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(54) **A joint for reinforced concrete pile sections**

Verbindung für Abschnitte eines Pfahles aus bewährtem Beton

Une connection pour sections de pieu en béton armé

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(56) References cited:  
**WO-A-97/38173** **CA-A- 1 109 303**  
**GB-A- 588 478** **GB-A- 2 029 920**

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**Description****SUBJECT OF THE INVENTION**

**[0001]** The present invention relates to a joint between two objects to be joined together, such as reinforced concrete pillars, said joint comprising

- a first connecting element at the end of a first object to be joined, such as a pillar, consisting of a projecting part, such as a spigot having a circular cross-section and provided with an annular groove,
- a second connecting element at the end of a second object to be joined, such as a pillar or equivalent, said connecting element consisting of a cavity, such as a dead hole having a circular cross-section and provided with an annular groove,
- a spring-like locking element, such as an annular spring or a part of one, which locks the groove of the first connecting element to the groove of the second connecting element.

**PRIOR ART**

**[0002]** There are various solutions for making a butt joint between reinforced concrete pillars. Generally used is a butt joint solution in which each pillar to be joined has at its one end four guiding and locking spigots provided with a transverse hole, which fit into corresponding cavities provided at the end of the opposite pillar when the pillars are set end to end to form extensions of each other. The butt joint is locked by inserting locking splines laterally through the transverse holes in the pillar ends and through the holes provided at a corresponding position in the guiding and locking spigots. However, this method of making a joint has proved to be difficult and laborious in practice. The transverse holes in the pillar ends and the holes of the guiding and locking spigots are not always properly aligned, so it is difficult to drive the transverse locking splines into position. In this case, one or more of the locking splines of the joint are left out, so a weak butt joint is formed between the pillars.

**[0003]** The document WO 97 38173 A describes a joint for joining concrete piles provided with two clamp joints in the corners of the piles. The clamp joints are locked by means of pins, which are pushed from side through the channels. The pins turn around the locking bars forming toroids because of plastical deformation. In the direction of the toroid diameter the opposite surfaces are parallel. However, in the longitudinal direction the opposite surfaces can be slightly sphenoid so that the wedged property extends evenly along the entire length of the insert pin.

**[0004]** The document CA-A-1 109 303 describes an anchoring bolt to be secured to a building structure. In the bolt there is a conical surface bevelled at approximately 45° and an expansion ring made of malleable material around the conical surface. The bolt is anchored to

a pre-drilled hole by adapting axial force to the conical surface by using a thread and a nut at the outer end of the bolt. In consequence the ring will expand and press against the walls of the hole. The mechanism is not suitable for a joint between two pieces, as described in the invention.

**[0005]** The document GB 588 478 A describes a stud and socket fastener for attaching two panels together. In the fastener there is a spring ring, which is locked to a stud member.

**[0006]** The document GB-A-2 029 920 describes a joint for joining concrete pillars end to end. At the ends of the pillars there are circular grooves, which together form a locking channel. The locking of the pillars is achieved by positioning a locking rod into the locking channel.

**[0007]** As the above-mentioned types of butt joint have proved to be very problematic in practice, there has arisen a need to develop different bayonet-connector type joining elements even for butt joints between reinforced concrete pillars. According to one solution, the joining element at the end of a pillar to be extended comprises a round spigot, which is fitted into a round cavity at the end of another pillar, said cavity being provided with an annular groove and an annular spring. The end of the spigot is conically shaped so that, when inserted into the cavity, it opens and strains the annular spring in the cavity. When the ends of the reinforced concrete pillars to be joined together meet at the end of the insertion movement, being pressed against each other, the annular spring latches into the annular groove of the spigot, thus locking the joint.

**[0008]** The above-described bayonet-type joint, which in principle is easy to use, has not, however, proved to be a workable solution for joining reinforced concrete pillars end to end. One of the reasons for this is that, when the pillars are being set end to end as extensions of each other, they have to be brought into tight contact and perfect alignment with each other before the annular spring in the cavity of the joining element at the end of one of the pillars is locked in the annular groove of the spigot of the joining element of the opposite pillar. However, this is difficult because the joining elements must be made to tolerances allowing no large backlash. Therefore, even a slight defect, a deformation caused by a bruise or a small foreign object caught on the joining elements may prevent locking of the joint. On the other hand, if larger clearances are provided between the joining elements, then the joint will not be sufficiently firm and rigid.

**OBJECT OF THE INVENTION**

**[0009]** The object of the present invention is to achieve a butt joint for pillars that does not have the above-described disadvantages.

## FEATURES OF THE INVENTION

**[0010]** The joint of the invention for joining two objects, such as reinforced concrete pillars, is characterized by the characterizing features of appended claim 1.

## EMBODIMENTS OF THE JOINT OF THE INVENTION

**[0011]** A preferred embodiment of the joint of the invention is characterized in that the annular groove in the projecting part of the first joining element has a wedge-shaped cross-section so that at least one of the side walls of the groove forms an element, such as a conical surface, that produces a wedging effect on the spring-like locking element.

**[0012]** A second preferred embodiment of the joint of the invention is characterized in that the spring-like locking element is a severed annular spring having a rectangular cross-section.

**[0013]** A third preferred embodiment of the joint of the invention is characterized in that

- the spring-like locking element is a severed annular spring having a wedge-shaped cross-section such that the conical wedge surface of the annular spring mainly corresponds to the conical surface of the annular groove of the joining element, and that
- the conical wedge surface of the annular spring and the conical surface of the annular groove of the joining element are fitted against each other.

**[0014]** A fourth preferred embodiment of the joint of the invention is characterized in that the spring-like locking element is a severed annular spring of circular cross-section.

**[0015]** A fifth preferred embodiment of the joint of the invention is characterized in that

- the first object to be joined is a reinforced concrete pillar with a joining element at its end consisting of a projecting part having a circular cross-section and provided with an annular groove, and
- the second object to be joined is a rock shoe with a joining element consisting of a cavity of circular cross-section provided with an annular groove, and that
- the joining elements of the reinforced concrete pillar and the rock shoe are locked together by means of an annular spring that is fitted into the annular grooves of the joining elements, at least one of said grooves having a wedge-like shape.

**[0016]** A further preferred embodiment of the joint of the invention is characterized in that the annular groove in the cavity has a wedge-shaped cross-section such that at least one of the side walls of the groove forms an element, such as a conical surface, that produces a wedging effect on the spring-like locking element.

## EXAMPLES OF EMBODIMENTS

**[0017]** In the following, the invention will be described in detail by the aid of examples with reference to the attached drawings, wherein

## LIST OF FIGURES

**[0018]**

- Fig. 1 presents the ends of two reinforced concrete pillars and their mutually fitting joining elements in an axonometric view partially sectioned.
- Fig. 2 presents the ends of two reinforced concrete pillars and their mutually fitting joining elements in vertical section.
- Fig. 3 presents a joint between reinforced concrete pillars in vertical section.
- Fig. 4 corresponds to Fig. 3 and presents a joint between reinforced concrete pillars according to a second embodiment.
- Fig. 5 presents a diagrammatic vertical section of a joint between two objects according to a third embodiment.
- Fig. 6 corresponds to Fig. 5 and presents a joint between two objects according to a fourth embodiment.
- Fig. 7 presents a joint between a reinforced concrete pillar and a rock shoe in vertical section.
- Fig. 8 corresponds to Fig. 3 and presents a joint between reinforced concrete pillars according to a fifth embodiment.

## DESCRIPTION OF THE FIGURES

**[0019]** Fig. 1 illustrates a situation where two reinforced concrete pillars 10a and 10b are being joined together end to end, with the pillar ends brought close to each other but still remaining apart. The principal material of the pillars 10a and 10b is concrete 11, in addition to which they also contain numerous steel reinforcements as is known in the art, which are not shown. Instead, Fig. 1 presents a detailed illustration of the structure of the joining elements 20a and 20b. Each joining element 20a and 20b comprises an end plate 21a and 21, an edge collar 22a and 22b welded on it and anchor bars 23a and 23b welded to the end plates 21a and 21.

**[0020]** The joining element 20a of the reinforced concrete pillar 10a shown above the other one in Fig. 1 comprises a cylindrical projecting part 30 welded to the end plate 21 a and having an annular groove 31 in the outer surface of its cylinder barrel. The inner end of the cylinder 30 is closed by a bottom plate 32. Similarly, the joining element 20b of the reinforced concrete pillar 10b shown below the other one in Fig. 1 comprises a cylindrical cavity 40 welded to the end plate 21 b and having an annular groove 41 in the inner surface of its cylinder barrel. This cylinder 40, too, is provided with a bottom plate 42. The

extremity of the cylindrical projecting part 30 is shaped as a conical surface 33, which, when the reinforced concrete pillars 10a and 10b are being joined together, causes the severed annular spring 50 in the groove 31 of the cavity 40 to open until the spring falls into the groove 31 of the projecting part 30, locking the joint between the joining elements 20a and 20b and therefore the joint between the reinforced concrete pillars 10a and 10b.

[0021] From Fig. 1 it can be seen that it is possible to add a suitable number of reinforcing rods to the circumference of the joining elements 20a and 20b in accordance with the strength requirements regarding the joint between the reinforced concrete pillars 10a and 10b.

[0022] Fig. 2 presents the structure of the joining elements 20a and 20b of reinforced concrete pillars 10a and 10b in vertical section. The projecting cylindrical part 30 attached to the end plate 21a of the upper pillar 10a has a conical end 33 and an annular groove 31. It can be seen from the figure that one 34 of the side walls of the annular groove 31 is inclined, forming an angle  $\alpha$  with a plane perpendicular to the longitudinal axis of the cylinder 30. Since the projection 30 is a round cylinder, the inclined wall 34 forms a conical surface. The angle  $\alpha$  preferably has a magnitude of only a few degrees. An inclination of e.g. 5-10° is sufficient to cause the annular spring 50 to be wedged against this surface, locking the joining elements 21 a and 21 b tightly together. On the other hand, the cylinder 40 of the joining element 20b of the lower pillar 10b is provided with an internal annular groove 41 of rectangular cross-section, with a severed annular spring 50 of rectangular cross-section placed in the groove.

[0023] In Fig. 2, the letters a and b indicate the distances from the edges of the annular grooves 31 and 41 to the stop faces of the reinforced concrete pillars 10a and 10b to be placed against each other. In manufacture, these measurements are essential to flawless functioning of the joining elements 20a and 20b. To allow the annular spring 50 to be effectively locked against the conical surface 34, measurement a must be smaller than or equal to measurement b.

[0024] Fig. 3 shows the reinforced concrete pillars 10a and 10b of Fig. 2 joined together, with the annular spring 50 latched in the groove 31 of the projecting part 30 of the joining element of the upper reinforced concrete pillar 10a. Since the annular spring 50 was expanded by the conical surface 33 of the projecting part 30 during the insertion movement, in the locked state of the joint the annular spring 50 is still exerting compression. Thus, the annular spring 50 is wedged against the conical surface 34 of the groove 31. When the pillar thus extended is jolted by impacts applied to the end of the upper pillar, each impact will cause the annular spring 50 to be more and more tightly wedged against the conical surface 34, a very firm joint being thus formed.

[0025] Fig. 4 presents an embodiment in which a more effective wedging of the annular spring 50 as the conical surface 34 is additionally ensured by using screws 51a

and 51 b that press the annular spring towards the bottom of the groove 31.

[0026] Fig. 5 presents a diagrammatic vertical section of a joint connecting two objects, in which the cylindrical projecting part 30 has been pressed into the cylindrical cavity of the other object. In this embodiment, both the groove 31 of the cylindrical projecting part 30 and the annular spring 50 have a wedge-shaped cross-section, i.e. both have conical surfaces, which are placed against each other. In this case, the annular spring 50 is wedged still more effectively into the groove 31, interlocking the projecting part 30 and the cavity 40 of the joining elements.

[0027] Fig. 6 presents an alternative annular spring 50, according to which the annular spring 50 has a circular cross-section.

[0028] Fig. 7 presents a joint between a reinforced concrete pillar 10 and a rock shoe 60 in vertical section. The structure of this joint fully corresponds to the above-described joint between two pillars. Thus, a rock shoe 60 as shown here can be joined to the end of any pillar. In the rock shoe 60, an actual shoe part 61 is fastened with a screw 62 to a frame part 63, which corresponds to the cylinder 40 of the joining element 20b at the end of a pillar 10b. This frame cylinder 63 has inside it a corresponding cavity and an annular groove 65 for an annular spring 50. The frame cylinder 63 is attached to an end plate 64, which meets the end plate 21 of the pillar.

[0029] Fig. 8 presents an alternative joint between reinforced concrete pillars 10a and 10b, where, before the joining, the annular spring 50 is placed in the groove 31 of rectangular cross-section of the projecting part 30. In this case, the mouth of the cavity 40 has a conical shape 43 that compresses the annular spring 50 as the pillars are being joined together. Once the projecting part 30 has been inserted all the way down into the cavity, the annular spring 50 will expand into the groove 41 in the cavity 40 and get wedged against the conical surface 44. As compared with the above-described other embodiments, the operation of the annular spring 50 is thus reversed. In this case, too, to allow the joint to be further tightened during impacts applied to the pillar, the inclined surface 44 of the groove 41 in the cavity 40 must be located on the opposite side.

#### ADDITIONAL REMARKS

[0030] It is obvious to the person skilled in the art that different embodiments of the invention may vary within the scope of the claims presented below.

#### Claims

1. Joint between two objects (10, 60) to be joined together, such as pillars, said joint comprising

- a first connecting element (20a) at the end of

a first object (10a) to be joined, such as a pillar, consisting of a projecting part (30), such as a spigot, having a circular cross-section and provided with an annular groove (31),

- a second connecting element (20b) at the end of a second object (10b, 60) to be joined, such as a pillar or equivalent, said second connecting element consisting of a cavity, such as a dead hole, having a circular cross-section and provided with an annular groove (41, 65),  
 - a spring-like locking element (50), such as an annular spring or a part of one, which locks the groove (31) of the first connecting element (21a) to the groove (41, 65) of the second connecting element (21b),

#### characterized in that

- in the connecting elements (20a, 20b) the groove (31) of the first connecting element (20a) and/or the groove (41) of the second connecting element (20b) is wedge-shaped in the cross-section; or both the groove of the cylindrical projecting part (30) and the spring-like locking element (50) is wedge-shaped in the cross-section such that the conical wedge surface of the spring-like locking element (50) mainly corresponds to the conical surface of the annular groove (31) of the projecting part (30); so that impacts applied to the end of the second object to be joined (10b, 60) will cause the annular spring to be more and more tightly wedged into the groove.

2. Joint according to claim 1, **characterized in that** the annular groove (31) in the projecting part (30) of the first joining element (10a) has a wedge-shaped cross-section such that at least one (34) of the side walls of the groove forms an element, such as a conical surface, that produces a wedging effect on the spring-like locking element (50).

3. Joint according to claim 1 or 2, **characterized in that** the spring-like locking element (50) is a severed annular spring having a rectangular cross-section.

4. Joint according to claim 1, or 2, **characterized in that**

- the spring-like locking element (50) is a severed annular spring having a wedge-shaped cross-section such that the conical wedge surface (52) of the annular spring mainly corresponds to the conical surface of the annular groove (31) of the joining element (30), and that  
 - the conical wedge surface (52) of the annular spring (50) and the conical surface (34) of the annular groove (31) of the joining element (30)

are fitted against each other.

5. Joint according to any one of claims 1 or 2, **characterized in that** the spring-like locking element (50) is a severed annular spring of circular cross-section.

6. Joint according to any one of claims 1-5, **characterized in that**

- the first object (10) to be joined is a reinforced concrete pillar and

- the second object (60) to be joined is a rock shoe and that

- the connecting elements (20a, 20b) of the reinforced concrete pillar (10) and the rock shoe (60) are locked together by means of the spring-like locking element which is an annular spring (50) fitted into the annular grooves (31, 65) of the connecting elements, at least one of said grooves having a wedge-like shape.

7. Joint according to any one of claims 1-6, **characterized in that** the annular groove (41) in the cavity (40) of the second connecting element (20b) has a wedge-shaped cross-section such that at least one (44) of the side walls of the groove forms an element, such as a conical surface, that produces a wedging effect on the spring-like locking element (50).

#### Patentansprüche

1. Verbindung zwischen zwei zu verbindenden Objekten (10, 60), wie Pfeiler, wobei besagte Verbindung

- ein erstes Verbindungselement (20a) am Ende eines ersten zu verbindenden Objektes (10a), wie etwa ein Pfeiler, das aus einem vorspringenden Teil (30) besteht, wie beispielsweise einer Muffenverbindung mit einem runden Querschnitt und mit einer Ringnut (31) versehen ist,

- ein zweites Verbindungselement (20b) am Ende eines zweiten zu verbindenden Objektes (10b, 60), wie etwa ein Pfeiler oder ähnliches, wobei besagtes zweites Verbindungselement aus einer Höhlung, wie etwa einem Sackloch mit rundem Querschnitt, besteht und mit einer Ringnut (41, 65) versehen ist,

- ein federartiges Verschlusselement (50), etwa einer ringförmigen Feder oder einem Teil derselben, die die Nut (31) des ersten Verbindungselements (21a) mit der Nut (41, 65) des zweiten Verbindungselements verbindet, umfasst,

**dadurch gekennzeichnet, dass**

- in den Verbindungselementen (20a, 20b) die Nut (31) des ersten Verbindungselements (20a)

und/oder die Nut (41) des zweiten Verbindungselements (20b) einen keilförmigen Querschnitt hat; oder sowohl die Nut des zylindrischen vorspringenden Teils (30) und das federartige Verriegelungselement (50) einen keilförmigen Querschnitt hat, so dass die konische Keiloberfläche des federartigen Verriegelungselements (50) größtenteils der konischen Oberfläche der Ringnut (31) des vorspringenden Teils (30) entspricht; so dass durch Krafteinwirkung auf das Ende des zweiten zu verbindenden Objekts (10b, 60) sich der Sprengring immer fester in der Nut verkeilt.

2. Verbindung gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Ringnut (31) im vorspringenden Teil (30) des ersten Verbindungselements (10a) einen keilförmigen Querschnitt hat, so dass mindestens eine der Seitenwände (34) der Nut eine konische Oberfläche hat, die einen Keileffekt auf das federartige Verriegelungselement (50) ausübt. 15
3. Verbindung gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das federartige Verriegelungselement (50) eine offene ringförmige Feder mit rechteckigem Querschnitt ist. 20
4. Verbindung gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, dass**
  - das federähnliche Verriegelungselement (50) eine offene ringförmige Feder mit keilförmigem Querschnitt ist, so dass die konische Keiloberfläche (52) der ringförmigen Feder hauptsächlich der konischen Oberfläche der Ringnut (31) des Verbindungselements entspricht und dass
  - die konische Oberfläche (52) der ringförmigen Feder (50) und die konische Oberfläche (34) der Ringnut (31) des Verbindungselements (30) aneinander anliegen. 30
5. Verbindung gemäß einem der Ansprüche 1 oder 2, **dadurch gekennzeichnet, dass** das federartige Verriegelungselement (50) eine offene ringförmige Feder mit rundem Querschnitt ist. 35
6. Verbindung gemäß einem der Ansprüche 1-5, **dadurch gekennzeichnet, dass**
  - das erste zu verbindende Objekt (10) ein Stahlbetonpfeiler und
  - das zweite zu verbindende Objekt (60) eine Felsspitze ist und dass
  - die Verbindungselemente (20a, 20b) des Stahlbetonpfeilers (10) und die Felsspitze (60) mit dem federartigen Verriegelungselement verbunden werden, das eine ringförmige Feder (50) ist, die in die Ringnuten (31, 65) der Verbin-

dungselemente passt, wobei mindestens eine der besagten Nuten keilförmig sein muss.

7. Verbindung gemäß einem der Ansprüche 1-6, **dadurch gekennzeichnet, dass** die Ringnut (41) in der Vertiefung (40) des zweiten Verbindungselements (20b) einen keilförmigen Querschnitt hat, so dass mindestens eine der Seiten (44) der Nut eine konische Oberfläche hat, die einen Keileffekt auf das federartige Verriegelungselement (50) ausübt. 5

## Revendications

1. Joint entre deux objets (10, 60) à joindre entre eux, tels les piliers, ledit joint comportant
  - un premier élément de connexion (20a) à l'extrémité d'un premier objet (10a) à joindre, tel un pilier, consistant en une partie en saillie (30), tel un bout uni, ayant une section transversale circulaire et étant munie d'une rainure annulaire (31),
  - un second élément de connexion (20b) à l'extrémité d'un second objet (10b, 60) à joindre, tel un pilier ou équivalent, ledit second élément de connexion consistant en une cavité, tel un trou borgne, ayant une section transversale circulaire et étant munie d'une rainure annulaire (41, 65),
  - un élément de verrouillage de type ressort (50), tel un ressort annulaire ou une partie de celui-ci, qui verrouille la rainure (31) du premier élément de connexion (21a) dans la rainure (41, 65) du second élément de connexion (21b),

## caractérisé en ce que

- dans les éléments de connexion (20a, 20b), la rainure (31) du premier élément de connexion (20a), et/ou la rainure (41) du second élément de connexion (20b); a une section transversale en forme de coin; ou aussi bien la rainure de la partie cylindrique en saillie (30) que l'élément de verrouillage de type ressort (50) est en forme de coin dans la section transversale, de façon à ce que la surface en coin conique de l'élément de verrouillage de type ressort (50) corresponde essentiellement à la surface conique de la rainure annulaire (31) de la partie en saillie (30); si bien que les impacts appliqués à l'extrémité du second objet à joindre (10b, 60) auront pour effet de caler le ressort annulaire de plus en plus fermement dans la rainure
2. Joint selon la revendication 1, **caractérisé en ce que** la rainure annulaire (31) dans la partie en saillie (30) du premier élément de jonction (10a) a une sec-

- tion transversale en forme de coin de façon à ce qu'au moins une (34) des parois latérales de la rainure forme un élément, telle une surface conique, qui produit un effet de calage sur l'élément de verrouillage de type ressort (50). 5
3. Joint selon la revendication 1 ou 2, **caractérisé en ce que** l'élément de verrouillage de type ressort (50) est un ressort annulaire coupé ayant une section transversale rectangulaire. 10
4. Joint selon la revendication 1 ou 2, **caractérisé en ce que**
- l'élément de verrouillage de type ressort (50) est un ressort annulaire coupé ayant une section transversale en forme de coin de façon à ce que la surface de coin conique (52) du ressort annulaire corresponde essentiellement à la surface conique de la rainure annulaire (31) de l'élément de jonction (30), et que 15 20
  - la surface de coin conique (52) du ressort annulaire (50) et la surface conique (34) de la rainure annulaire (31) de l'élément de jonction (30) sont placées l'une contre l'autre. 25
5. Joint selon l'une quelconque des revendications 1 ou 2, **caractérisé en ce que** l'élément de verrouillage de type ressort (50) est un ressort annulaire coupé de section transversale circulaire. 30
6. Joint selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que**
- le premier objet (10) à joindre est un pilier de béton armé et 35
  - le second objet (60) à joindre est une pointe roche et que
  - les éléments de connexion (20a, 20b) du pilier de béton armé (10) et de la pointe roche (60) sont verrouillés l'un à l'autre au moyen de l'élément de verrouillage de type ressort qui est un ressort annulaire (50) logé dans les rainures annulaires (31, 65) des éléments de connexion, au moins une desdites rainures ayant une forme de coin. 40 45
7. Joint selon l'une quelconque des revendications 1 à 6, **caractérisé en ce que** la rainure annulaire (41) dans la cavité (40) du second élément de connexion (20b) a une section transversale en forme de coin de façon à ce qu'au moins une (44) des parois latérales de la rainure forme un élément, telle une surface conique, qui produit un effet de calage sur l'élément de verrouillage de type ressort (50). 50 55

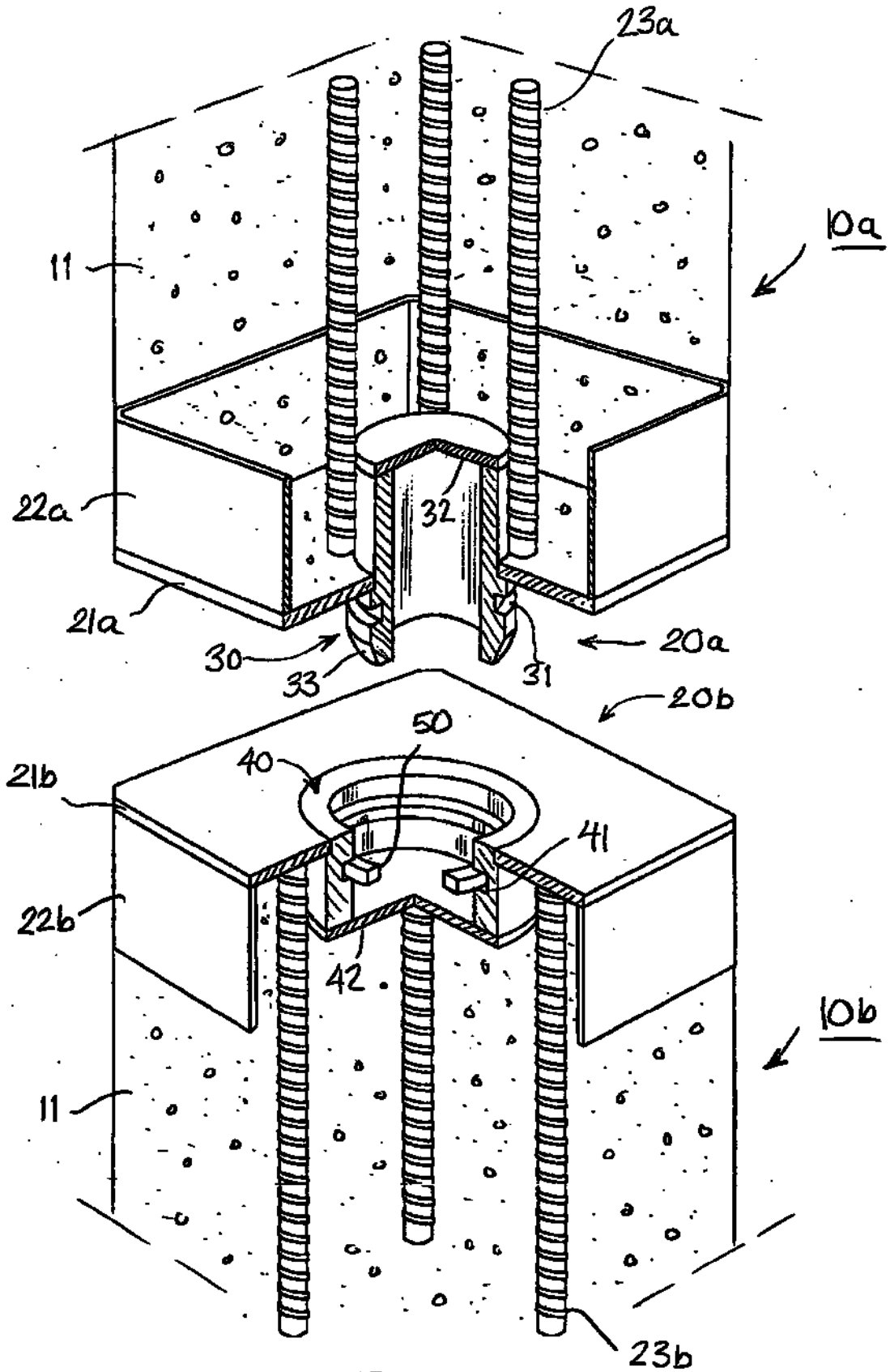


FIG. 1

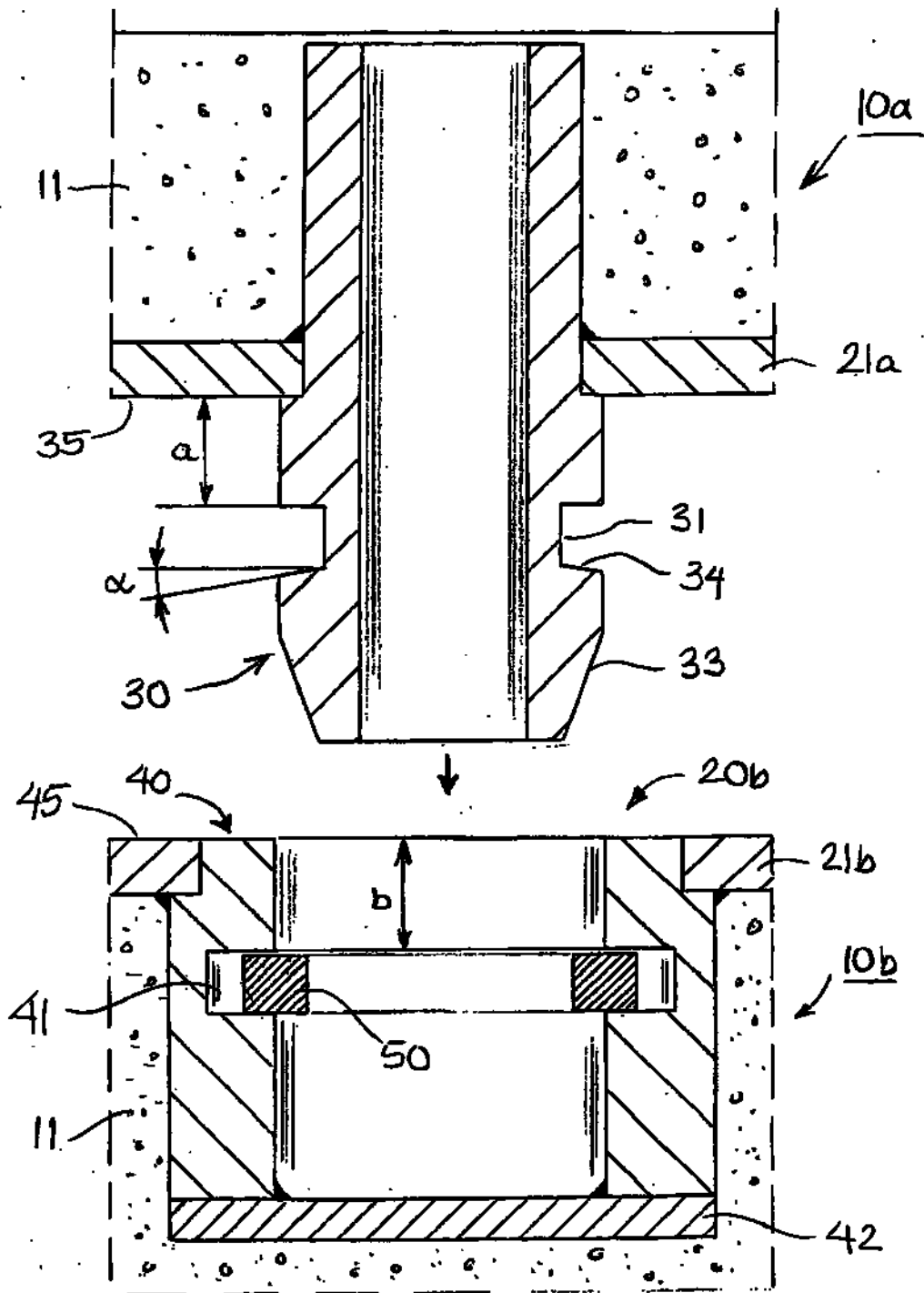


FIG. 2

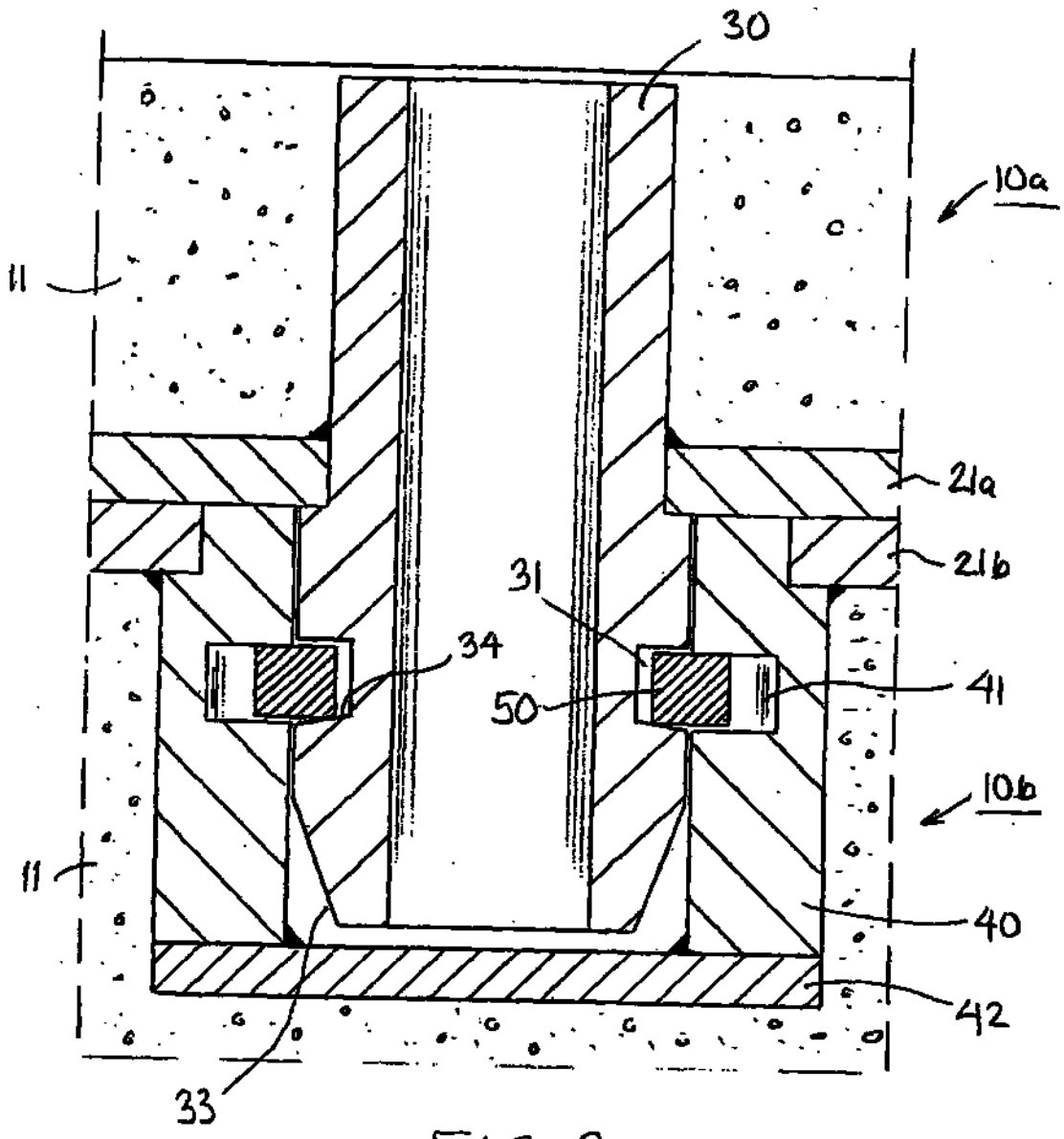


FIG. 3

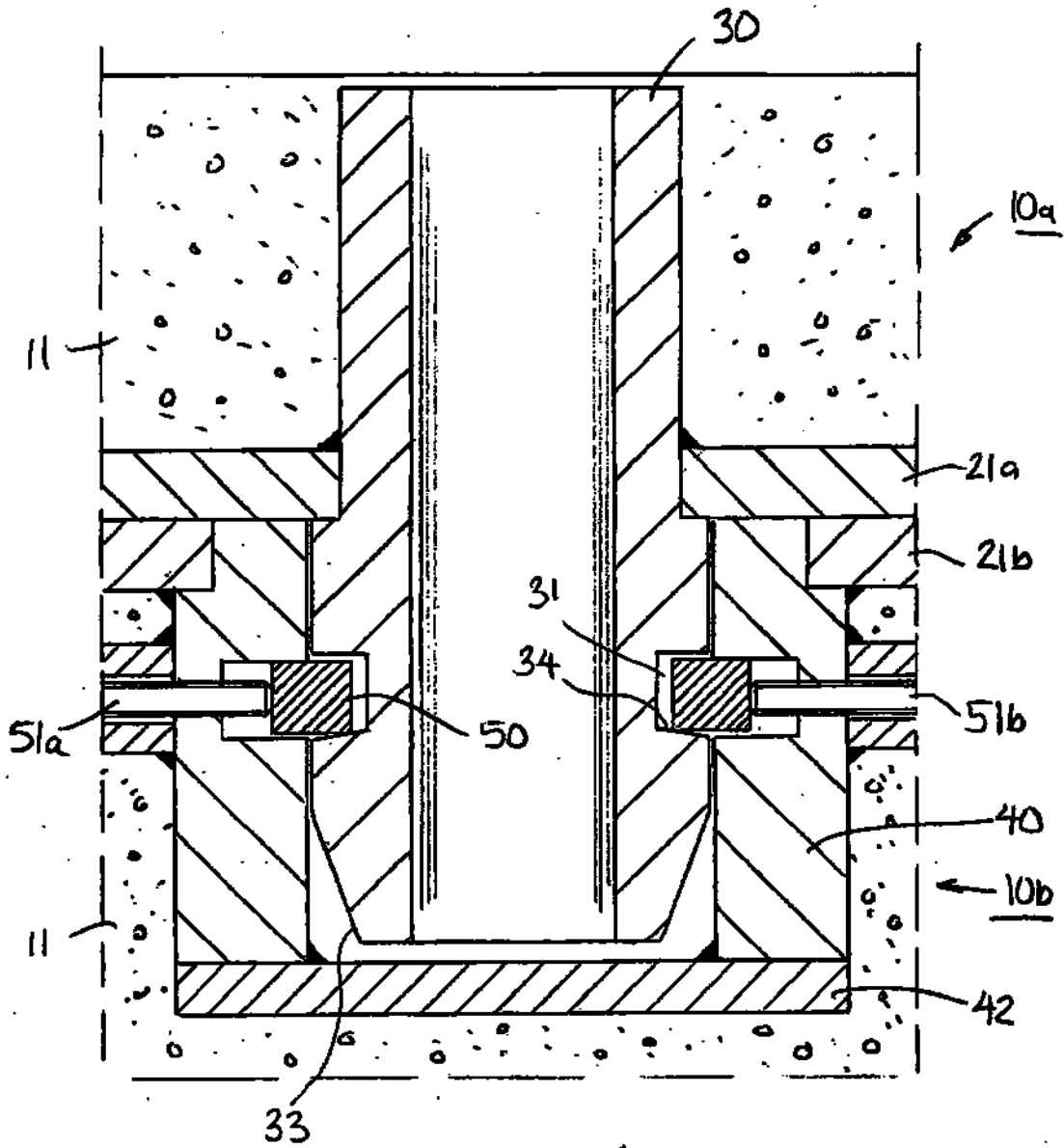


FIG. 4

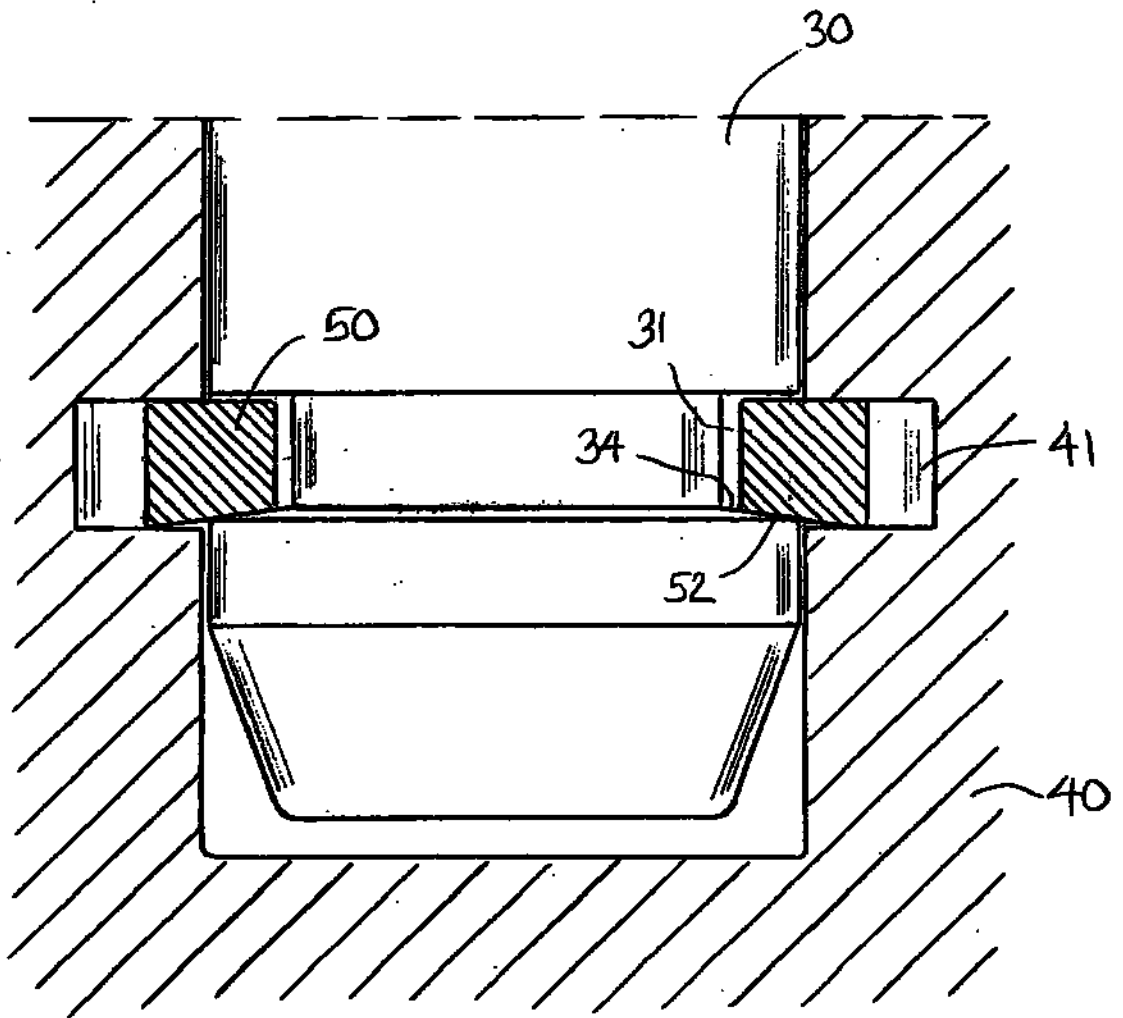


FIG. 5

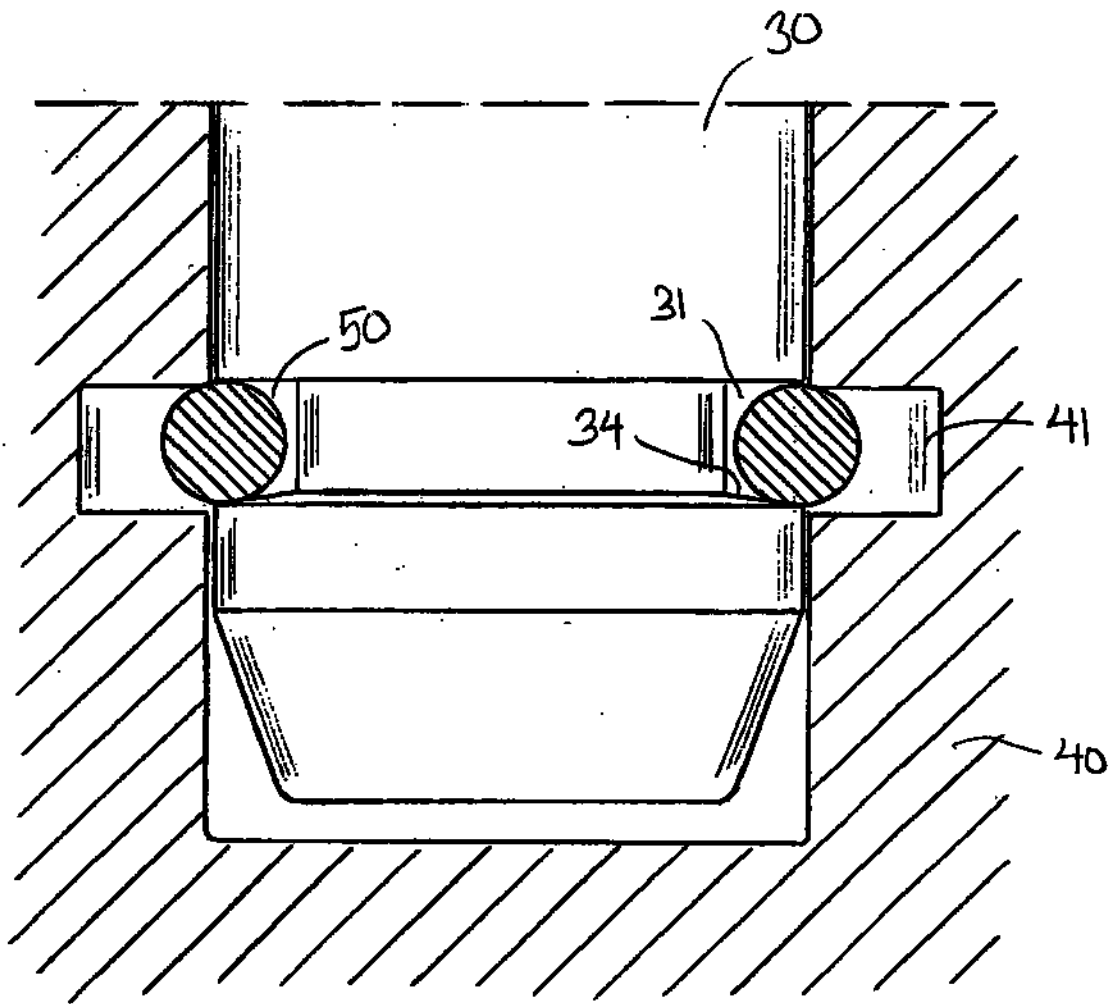


FIG. 6

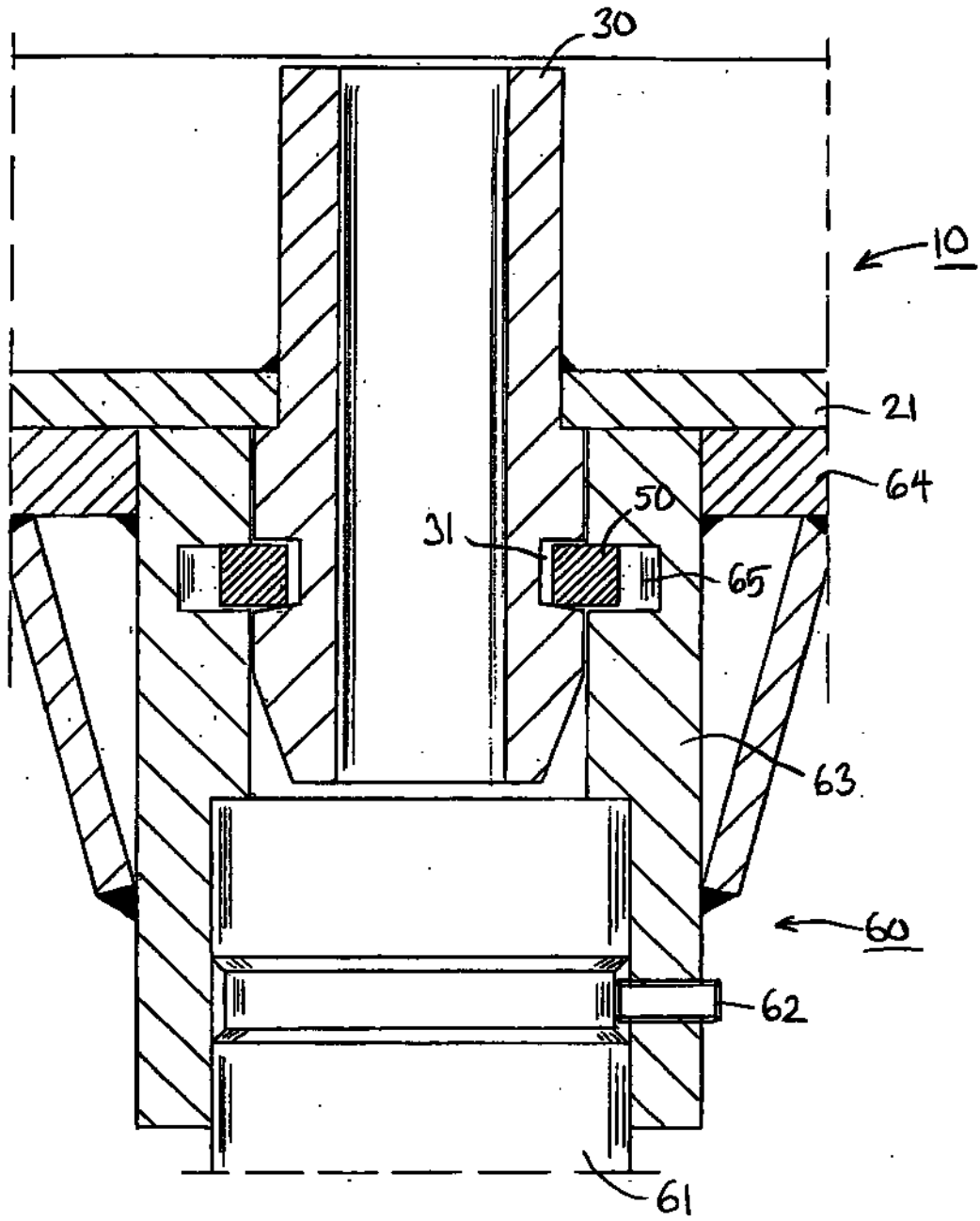


FIG. 7

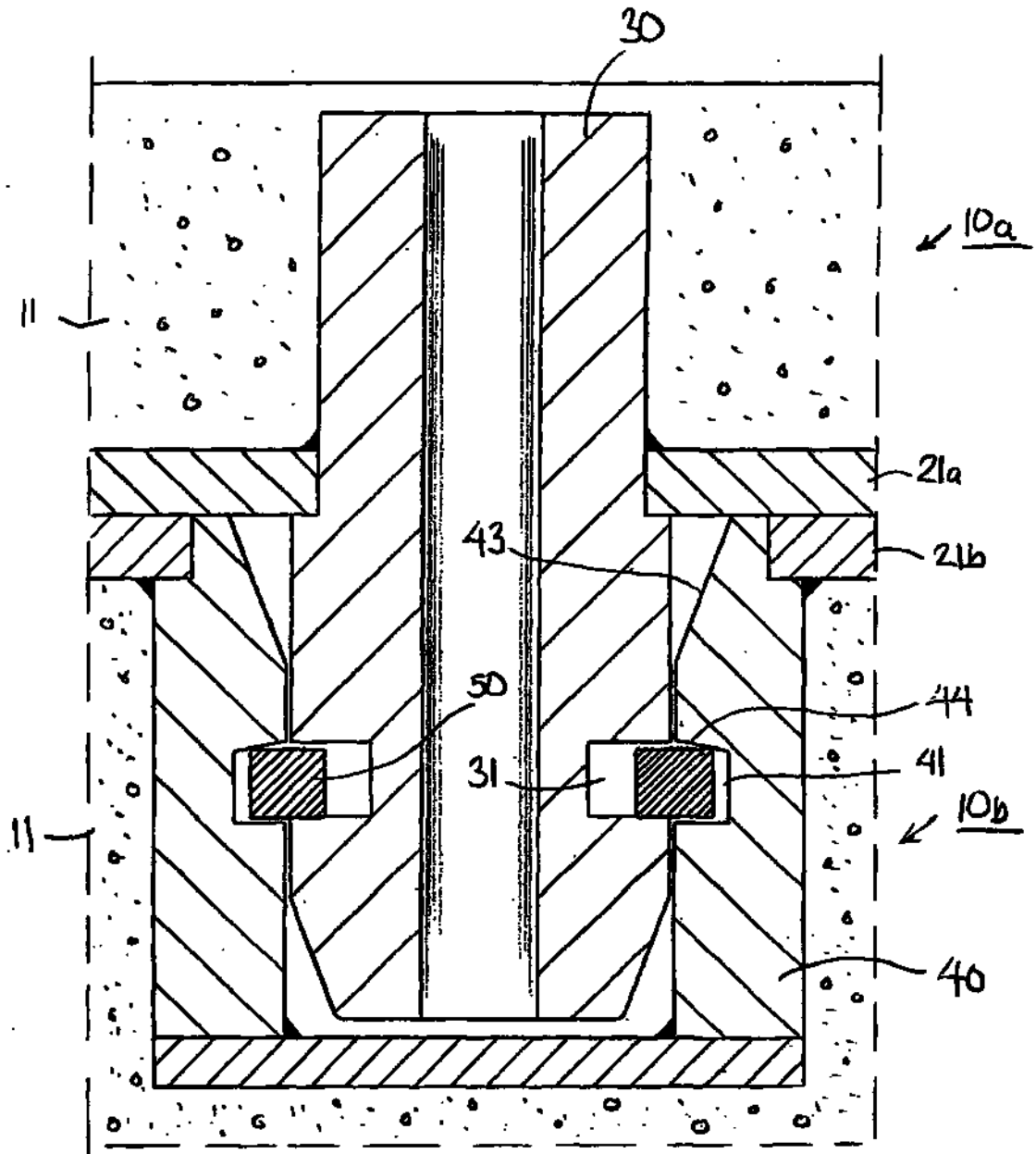


FIG. 8