about the central axis and about two other axes extending vertically thereto.

In yet another embodiment of the device according to the invention, the second body is integral with the tension member. This embodiment is specially suitable for the use of the device of the invention in a vertebral column fixation system, the second body being preferably realised in the form of a bone screw and the first body having the form of a connecting member between the bone screw and a longitudinal carrier. A configuration of the joint-like connection suitable for this purpose includes a ball-and-socket joint with a cavity shaped in the form of a spherical segment between two parallel circles.

In another embodiment of the device according to the invention, the first body is shaped in the form of a bone plate, whereas the second body forms a connecting member with another bone plate, said elements forming together a bone fixation device including two articulatedly connected

bone plates. A joint-like connection suitable for this purpose has a circularly cylindrical cavity and is pivotable relative to only one axis.

The device according to the invention may in various embodiments also comprise a plurality of tension members which are displaceable coaxially to the longitudinal axis in both directions relative to the bore. In the case of embodiments including two tension members, the clamping member is preferably provided, contiguous to its end portions, with two resiliently deformable, longitudinal sections, so that one tension member may be inserted from each side into the bore.

Further advantageous embodiments of the invention will be characterised in the dependent claims.

The advantages achieved by the present invention consist basically in the fact that the device according to the invention provides a clamping connection based on a cone mechanism or a wedge mechanism which may be locked and, inversely, be released again by means of a screw driver and without the aid of any additional instruments.

In the following, the invention and further developments of the invention will be illustrated in greater detail with reference to the partially diagrammatic representations of several embodiments.

In the drawings:

Fig. 1 is a sectional view of an embodiment of the device according to the invention for connecting a bone fixation element with another implant;

Fig. 2 is a sectional view of another embodiment of the device according to the invention for connecting a bone fixation element with another implant;

Fig. 3 is a sectional view of yet another embodiment of the device according to the invention for connecting a bone fixation element with another implant;

Fig. 4 is a perspective view of an embodiment of the device according to the invention for connecting two plate-like bodies;

Fig. 5 shows a detail of one of the bodies forming the embodiment of the device according to the invention shown in Fig. 4;

Fig. 6 is a sectional view of a further embodiment of the device according to the invention;

Fig. 7 is a view of the embodiment of the device according to the invention shown in Fig. 6 as applied to a vertebral column; and

Fig. 8 is a sectional view of the embodiment of the device according to the invention shown in Fig. 3 as a part of a vertebral column fixation system.

Fig. 1 shows an embodiment of the device according to the invention which comprises a first body 1 shaped in the form

of a connecting member with a top surface 3, a bottom surface 4 extending parallel to the top surface 3, and a cavity 5 with a central axis 6 extending vertically to the top surface 3, a second body 2 shaped in the form of a pedicle screw, a tension member 12 integral with the second body 2, a clamping member 8, and a driving member 19 shaped in the form of a straining screw. The cavity 5 extends through the first body 1 coaxially to the central axis 6 and comprises an axial, longitudinal section E (N = 1) which is spherically concave and rotationally symmetrical relative to the central axis 6. Corresponding to the spherically concave form of the longitudinal section E, the clamping member 8 comprises a longitudinal section D (N = 1), so that the clamping member 8 is rotatable within the cavity 5 about the central axis 6 and about two other axes extending vertically to the central axis 6 and intersecting the centre of the spherical form. The clamping member 8 comprises in addition a longitudinal axis 11, a top end 13, a bottom end 14, and, extending coaxially to the longitudinal axis 11, a bore 15 and an aperture 50 axially contiguous to each other, so that the clamping member 8 is penetrated between the top end 13 and the bottom end 14. Said aperture 50 has a tapered form beginning from the bottom end 14 and extending over a longitudinal section B (N = 1) and is resiliently deformable in a direction vertical to the longitudinal axis 11 over a longitudinal section A (N = 1) containing said longitudinal section B. The resilient deformability is obtained by means of slots 47, the aperture preferably comprising four such slots 47 arranged about the circumference with a radial offset of 90 degrees and penetrating parallel to the longitudinal axis 11 from the bottom surface 14. The tension member 12 (M = 1) of this embodiment is formed integral with the

second body 2, the bottom end 17 being contiguous to the second body 2. The tension member 12 is inserted with its top end 16 from the bottom end 14 into the aperture 50 formed in the clamping member 8. The tension member 12 has an axially tapered form extending towards the top end 16 over a longitudinal section C (N = 1) which is complementary conical to the longitudinal section B of the aperture 50, so that the tension member 12 and the clamping member 8 form a conical clamping connection 18. A coaxial displacement of the tension member 12 within the aperture 50 causes the resilient longitudinal section A to be radially spread apart or to regain its initial position, as the tension member 12 is displaced in the opposite direction. This conical clamping connection allows the second body 2, which is integral with the tension member 12, to be releasably connected with the first body 1. The axial displacement of the tension member 12 is made possible by turning the driving member 19, realised in the form of a straining screw, about the longitudinal axis 11. The rotatable and axially positive connection 29 between the driving member 19 and the clamping member 8 on the longitudinal section G is realised in the form of a coaxial, annular shoulder 20 formed on the clamping member 8 and of a corresponding annular groove 21 formed in the bore 15. The connection between the driving member 19 and the tension member 12, which is also axially positive and rotatable about the longitudinal axis 11, is realised in the form of a threaded engagement between an external screw thread 22 formed in the driving member 19 and a corresponding internal screw thread 24 formed in a bore 23 which penetrates into the tension member 12 from the top end 16. This threaded engagement allows the tension member 12 to be axially displaced within the clamping

member 8, as the driving member 19 is rotated, while the axial forces occurring between the driving member 19 and the clamping member 8 are absorbed by the shoulder 20 of the driving member 19 located within the groove 21.

Fig. 2 shows an embodiment of the device according to the invention which differs from the embodiment of the device according to the invention shown in Fig. 1 only in so far as the axial displacement of the tension member 12 within the clamping member 8 is realised by means of a threaded connection comprising an external screw thread 25 formed in a longitudinal section G of the driving member 19 and a complementary, internal screw thread 26 formed in the bore 15. The connection between the driving member 19 and the tension member 12, which is axially positive and rotatable about the longitudinal axis 11, is realised by means of anchoring means 29 arranged in the longitudinal section F of the driving member 19 which absorb the axial forces occurring between the driving member 19 and the tension member 12. These anchoring means are realised in the form of a coaxial, annular shoulder 27 formed in the driving member 19 which is located within an annular groove 28, said groove 28 being arranged in a bore 23 which penetrates into the tension member 12 from its top end 16.

Fig. 3 shows an embodiment of the device according to the invention which represents a combination of the embodiments shown in Figs. 1 and 2. On the one hand, the driving member 19 is connected to the clamping member 8 by means of a first threaded connection comprising an external screw thread 22 formed in the longitudinal section F of the driving member 19 and a corresponding, internal screw thread 24 arranged in a bore 23 of the tension member 12

which penetrates concentrically to the longitudinal axis 11 into said tension member 12 from the top end 16. On the other hand, by means of a second threaded connection comprising an external screw thread 30 formed in the longitudinal section G of the driving member 19 and a complementary, internal screw thread 31 formed in the bore 15 of the clamping member 8, the driving member 19 is connected to the clamping member 8 in such a way as to be axially in positive engagement while rotatable about the longitudinal axis 11.

Fig. 4 shows an embodiment of the device according to the invention comprising a first plate-like body 1 with a top surface 3, a bottom surface 4 extending parallel to the top surface 3, and a cavity 5 with a central axis 6 extending vertically to the top surface 3, a second plate-like body 2, a tension member 12, a clamping member 8, and a driving member 19 shaped in the form of a straining screw. The clamping member 8 defines the axis of rotation of the joint-like connection. The cavity 5 extends coaxially to the central axis 6 through the first body 1 and comprises a longitudinal section E (N = 1) which is circularly cylindrical and rotationally symmetrical relative to the central axis 6. Corresponding to the circularly cylindrical form of the longitudinal section E, the clamping member 8 comprises a longitudinal section D (N = 1), so that the clamping member 8 is rotatable about the central axis 6 within the cavity 5. The clamping member 8 comprises in addition a longitudinal axis 11, a top end 13, a bottom end 14, and, extending coaxially to the longitudinal axis 11, a bore 15 and an aperture 50 axially contiguous to each other, so that the clamping member 8 is penetrated from the top end 13 to the bottom end 14. This aperture 50 has a

tapered form beginning from the top end 13 and extending over a longitudinal section B (N = 1) and is resiliently deformable in a direction vertical to the longitudinal axis 11 over a longitudinal section A (N = 1) containing said longitudinal section B. The resilient deformability is obtained by the fact that in the longitudinal section A, the opening 50 penetrates the clamping member 8 also in a direction vertical to the longitudinal axis 11. The tension member 12 is inserted with its bottom end 17 from the top end 13 into the aperture 50 formed in the clamping member 8. The tension member 12 has a tapered form extending parallel to the longitudinal axis 11 on a longitudinal section C (N = 1) which is complementary to the longitudinal section B of the aperture 50, so that the tension member 12 and the clamping member 8 form a wedge-shaped clamping connection 49. A coaxial displacement of the tension member 12 within the aperture 50 causes the resilient longitudinal section A to be radially spread apart or to resiliently regain its initial position, as the tension member 12 is displaced in the opposite direction. From the bottom end 17 to the longitudinal section C, the tension member 12 is shaped in a square form corresponding to the square socket 37 (Fig. 5) formed in the bore 36 of the second body 2 extending coaxially to the longitudinal axis 11, which allows the second body 2 to be kept in place together with the tension member 12 relative to a rotation about the longitudinal axis 11. The displacement of the tension member 12 parallel to the longitudinal axis 11 is made possible by turning the driving member 19, realised in the form of a straining screw, about the longitudinal axis 11. On the one hand, by means of a first threaded connection comprising an external screw thread 22 formed in the longitudinal section F of the driving member 19 and of

a complementary, internal screw thread 24 formed in the tension member 12, the driving member 19 is connected to the clamping member 12 in such a way as to be axially in positive engagement while rotatable about the longitudinal axis 11, the internal screw thread 24 being arranged in a bore 23 extending concentrically to the longitudinal axis 11 through the tension member 12. On the other hand, by means of a second threaded connection comprising an external screw thread 30 formed in the longitudinal section G of the driving member 19 and of a complementary, internal screw thread 31 formed in the bore 15 of the clamping member 8, the driving member 19 is connected to the clamping member 8 in such a way as to be axially in positive engagement while rotatable about the longitudinal axis 11. In order to be secured against rotation about the central axis 6, the clamping member 8 is provided with an external toothing 33 formed in the longitudinal section D which is engageable with a corresponding internal toothing 35 formed in a longitudinal section E of the cavity 5.

Fig. 6 shows an embodiment of the device according to the invention which differs from the embodiment shown in Fig. 4 only in so far as it comprises a clamping member 8 with a first aperture 50 having a first, conically or wedge-shaped, tapered form beginning from the top end 13 and extending over a longitudinal section B, and a second aperture 50' having a second, conically or wedge-shaped, tapered form beginning from the bottom end 14 and extending over a longitudinal section B', as well as two tension members 12;12' which are complementary thereto. The driving member 19 is mounted within the clamping member 8 in such a way as to be axially in positive engagement while rotatable about the central axis 6. By analogy with the embodiment

shown in Fig. 2, the anchoring means 29 consist of a concentric, annular shoulder 27 formed in the longitudinal section G of the driving member 19 which is mounted in a complementary, annular groove 28 formed in the clamping member 8. Both tension members 12,12' are connected to the driving member 19 by means of threaded connections, one of said threaded connections having a right-hand thread whereas the other threaded connection has a left-hand thread.

Fig. 7 shows an application of the embodiment of the device according to the invention shown in Fig. 6 as a multipart bone plate attached laterally on a vertebral column. The body 1 forms a first part of the bone plate attached to the cranial vertebral body 43 by means of bone screws 41, whereas the body 2 serves as a connecting member with a part 40 of the bone plate attached to the caudal vertebral body 44. By means of the clamping member 8 which is mounted in the body 1 in such a way as to be rotatable about the central axis 6 (Fig. 6) extending vertically to the surface of the vertebral body 43, the body 2 is on one side articulatedly connected to the body 1. The second part 40 of the bone plate is connected to the other side of the body 2 in such a way as to be displaceable parallel to the longitudinal axis of the vertebral column and lockable by means of two set screws 42, so that the bone plate allows an angular movement of the vertebral bodies 43;44 relative to each other and a displacement of said vertebral bodies parallel to the longitudinal axis of the vertebral column. The joint can be locked by means of the driving member 19.

Fig. 8 illustrates the application of the embodiment of the device according to the invention shown in Fig. 3 as a

connecting member within a vertebral column fixation system. The body 1 serves as a connecting member between the body 2 shaped in the form of a pedicle screw and a longitudinal carrier 45. The longitudinal carrier 45 is kept in place within the body 1 for example by means of a screw 46. Such a vertebral column fixation system is known for example from WO 94/00066 SCHLÄPFER et al.

Claims

1. A device permitting a joint-like connection of two bodies, including

A) a first body (1) comprising a top surface (3), a bottom surface (4), and a cavity (5) extending coaxially to a central axis (6), the central axis (6) intersecting both the top surface (3) and the bottom surface (4), and the cavity (5) leading at least to the top surface (3);

B) a clamping member (8) with a longitudinal axis (11), a top end (13), a bottom end (14), and a bore (15) extending coaxially to the longitudinal axis (11) which leads to at least one aperture (50), the outside contour of the clamping member (8) in the area of the at least one aperture (50) being shaped in a form complementary to that of the cavity (5) and being resiliently deformable vertically to the longitudinal axis (11);

C) at least one tension member (12) insertable coaxially to the longitudinal axis (11) into the aperture (50), so that an axial displacement of the at least one tension member (12) within the corresponding aperture (50) may cause the clamping member (8) to be expanded and releasably locked within the cavity (5);

D) a second body (2) which is releasably connectable to the first body (1) by means of the at least one tension member (12) and of the clamping member (8);

E) a driving member (19) by means of which the at least one tension member (12) is axially displaceable relative to the corresponding aperture (50),

characterized in that

F) the driving member (19) is connected to both the clamping member (8) and the at least one tension member

(12) in such a way as to be axially in positive engagement while rotatable about the longitudinal axis (11).

2. A device as claimed in claim 1, characterised in that the clamping member (8) has a through bore extending along the longitudinal axis (11).

3. A device as claimed in claim 1 or 2, characterised in that the clamping member (8) comprises X slots (47) extending substantially in an axial direction and connecting the aperture (50) with the outside contour of the clamping member (8).

4. A device as claimed in claim 3, characterised in that X = 1.

5. A device as claimed in claim 3, characterised in that X = 2 and that the two slots (47) are arranged collaterally opposite to each other.

6. A device as claimed in claim 3, characterised in that X < 12 and X ≥ 3, X being preferably = 6.

7. A device as claimed in claim 5, characterised in that the two slots (47) and the respective aperture (50) continuously merge into each other.

8. A device as claimed in any of the claims 3 to 7, characterised in that the at least one aperture (50) extends coaxially to the longitudinal axis (11).

9. A device as claimed in claim 8, characterised in that the at least one aperture (50) is rotationally symmetrical.

10. A device as claimed in any of the claims 1 to 9, characterised in that the longitudinal axis (11) and the central axis (6) are in alignment.

11. A device as claimed in any of the claims 1 to 10, characterised in that the outside contour of the clamping member (8) in the area of contact with the wall defining the cavity (5) is rotationally symmetrical relative to the longitudinal axis (11).

12. A device as claimed in any of the claims 1 to 11, characterised in that it comprises at least one tension member (12), said at least one tension member (12) being displaceable in both directions coaxially to the longitudinal axis (11) and relative to the at least one aperture (50) by means of the driving member (19).

13. A device as claimed in any of the claims 1 to 12, characterised in that

A) the wall of the cavity (5) includes N ($N \geq 1$) longitudinal sections (E_i) ($i = 1$ to N);

B) the clamping member (8) has at least K ($K \geq 1$) longitudinal sections (A_i) ($i = 1$ to K) extending axially which are resiliently deformable in a direction vertical to the longitudinal axis (11);

C) the outside contour of the clamping member (8) in the area of the longitudinal sections (A_i) ($i = 1$ to K) has at least N ($N \geq 1$) longitudinal sections (D_i) ($i = 1$ to N) extending axially which are complementary, as far as their geometry and their surface structure are concerned, to the longitudinal sections (E_i) ($i = 1$ to N);

D) the device comprises M (M ≥ 1) tension members (12) having each a top end (16) and a bottom end (17);
E) the at least one aperture (50) of the clamping member (8) has in total at least M (M ≥ 1) axially arranged longitudinal sections (B_i) (i = 1 to M) which enter into contact with the M (M ≥ 1) tension members (12), as they are spread apart;
F) the M (M ≥ 1) tension members (12) are actively displaceable in both directions coaxially to the at least one aperture (50) by means of the driving member (19), whereby the resilient longitudinal sections (A_i) (i = 1 to K) are spread apart or moved back to their initial positions vertically to the longitudinal axis (11) so that the longitudinal sections (D_i) (i = 1 to N) may be locked within, or inversely released from, the longitudinal sections (E_i) (i = 1 to N) of the cavity (5),
G) the driving member (19) being connected in a longitudinal section (G) extending coaxially to the longitudinal axis (11) to the clamping member (8) and in M (M ≥ 1) longitudinal sections (F_j) (j = 1 to M) extending coaxially to the longitudinal axis (11) to the M (M ≥ 1) tension members (12) in such a way as to be axially in positive engagement while rotatable about the longitudinal axis (11).

14. A device as claimed in claim 12, characterised in that the aperture (50) has an axially tapered form extending at least over the area of the longitudinal sections (D_i) (i = 1 to N).

15. A device as claimed in claim 13, characterised in that the tension members (12) have an axially tapered form

extending at least over the area of the longitudinal sections (C_i) (i = 1 to M).

16. A device as claimed in claim 14, characterised in that the tension members (12) have an axially tapered form extending over the area of the longitudinal sections (C_i) (i = 1 to M) and being complementary to the longitudinal sections (D_i) (i = 1 to N).

17. A device as claimed in any of the claims 13 to 16, characterised in that K = N.

18. A device as claimed in any of the claims 13 to 17, characterised in that K = M.

19. A device as claimed in any of the claims 13 to 18, characterised in that M = N.

20. A device as claimed in any of the claims 13 to 19, characterised in that K = 1.

21. A device as claimed in any of the claims 13 to 20, characterised in that M = 1.

22. A device as claimed in any of the claims 13 to 21, characterised in that N = 1.

23. A device as claimed in claims 20 to 22, characterised in that the tension member (12) has a bore (23) extending concentrically to the longitudinal axis (11) and that in the longitudinal section (F_i) (i = 1) the driving member (19) may be screwed into said bore (23) coaxially to the longitudinal axis (11) while being connected, in the

longitudinal section (G), to the clamping member (8) by means of anchoring means 29 in such a way as to be axially in positive engagement while rotatable about the longitudinal axis (11).

24. A device as claimed in claim 23, characterised in that the driving member (19) has an external screw thread (22) formed in the longitudinal section (F_i) (i = 1) and that the bore (23) of the tension member (12) has a complementary, internal screw thread (24) extending concentrically to the longitudinal axis (11).

25. A device as claimed in claim 24, characterised in that the anchoring means (29) consist of an annular shoulder (20) formed in the longitudinal section (G) of the driving member (19) and of a complementary, annular groove (21) formed in the bore (15) of the clamping member (8).

26. A device as claimed in claim 25, characterised in that the bore (15) is open from the bottom end (14) of the clamping member (8) so that the driving member (19) may be inserted laterally into the groove (21).

27. A device as claimed in claims 20 to 22, characterised in that the driving member (19) in the longitudinal section (G) may be screwed into the bore (15) of the clamping member (8) coaxially to the longitudinal axis (11) whereas it is connected, in the longitudinal section (F_i) (i = 1), to the tension member (12) by means of anchoring means (29) in such a way as to be axially in positive engagement while rotatable about the longitudinal axis (11).

28. A device as claimed in claim 27, characterised in that the driving member (19) has an external screw thread (25) formed in the longitudinal section (G) and that the bore (15) of the tension member (8) has a complementary, internal screw thread (26) extending concentrically to the longitudinal axis (11).

29. A device as claimed in claim 28, characterised in that the anchoring means (29) consist of an annular shoulder (27) formed in the longitudinal section (F_1) (i = 1) of the driving member (19) and of a complementary, annular groove (28) formed in the bore (23) of the tension member (12).

30. A device as claimed in claim 29, characterised in that the bore (23) is open from the top end (16) of the tension member (12) so that the driving member (19) may be inserted laterally into the groove (28).

31. An anchoring member as claimed in claims 20 to 22, characterised in that

A) the driving member (19) has an external screw thread (22) formed in the longitudinal section (Fi) ($_i$ = 1) and the tension member (12) has a bore (23) with a complementary, internal screw thread (24) extending concentrically to the longitudinal axis (11);

B) the driving member (19) has an external screw thread formed in the longitudinal section (G) and the clamping member (8) has a complementary, internal screw thread (31) formed in the bore (15).

32. A device as claimed in claim 31, characterised in that the internal screw thread (24) and the corresponding, external screw thread (22) form a first threaded connection

and that the internal screw thread (31) and the corresponding external screw thread (30) form a second threaded connection.

33. A device as claimed in claim 32, characterised in that the one threaded connection is shaped in the form of a left-hand thread and the other threaded connection is shaped in the form of a right-hand thread.

34. A device as claimed in claim 33, characterised in that the pitch angles of the two threaded connections are identical.

35. A device as claimed in claim 32 or 33, characterised in that the pitch angles of the two threaded connections are different.

36. A device as claimed in any of the claims 13 to 35, characterised in that the clamping member (8) in the area of the longitudinal sections (E_i) (i = 1 to N) of the cavity (5) is connectable to the first body (1) in such a way as to be in non-positive engagement.

37. A device as claimed in any of the claims 13 to 35, characterised in that the clamping member (8) in the area of the longitudinal sections (E_i) (i = 1 to N) of the cavity (5) is connectable to the first body (1) in such a way as to be in positive engagement.

38. A device as claimed in any of the claims 13 to 37, characterised in that the M ($M \geq 1$) tension members (12) in the longitudinal sections (C_i) (i = 1 to M) have a conical taper.

39. A device as claimed in any of the claims 13 to 37, characterised in that the clamping member (8) in the longitudinal sections (B_i) (i = 1 to M) has a conical taper.

40. A device as claimed in claims 38 and 39, characterised in that said tapers are complementary.

41. A device as claimed in any of the claims 13 to 37, characterised in that the M (M > 1) tension members (12) in the longitudinal sections (C_i) (i = 1 to M) have a wedge-shaped taper.

42. A device as claimed in any of the claims 13 to 37, characterised in that the clamping member (8) in the longitudinal sections (B_i) (i = 1 to M) has a wedge-shaped taper.

43. A device as claimed in claims 41 and 42, characterised in that said tapers are complementary.

44. A device as claimed in any of the claims 13 to 43, characterised in that the M (M ≥ 1) tension members (12) are connectable to the body (2) in such a way as to be in non-positive engagement.

45. A device as claimed in any of the claims 13 to 43, characterised in that the M (M ≥ 1) tension members (12) are connectable to the body (2) in such a way as to be in positive engagement.

46. A device as claimed in any of the claims 13 to 45, characterised in that M = 1 and N = 1.

47. A device as claimed in claim 46, characterised in that the tension member (12) is integral with the second body (2).

48. A device as claimed in any of the claims 13 to 47, characterised in that the outer lateral area (10) of the clamping member (8) and the wall of the cavity (5) in the area of at least one of the pairs of longitudinal sections D_i and E_i (i = 1 to N) are shaped in complementary, circularly cylindrical forms.

49. A device as claimed in any of the claims 13 to 48, characterised in that K = 2, M = 2 and N = 2.

50. A device as claimed in claim 49, characterised in that

A) the cavity (5) comprises two longitudinal sections (E,E'), one of said longitudinal sections (E,E') leading to the top surface (3), the other to the bottom surface (4);
B) adjacent to the bore (15), two apertures (50;50') are arranged which have tapered forms, beginning each from one end (13;14) and extending over a longitudinal section (B;B');
C) the clamping member (8) in a longitudinal section (A;A') beginning from the end (13;14) and including the longitudinal section (B;B') is resiliently deformable vertically to the longitudinal axis (11) and has on its longitudinal section (D;D'), which at least partially includes the longitudinal section (A;A'), a form corresponding to that of the longitudinal section (E;E');
D) the device comprises two tension members (12;12');

E) the driving member (19) comprises an external screw thread (22) formed in the longitudinal section (F) and an external screw thread (51) formed in the longitudinal section (F'), one of said screw threads being a left-hand thread, the other a right-hand thread; and

F) one of the tension members (12;12') has an internal screw thread (24) corresponding to the external screw thread (22) and the other has an internal screw thread (52) corresponding to the external screw thread (51).

51. A device as claimed in claim 50, characterised in that the external screw thread (22) and the external screw thread (51) have pitch angles of identical amounts.

52. A device as claimed in claim 50, characterised in that the external screw thread (22) and the external screw thread (51) have pitch angles of different amounts.

53. A device as claimed in claim 51 or 52, characterised in that the apertures (50;50') in the areas of the longitudinal sections (B;B') are conically shaped.

54. A device as claimed in claim 51 or 52, characterised in that the tension members (12;12') in the areas of the longitudinal sections (C;C') are conically shaped.

55. A device as claimed in claim 53, characterised in that the tension members (12;12') in the areas of the longitudinal sections (C;C') are conically complementary to the longitudinal sections (B;B').

56. A device as claimed in claim 51 or 52, characterised in that the apertures (50;50') in the areas of the longitudinal sections (B;B') are wedge-shaped.

57. A device as claimed in claim 51 or 52, characterised in that the tension members (12;12') in the areas of the longitudinal sections (C;C') are wedge-shaped.

58. A device as claimed in claim 56, characterised in that the tension members (12;12') in the areas of the longitudinal sections (C;C') are wedge-shaped and complementary to the longitudinal sections (B;B').

59. A device as claimed in any of the claims 1 to 58, characterised in that the clamping member (8) and the body (1) are connectable in such a way as to be in non-positive engagement.

60. A device as claimed in any of the claims 1 to 58, characterised in that the clamping member (8) and the body (1) are connectable in such a way as to be in positive engagement.

61. A device as claimed in any of the claims 13 to 60, characterised in that the clamping member (8) comprises an outer lateral surface (10) which in the longitudinal section (D_i) (i = 1 to N) is provided with a three-dimensionally structured portion.

62. A device as claimed in any of the claims 13 to 61, characterised in that the cavity (5) in the longitudinal section (E_i) (i = 1 to N) is provided with a three-dimensionally structured portion.

63. A device as claimed in any of the claims 13 to 60, characterised in that the clamping member (8) comprises an outer lateral surface (10) which is roughened in the longitudinal section (D_i) (i = 1 to N).

64. A device as claimed in any of the claims 13 to 60, characterised in that the cavity (5) is roughened in the longitudinal section (E_i) (i = 1 to N).

65. A device as claimed in any of the claims 13 to 60, characterised in that the clamping member (8) comprises an outer lateral surface (10) which in the longitudinal section (D_i) (i = 1 to N) is provided with a toothing (33).

66. A device as claimed in claim 65, characterised in that the cavity (5) in the longitudinal section (E_i) (i = 1 to N) is provided with a toothing (35) which corresponds to the toothing (33).

67. A device as claimed in any of the claims 13 to 66, characterised in that the body (1) in the longitudinal section (E_i) (i = 1 to N) and the clamping member (8) in the longitudinal section (D_i) (i = 1 to N) have different degrees of hardness.

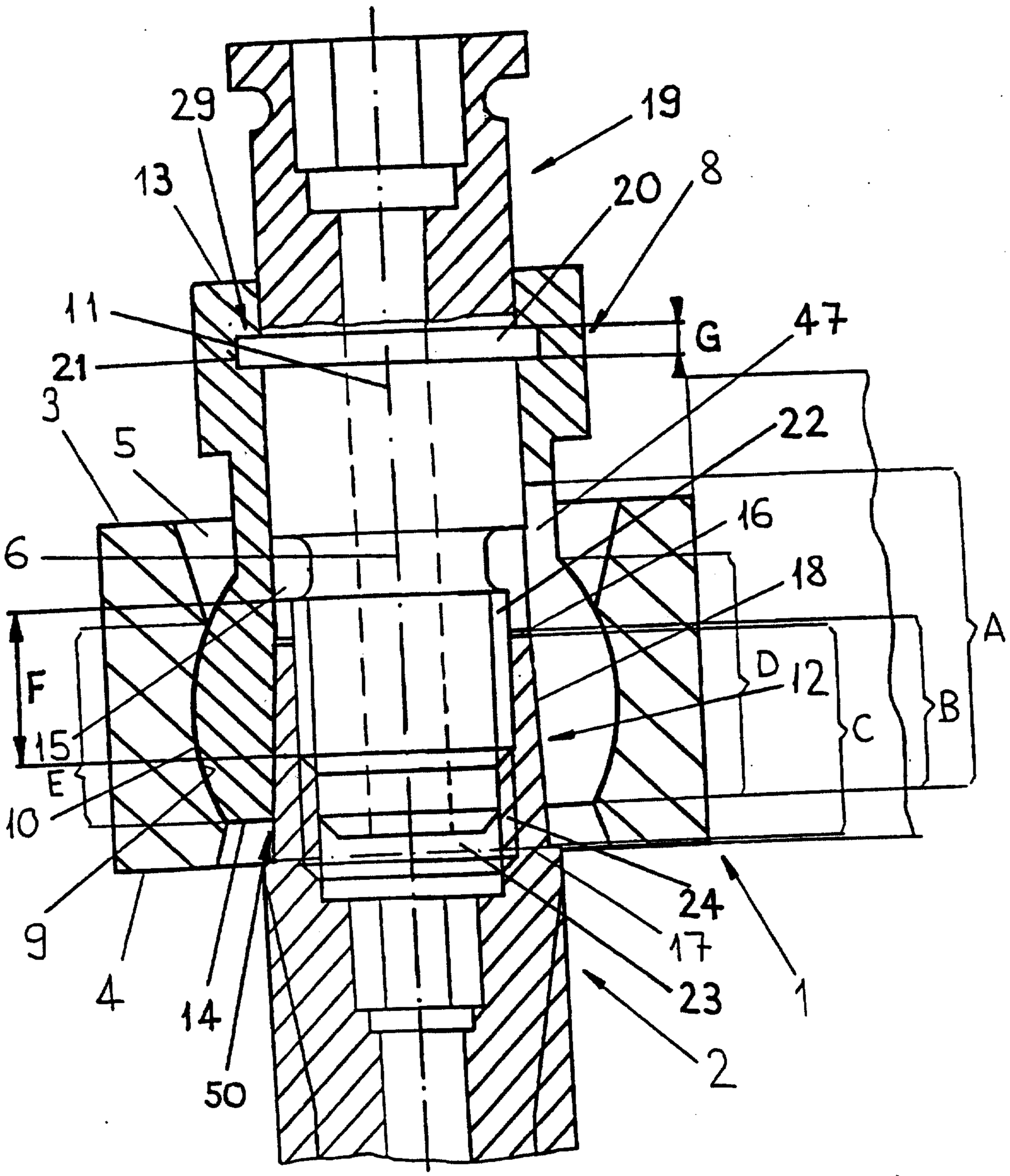
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Fig. 1

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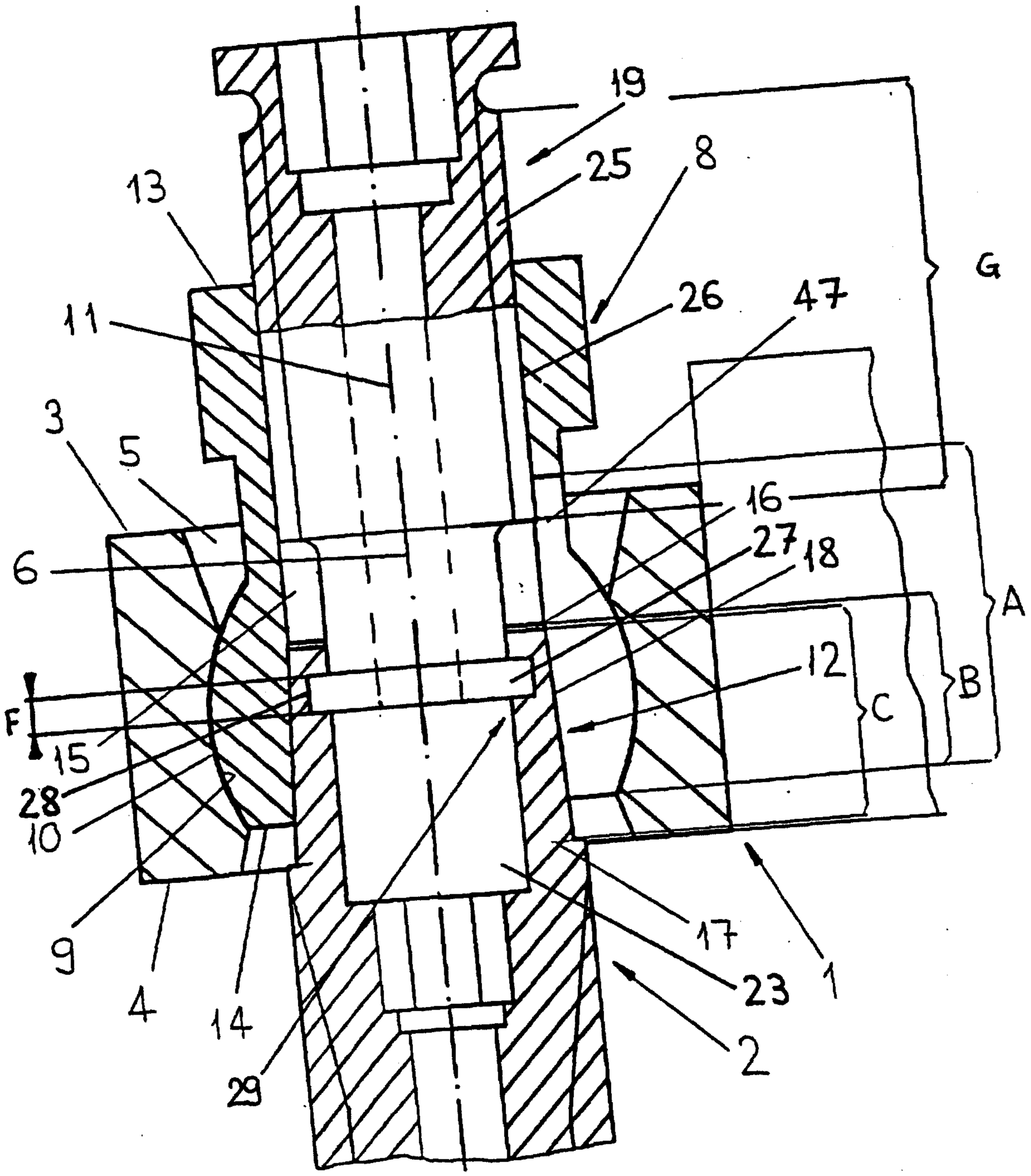

Fig. 2

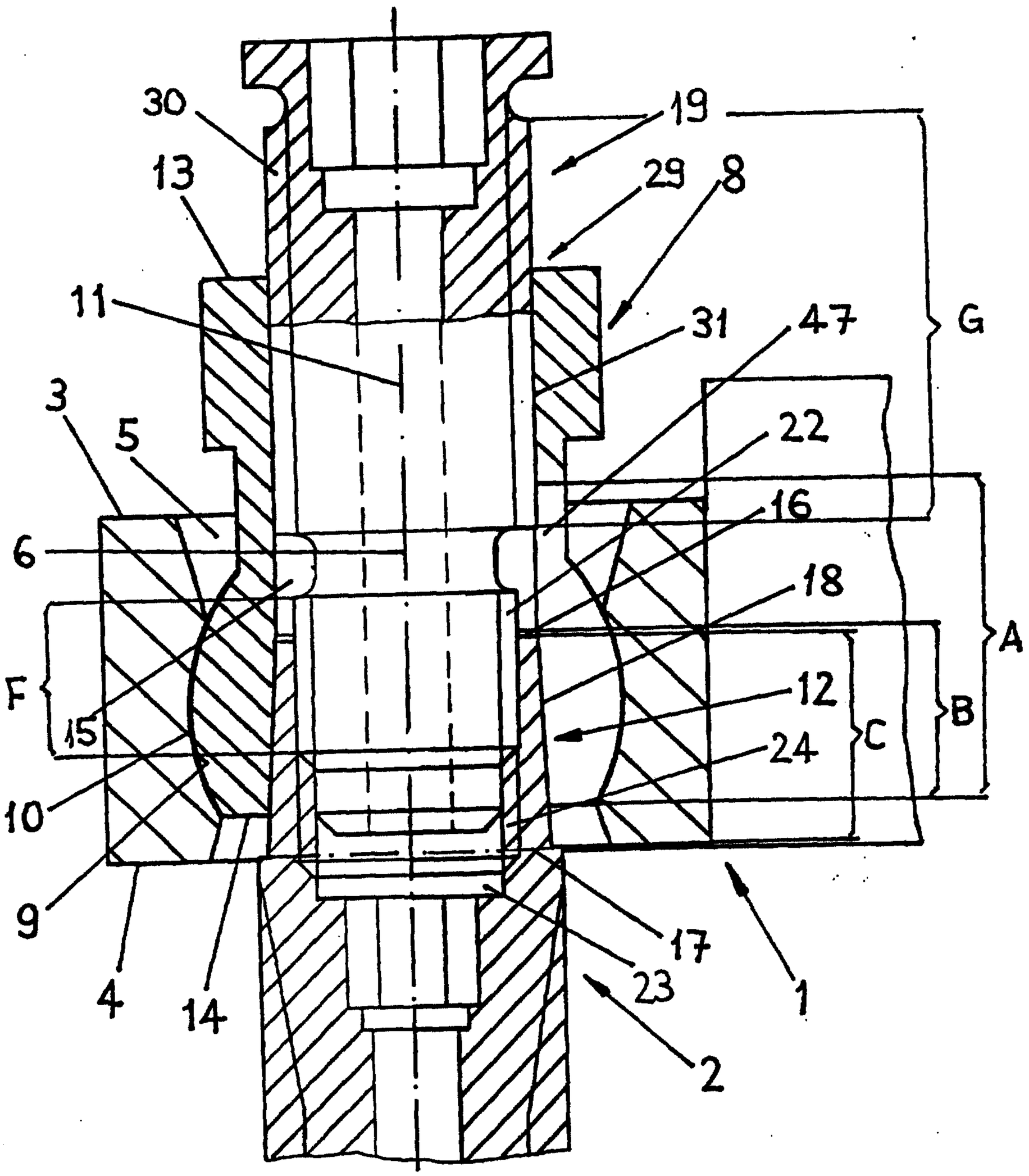

Fig. 3

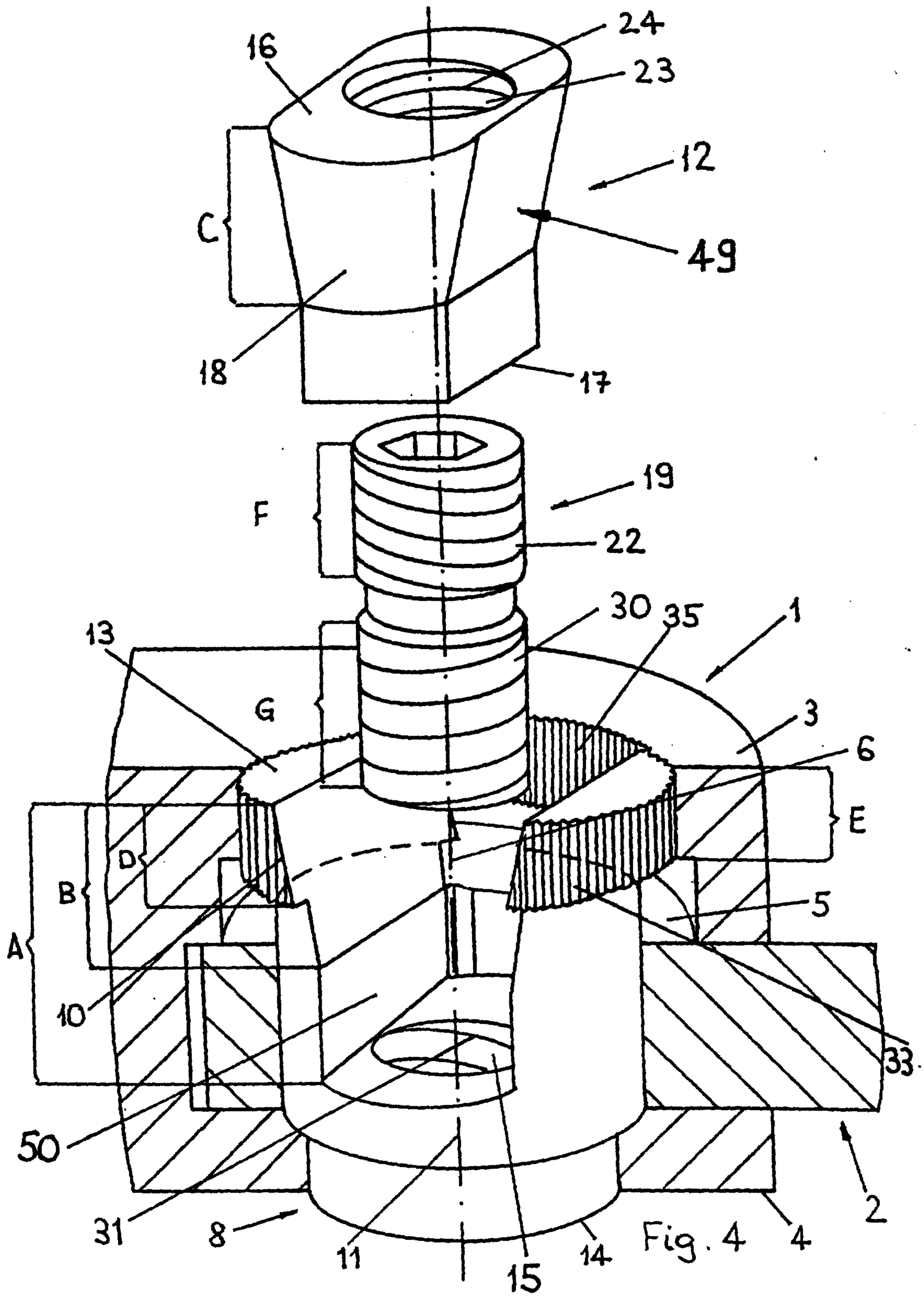
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Fig. 4

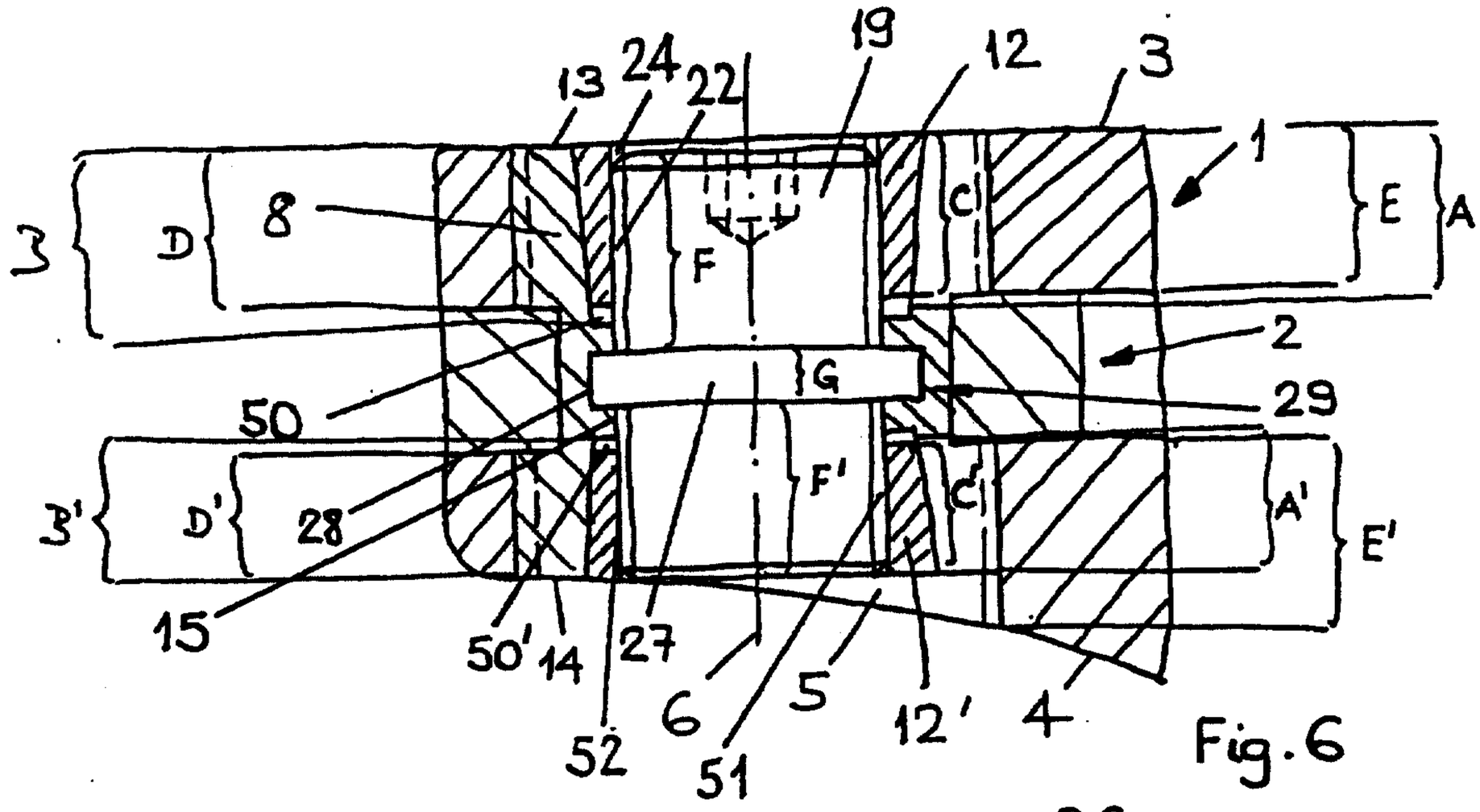
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Fig.6

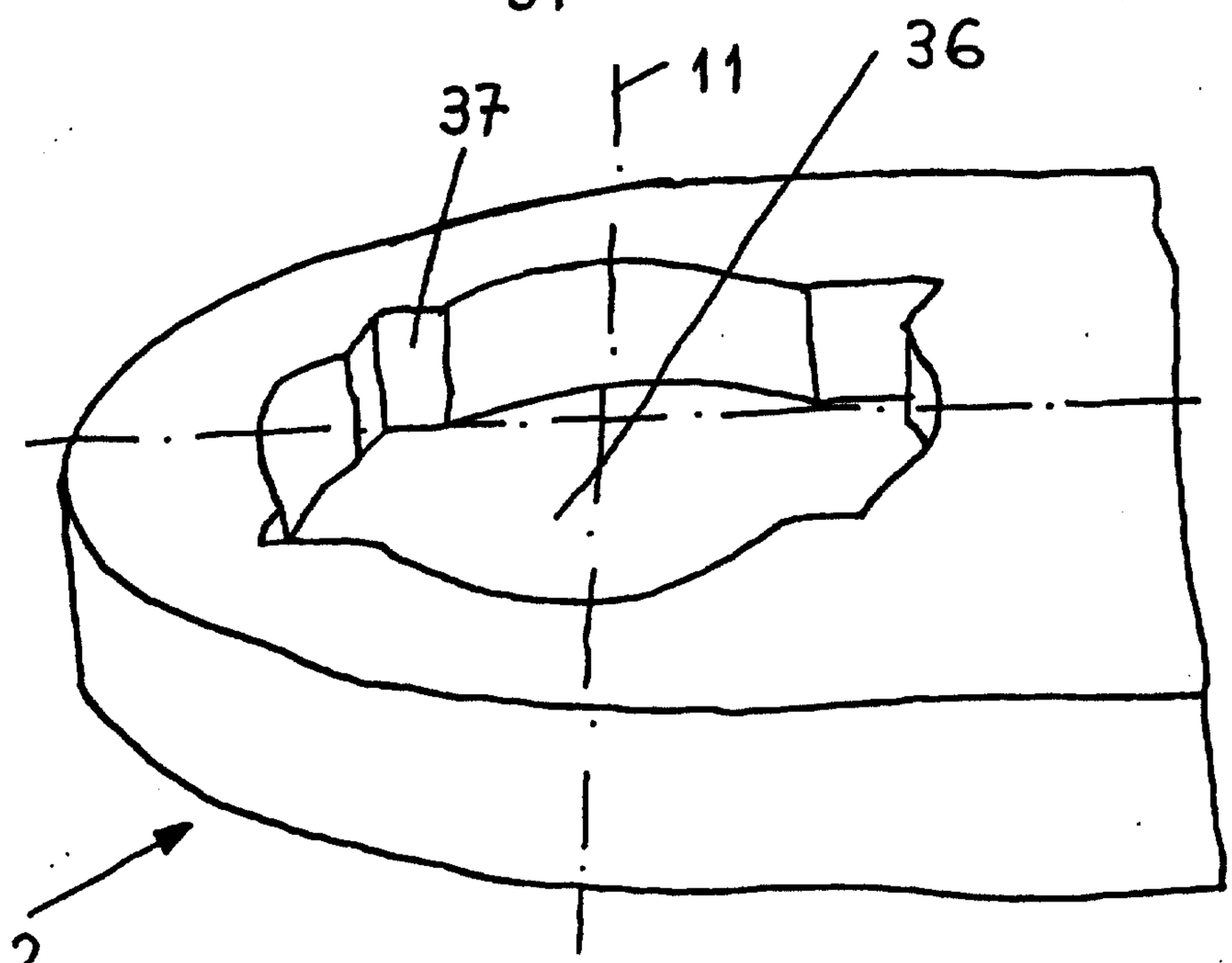
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Fig . 5

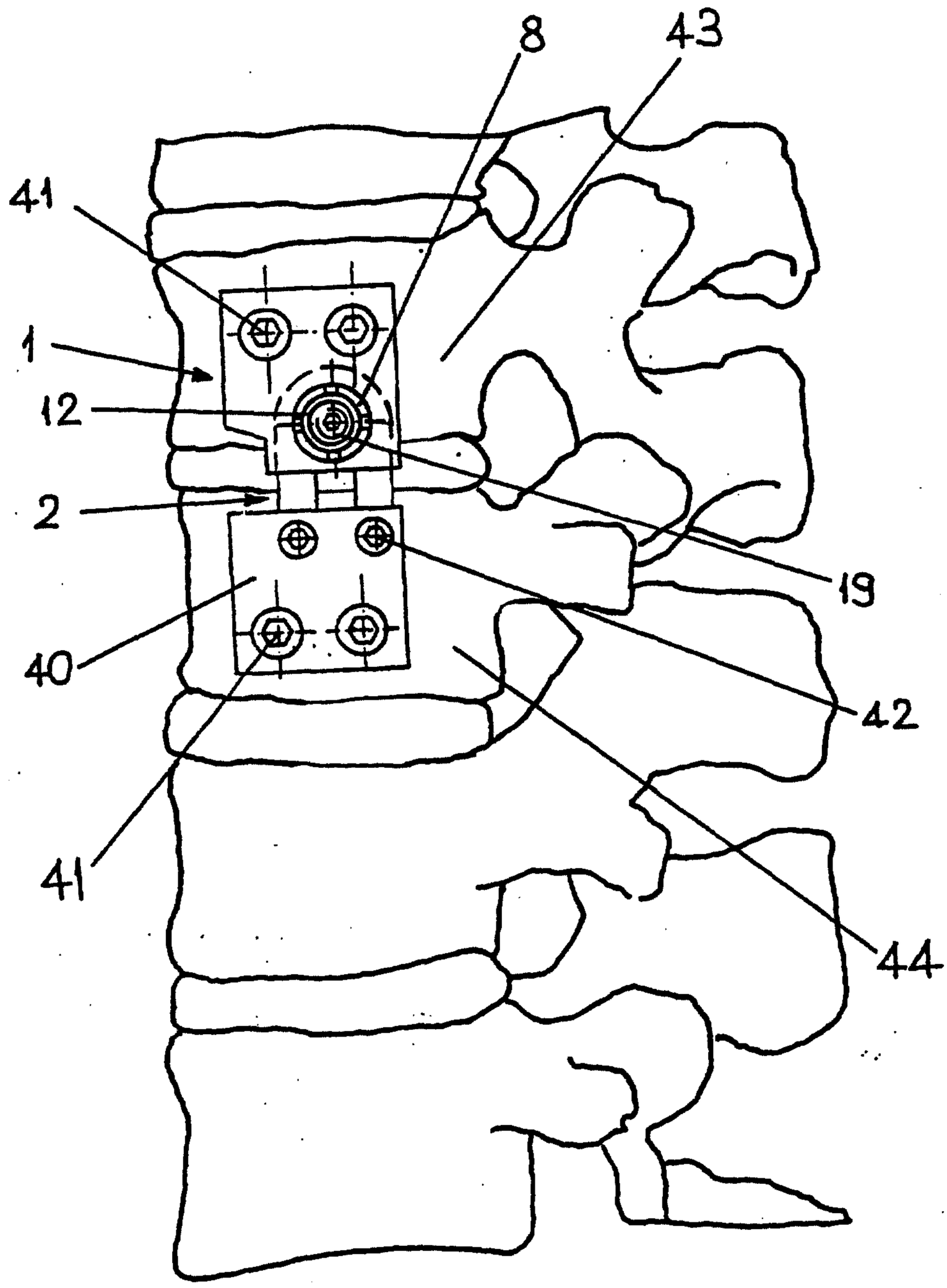


Fig. 7

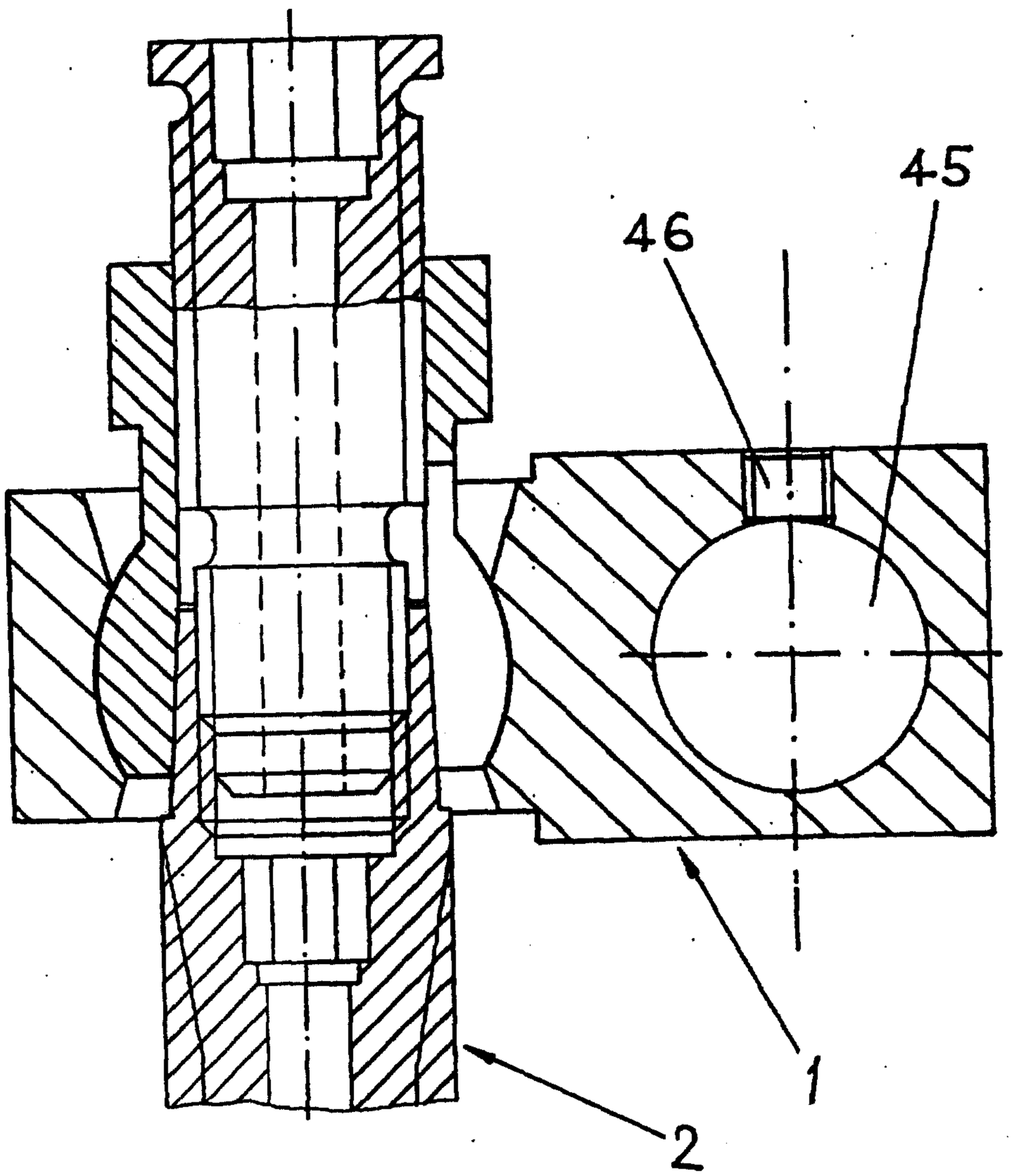
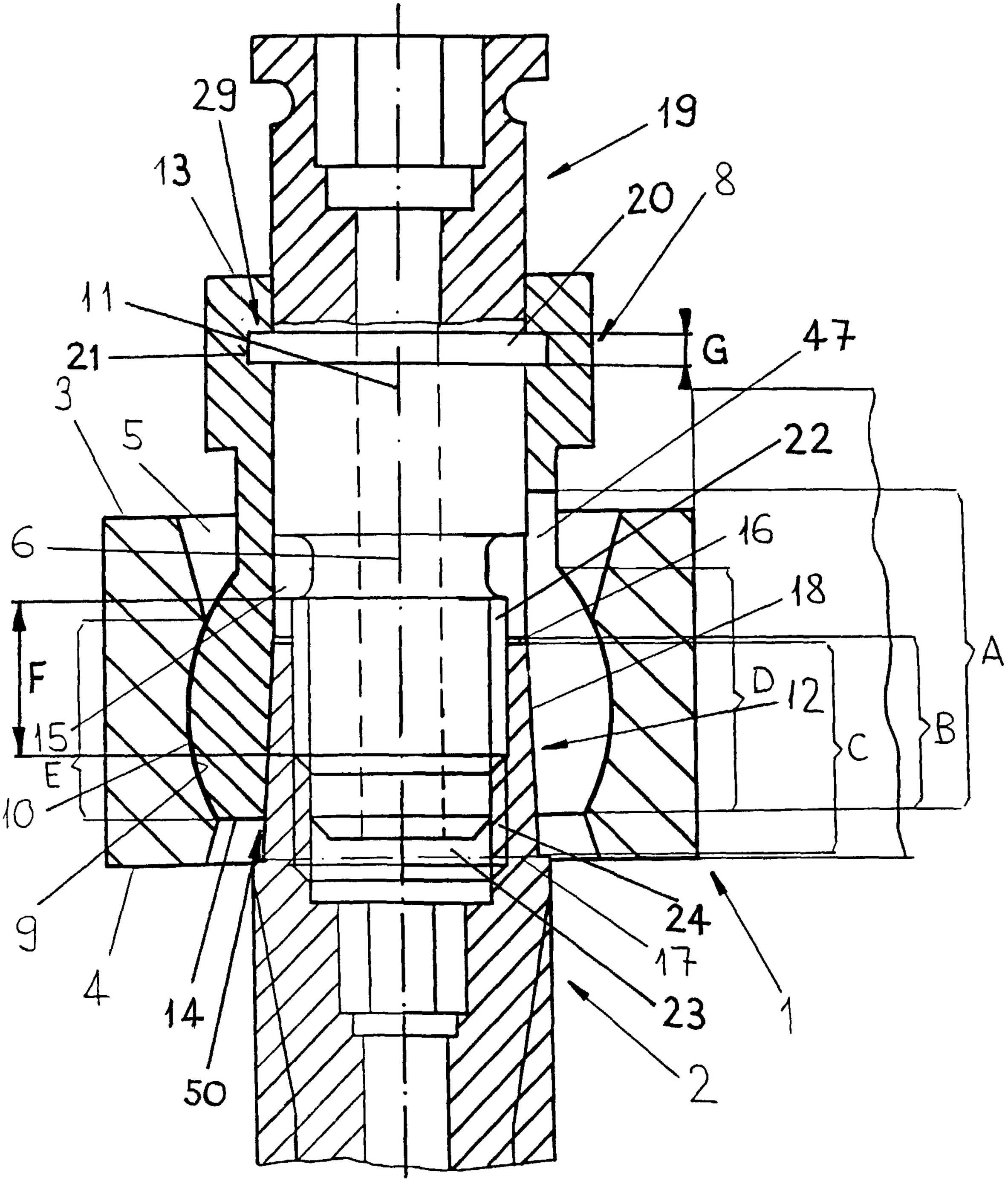


Fig. 8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