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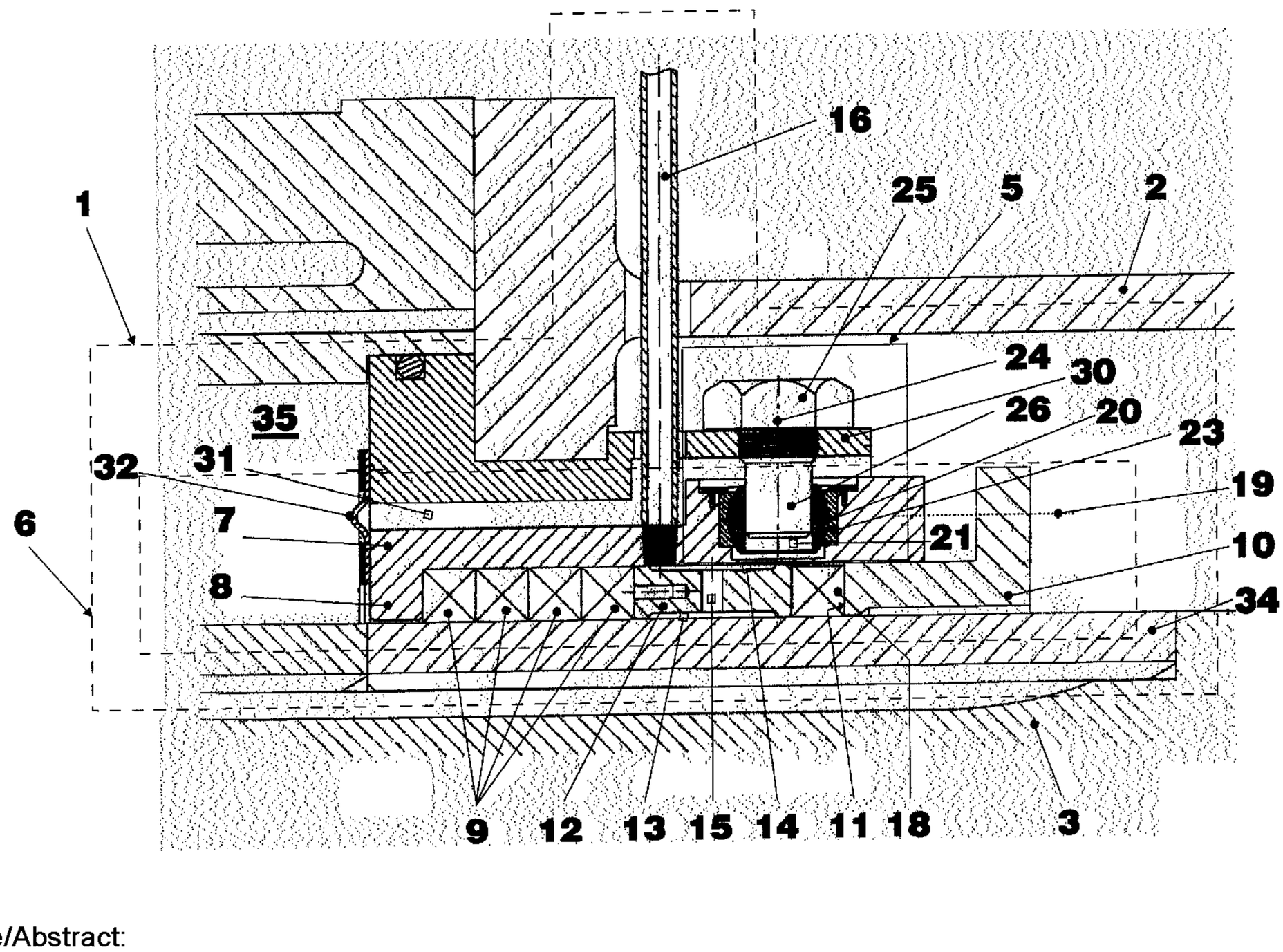


(57) Abrégé/Abstract:
The invention provides a packing assembly for rotating and/or oscillating machine shafts arranged in a machine housing. The packing assembly comprises a packing accommodation unit floating on said shaft. The packing accommodation unit is supported on the housing by means of a ball joint assembly that is pivotable and translatory movable in a radial direction to and from the shaft. The ball joint assembly comprises a ball member provided with a central bore received in a ball socket. A guiding element projecting into the bore of the ball member serves for translatory guiding the ball member along the axis of the bore in the ball member, whereby the axis of the bore on the ball member runs essentially perpendicular to the central longitudinal axis of the shaft.

Abstract of the Disclosure

The invention provides a packing assembly for rotating and/or oscillating machine shafts arranged in a machine housing. The packing assembly comprises a packing accommodation unit floating on said shaft. The packing accommodation unit is supported on the housing by means of a ball joint assembly that is pivotable and translatory movable in a radial direction to and from the shaft. The ball joint assembly comprises a ball member provided with a central bore received in a ball socket. A guiding element projecting into the bore of the ball member serves for translatory guiding the ball member along the axis of the bore in the ball member, whereby the axis of the bore on the ball member runs essentially perpendicular to the central longitudinal axis of the shaft.

PACKING ASSEMBLY

Background of the Invention

The present invention refers to a packing assembly for sealing a machine shaft rotating and/or oscillating in a machine housing, comprising a packing accommodation member adapted to be floatingly arranged on the machine shaft and a ball joint assembly adapted to support the packing accommodation member such as to prevent rotation and/or axial motion thereof with respect to the machine housing.

Such a packing assembly can be used, for example, for sealing the interior of the working chamber of a processing machine having a rotating and/or oscillating shaft, particularly machines and apparatuses used in the chemical, plastic, food, pharmaceutical and cosmetics industries for mixing, kneading, plasticizing and homogenizing a product.

A fundamental problem in the field of sealing a working chamber having therein a rotating shaft may be seen in the fact that such shaft always show, to a more or less extent, run out of true, pendulum motion and dynamic unbalance. It is understood that these errors have a negative influence on the sealing properties of the

packing assemblies discussed herein, because a radially directed relative motion of the shaft with respect to the sealing packets of the packing assembly occurs, with the result that the sealing packets are heavily stressed. Particularly, pendulum motions have a pronounced negative effect on the sealing characteristics and the service life of such packing assemblies.

The above discussed problems are particularly accentuated in the case of big, heavy and greatly stressed shafts, particularly if they not only rotate, but simultaneously perform an oscillating movement.

In order to circumvent the above mentioned problems, so-called floating shaft sealing assemblies have been used in the past, in which a sealing packet accommodation member is floatingly received on the machine shaft. A problem to be solved in connection with these floating sealing assemblies is how to support such assemblies, ensuring a corresponding degree of freedom to allow for pendulum and wobbling motions of the shaft. Up to now, usually elastic support elements have been used which allow both for radial deflection and pendulum motion of the machine shaft. However, experience has shown that the service life of such elastic support elements is very limited, particularly if they are under great thermal stress. Moreover, they can bear only comparatively small torque forces and show relatively high reset forces, further impairing the service life of the sealing packets.

Prior Art

The patent publication DE 1,214,199 discloses an apparatus for mounting vertically extending rotating shafts. This apparatus comprises a packing gland floatingly arranged on the shaft, sealing the shaft with regard to the housing in cooperation with a movable folding bellows, a stuffing box and a stuffing box gland.

The patent publication FR 2,450,393 discloses a sealing assembly for sealing shaft members extending through the wall of a housing. The sealing assembly includes a stuffing box floatingly arranged between the housing and the shaft. As a means for preventing rotation of the stuffing box, a screw is provided which is fixed to the housing and engages a recess in the stuffing box. A waterproof seal between the housing wall and the stuffing box is ensured by a bellows sealing member, allowing for relative movement between the floating stuffing box and the housing.

The patent publication GB 684,373 discloses a reaction vessel having a rotating mixing and stirring shaft. For the sake of sealing the shaft extending through the vessel wall, both sides of the wall of the reaction vessel comprise sealing members in the form of stuffing boxes. A portion of the housing of the stuffing box shows a spherical surface which is supported by means of an annular element, having a spherical surface as well and being welded to the wall of the reaction vessel. For stationary fixing the

stuffing box, a retainer cap is provided which is bolted to the housing of the reaction vessel. The retaining cap is provided with a spherical interior surface located at its upper end, in which the stuffing box housing, having a spherically shaped surface portion as well, is supported. Such a design allows for pendulum motions of the shaft with regard to the reaction vessel. For filling a space between the stuffing box housing and the retaining cap, pipes extending through the retaining cap are provided.

Finally, the patent publication WO 94 21944 discloses a self-aligning shaft bearing provided with a stuffing box. The shaft bearing comprises a bearing housing defining in its interior a bearing chamber. The bearing housing comprises an essentially tube-shaped base member and a closure element bolted to the base member. The bearing chamber is located between the outermost end of the base member and the interior of the closure element. Moreover, that shaft bearing comprises a guiding assembly comprising a tube-shaped inner element through which the shaft extends. The inner element is provided with two radially extending flange members which are supported by a bearing element located in the corresponding bearing chamber. This shaft bearing is suitable both for rotating and oscillating movements of the shaft.

Objects of the Invention

With the above discussed prior art in mind, it is an object of the present invention to provide a packing assembly for sealing a machine shaft rotating and/or oscillating in a machine housing, having a ball joint assembly for supporting a packing accommodation member adapted to be floatingly arranged on the machine shaft, which is of simple design and can be manufactured at low costs, whose service life nevertheless is considerably extended and which ensures a reliable and long-time stable sealing of the machine shaft.

Summary of the Invention

In order to meet this and other objects, the present invention provides a packing assembly for sealing a machine shaft rotating and/or oscillating in a machine that comprises a packing accommodation member adapted to be floatingly arranged on the machine shaft and a ball joint assembly adapted to support the packing accommodation member such as to prevent rotation and/or axial motion with respect to the machine housing.

The ball joint assembly includes a ball member provided with a central bore and a socket member for rotatably receiving the ball member. The packing assembly further comprises a guiding element having a guiding portion projecting into the central bore

provided in the ball member and adapted to translatory guide the ball member along the central longitudinal axis of the central bore in the ball member. Thereby, the central longitudinal axis of the bore in the ball member runs essentially perpendicular to the central longitudinal axis of the machine shaft.

The proposed packing assembly avoids to a farthest extent both translatory relative motions between packing assembly and machine shaft as well as relative pendulum motions between packing assembly and machine shaft. Moreover, the herein disclosed ball joint assembly is essentially maintenance-free. Pendulum motions of the shaft and the sealing packet accommodation member floatingly received thereon, respectively, are absorbed by the ball joint assembly and transformed into lateral motions. The ball joint assembly, moreover, is of simple design, can be manufactured at low costs and has an extended service life. Furthermore, it exhibits comparatively low reset forces.

Brief Description of the Drawings

In the following, an embodiment of the apparatus according to the invention will be further described, with reference to the accompanying drawings, in which:

Fig. 1 shows a longitudinal sectional view of the packing assembly, including the ball joint assembly; and

Fig. 2 shows a cross sectional view of the ball joint assembly.

Detailed Description of a Preferred Embodiment

In the following, the design and the principle of operation of an embodiment of the packing assembly according to the invention will be further described, with the help of Fig. 1.

The packing assembly, generally designated by reference numeral 1, is located between a machine housing 2 and a machine shaft 3 which is mounted in the machine housing 2 to be rotating and/or oscillating. The packing assembly 1 is provided with a packing accommodation unit 6 designed and operating according to the principle of a stuffing box or packing gland. The packing accommodation unit 6 is adapted to receive and fix sealing packets 9. The packing accommodation unit 6 comprises a hollow cylindrical sleeve member 7 enclosing the machine shaft 3. The one end portion of the sleeve member 7 is provided with a stop collar 8 protruding radially inwards, and the other end portion of the sleeve member 7 is provided with a (not shown) internal thread. For fixing the sealing packets 9, a clamping liner 10, having a (not shown) external thread, is provided which is adapted to be screwed into the sleeve member 7. Between the front face 11 of the clamping liner 10 and the stop collar 8 of the sleeve member 7, four sealing packets 9 as well as an annular element 12 and a further sealing

packet and/or a bearing ring member 18 are provided. The clamping liner 10 is provided with a plurality of bores (not shown) located along a scribed circle 19, said bores being adapted to receive threaded bolt means (not shown) that are screwed into an end region of said sleeve member 7 opposite to said clamping liner 10 for fixing and compressing said sealing packets 9.

For supporting the packing assembly such that any rotational movement thereof is prevented, a ball joint assembly 5 is provided. The ball joint assembly 5 comprises a ball member 20 provided with a central bore 21. The ball member 20 is supported in a ball socket 23 fixed to the sleeve member 7. The ball member 20 is arranged such that the central axis of the bore 21 runs perpendicular to the central longitudinal axis of the machine shaft 3. For translatorily guiding the ball member 20 along the axis of its central bore 21, a guiding element 25 is provided which projects into the central bore 21 of the ball member 20. The guiding element 25 is generally designed as a screw member having a cylindrical front portion 26. It is screwed into a supporting member 30 whereby the cylindrical front portion 26 of the guiding element 25 stands out of the supporting member 30. The supporting member 30 is of annular shape and fixed to the machine housing 2.

The ball joint assembly 5, as shown in the drawings, can follow both tilting movements of the shaft 3 as well as translatory

motion thereof running perpendicular to the central and rotational axis of the shaft 3. While a pendulum motion of the machine shaft 3 is followed by a rotation of the ball member 20 relative to its ball socket 23, radial deflections of the machine shaft 3, particularly initiated by a shaft 3 running out of true or by dynamic unbalance, cause a translatory relative movement between ball member 20 and the guiding element 25 along the central longitudinal axis of the bore 21 in the ball member 20 and the central longitudinal axis of the guiding element 25, respectively.

Such a ball joint assembly 5 constitutes a fundamentally rigid element for supporting the packing assembly 1 in a manner preventing rotation thereof, whereby the packing assembly 1 can float on the machine shaft 3. The result is that wear of the packing assembly 1 and particularly of the sealing packets 9 is considerably reduced since only rotational and, if appropriate, axial motions occur between the sealing packets 9 and the machine shaft 3. The sliding friction of the cylindrical front portion 26 of the guiding element 25 running in the central bore 21 of the ball member 20 is close to zero, with the result that unwanted deformation forces acting on the sealing packets 9 are virtually eliminated. The ball joint assembly 5 itself is essentially maintenance-free and free from wear, in contrast to the flexible supporting assemblies known in the prior art.

It is understood that a kinematically reverse arrangement between the ball joint assembly 5 and the guiding element 25 would be possible, for example, if the ball joint assembly 5 would be directly or indirectly fixed to the machine housing 2 and the guiding element 25 fixed to the packing assembly 1.

In order to be able to seal an annular gap 31 located between the sleeve member 7 and the supporting member 30 against the working chamber 35, a diaphragm 32 is provided whose front face is fixed to the supporting member 30 and to the sleeve member 7. Additionally or alternatively, the annular gap 31 can be filled with a sealing foam.

The ring element 12 is provided with a first recess 13 located at its outside and facing the machine housing 2, and a second recess 14 located at its inside and facing the shaft 3. Moreover, the ring element 12 is provided with at least one bore 15 interconnecting the two recesses 13, 14. The recesses 13, 14 of the ring element 12 are communicating with a tube member 16 running through the machine housing 2 in radial direction. By means of this tube member 16, the recesses 13, 14 can be flooded with a fluid or gaseous medium. Thereby, the danger is eliminated that for example atmospheric oxygen can penetrate into the working chamber 35 through the sealing packets 9.

The bearing ring 18 inserted between the annular element 12 and the clamping liner 10 acts as a plain bearing, favoring the

floating of the packing assembly 1 on the shaft 3. Preferably, the bearing ring 18 is manufactured of a plastic material having good self-lubricating properties. In place of the bearing ring 18 or additionally to the bearing ring 18, one or more sealing packets can be inserted for preventing the medium used for flooding the recesses 13, 14 to escape to the outside.

In order to increase the abrasion resistance of the shaft 3 in the area of the packing accommodation unit 6 and the sealing packets 9, respectively, the shaft 3 is provided with a jacket member 34 of hollow cylindrical shape and a surface that matches the specific requirements.

Fig. 2, showing the ball joint assembly 5 in a cross sectional view, clearly illustrates the ball member 20 provided with a central bore 21, the ball socket 23 as well as the guiding element 25 projecting into the central bore 21.

The packing assembly as herein before described and according to the invention offers a number of considerable advantages:

- The ball joint assembly can follow both radial deflections and pendulum motions of the shaft.
- The ball joint assembly is thermally tolerant.
- The ball joint assembly exhibits comparatively low reset forces.
- The ball joint assembly can bear high torque forces.

- The ball joint assembly has a long service life ans is essentially maintenance-free.
- The ball joint assembly is of simple design and can be manufactured at low costs.
- The ball joint assembly can be used with shafts running horizontally, vertically or in an arbitrary three dimensional spatial angle.

WHAT IS CLAIMED IS:

1. A packing assembly for sealing a shaft means rotating and/or oscillating in a housing means and having a central longitudinal axis, comprising:

a packing accommodation means adapted to be floatingly arranged on said shaft means;

a ball joint assembly means adapted to support said packing accommodation means such as to prevent rotation and/or axial motion with respect to said housing means;

said ball joint assembly means including a ball means provided with a central bore having a central longitudinal axis;

a socket means for rotatably receiving said ball means;

said packing assembly further comprising a guiding element means having a guiding portion projecting into said central bore provided in said ball means and adapted to translatory guide said ball means along said central longitudinal axis of said central bore; and

said central longitudinal axis of said bore in said ball means running essentially perpendicular to said central longitudinal axis of said shaft means.

2. A packing assembly according to claim 1 in which said ball means and said socket means is fixed to said packing accommodation

means provided with sealing means, and said guiding element means is attached to said housing means directly or by means of an attachment means.

3. A packing assembly according to claim 1 in which said ball means and said socket means is attached to said housing means directly or by means of an attachment means, and said guiding element means is fixed to said packing accommodation means provided with sealing means.

4. A packing assembly according to claim 2 or 3 in which said ball means is translatory movable in radial direction to and from said shaft means with regard to said guiding element means.

5. A packing assembly according to claim 2 or 3 in which said guiding element means is translatory movable in a radial direction to and from said shaft means with regard to said ball means.

6. A packing assembly according to claim 2 in which said packing accommodation means is enclosed by an annular gap which is sealed by means of a diaphragm means and/or is foam filled.

7. A packing assembly according to claim 2, further comprising a supporting member means, connected to said housing means or

being integral with said housing means, said guiding element means projecting into said bore in said ball means being fixed to said supporting member means.

8. A packing assembly according to claim 7 in which said guiding element means is in the form of a screw means provided with a cylindrical front portion adapted to guide said ball means, said screw means being screwed into said supporting member means such that said front portion projects over said supporting member means.

9. A packing assembly according to claim 1 in which said packing accommodation means comprises a sleeve means having hollow cylindrical shape and enclosing said shaft means, the interior of said sleeve means being provided with a plurality of sealing packet means resting on said shaft means.

10. A packing assembly according to claim 9 in which the one end portion of said sleeve means is provided with a stop collar means projecting radially inwards, and the other end portion of said sleeve means is provided with an internal thread means, said packing assembly further comprising a clamping liner means provided with an external thread means adapted to be screwed into said sleeve means for fixing and compressing said sealing packet

means between said stop collar means and the end front face of said clamping liner means.

11. A packing assembly according to claim 10 in which said clamping liner means is provided with a plurality of bores located along a scribed circle, said bores being adapted to receive threaded bolt means that are screwed into an end region of said sleeve means opposite to said clamping liner means for fixing and compressing said sealing packet means.

12. A packing assembly according to claim 10 or 11, further comprising an annular element means inserted between said front face of said clamping liner means and said sealing packet means, said annular element means being provided with a first recess means located at its outside and facing said housing means, and a second recess means located at its inside and facing said shaft means, said first and second recess means communicating with a supply tube means for supplying a fluid or gaseous medium.

13. A packing assembly according to claim 10 in which at least one sealing packet means and/or a bearing ring means is inserted between said stop collar means of said sleeve means and said front face of said clamping liner means.

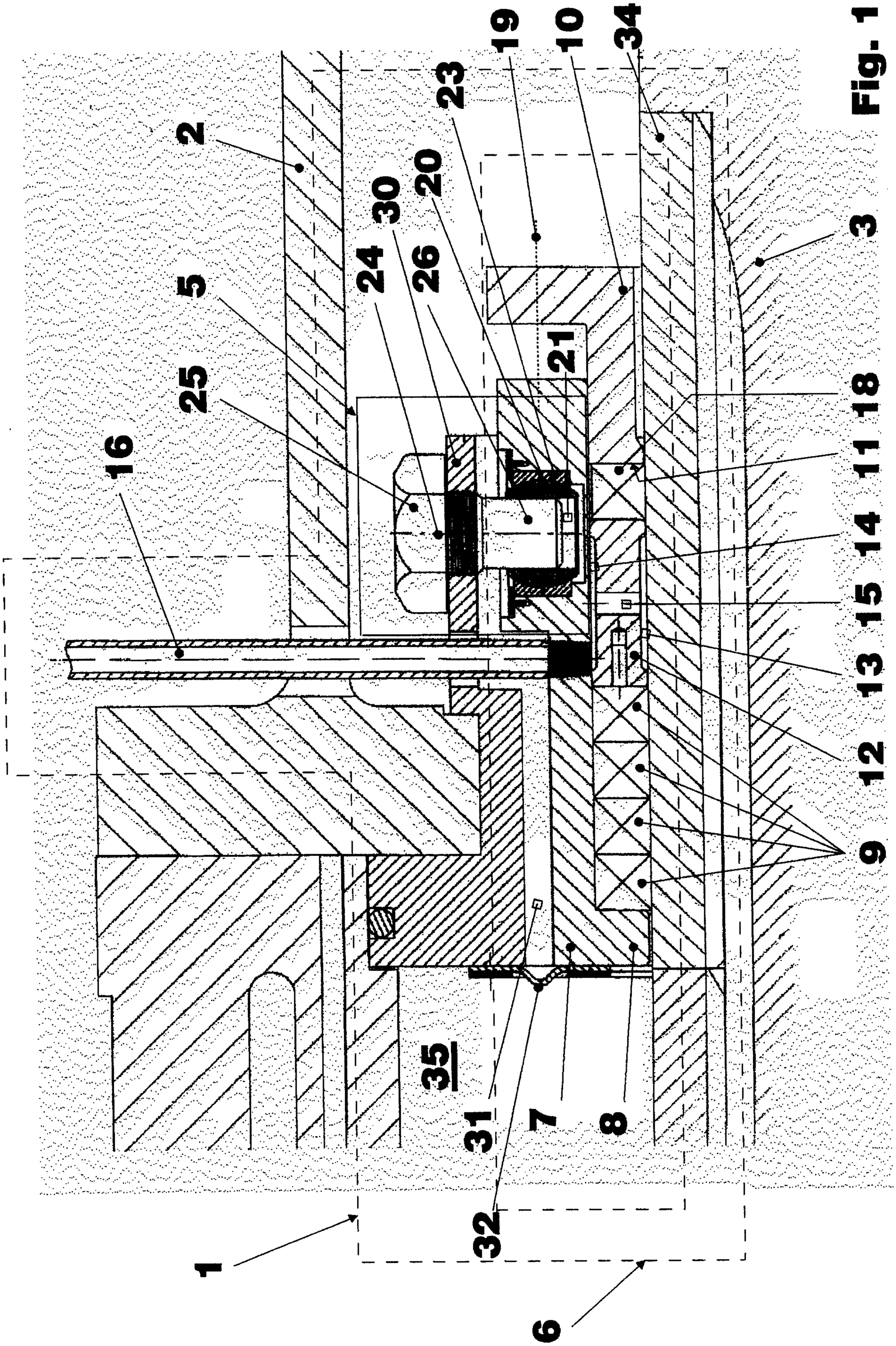
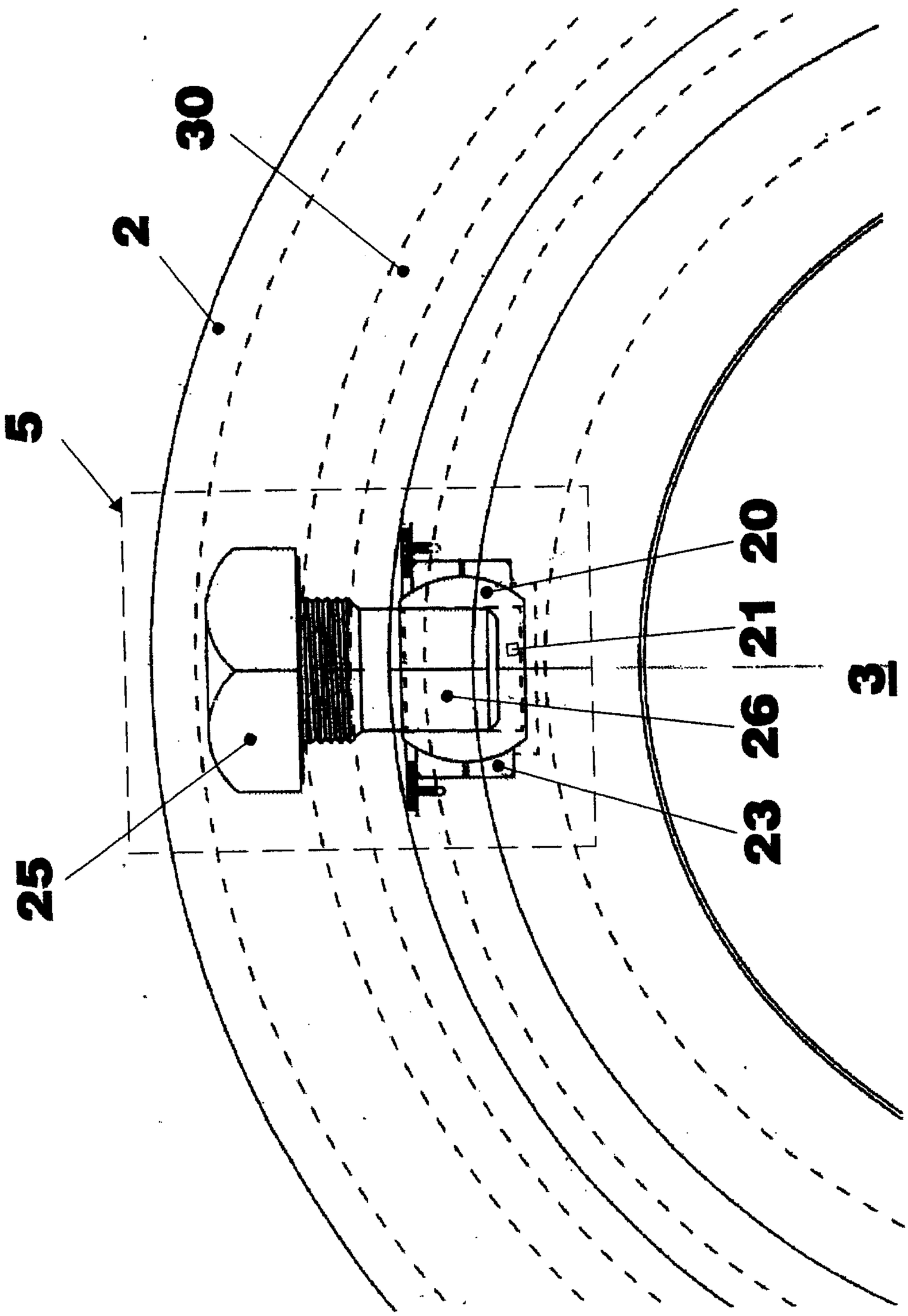
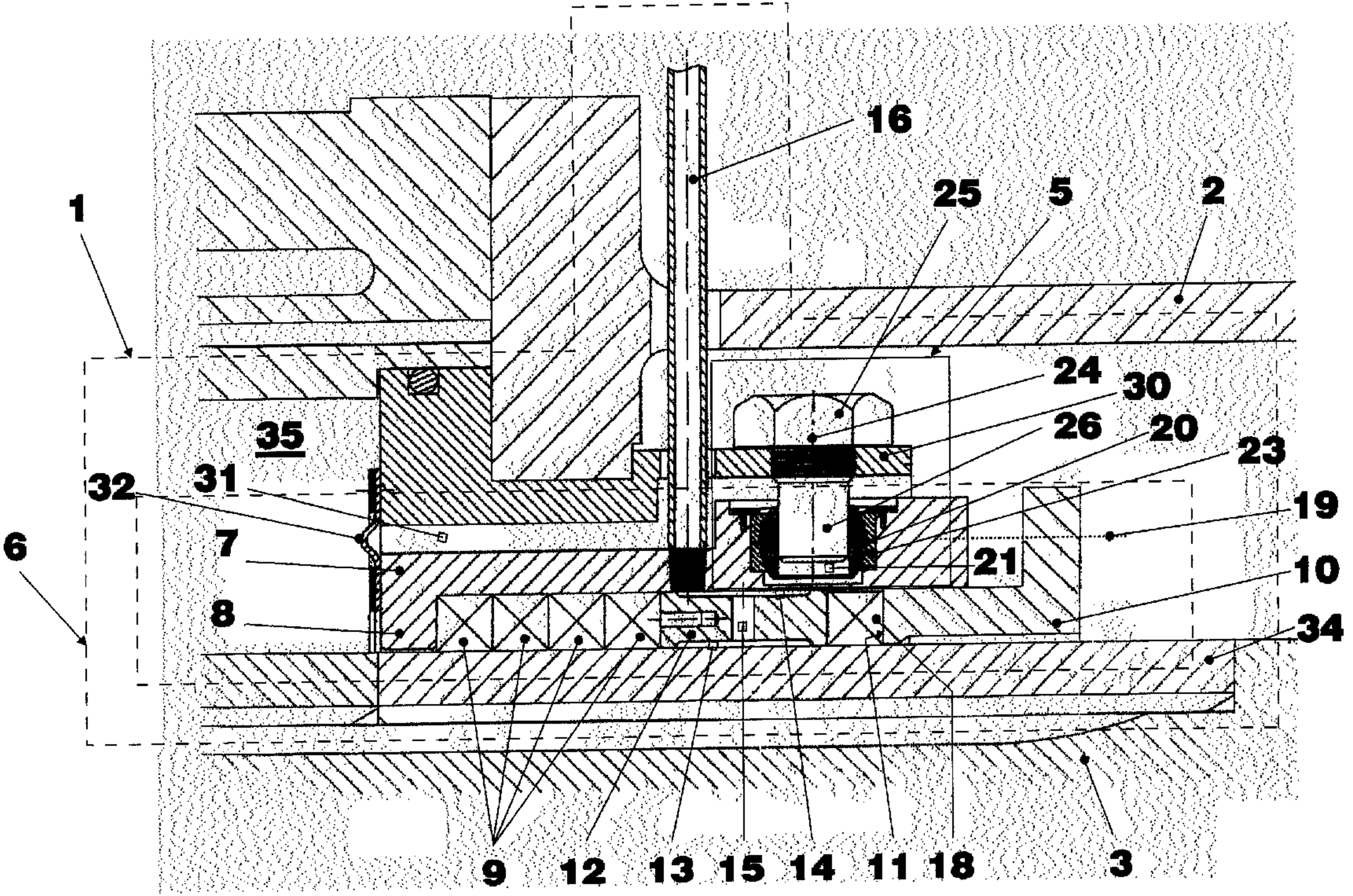


Fig. 1

Fig. 2

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