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(54) **INJECTION PLUG AND INJECTION METHOD**

EINSPRITZSTOPFEN UND EINSPRITZVERFAHREN

TAMPON ET PROCEDE D'INJECTION

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Description

The present invention relates to a packer as defined in the preamble of claim 1 and to an injection method as defined in the preamble of claim 9.

In concrete structures, such as bridges, supporting walls, foundations, pillars, girders and various underground tunnels, cracks appear when the tension exceeds the tensile strength of the concrete. Such cracks significantly reduce the strength and service life of the structure. The formation of cracks is mostly due to factors resulting from faulty design, over-stressing, movement of structures, excessive construction joints or defective work. Such cracks, generally less than one millimetre wide, extending over a large area and reaching the reinforcement, reduce the service life of the structure as the reinforcement undergoes faster corrosion, and lead to a reduced strength of the structure. Especially cracks appearing in rock often lead to significant water damage as water flows through them into constructions.

Generally it is assumed that a cracked structure can be restored to its original strength by the injection method. Injection is generally performed by pumping injection material into the crack through a packer using pressure generated by means of a manual or mechanical injection device, the crack being packed with the mixture solidifying in it. The mixture is introduced using disposable connectors, which are placed in holes made around or in the crack so that they remain in position while a liquid mixture is being pumped into the crack. A suitable injection pressure and the distances between injection points are determined via a preliminary test carried out prior to the operation.

A known device currently used in the procedure described above is a packer comprising a rubber seal around a plug placed in the hole. The rubber seal is pressed into the hole by means of a tightening sleeve placed at the outer end of the plug, said sleeve being provided with a thread. When the sleeve is screwed onto the plug, it causes the seal to be pressed against the interior surface of the hole. The inner end of the plug is provided with a check valve, formed by a ball and a spring, designed to prevent the mass forced into the crack from flowing back through the plug. After use, the tightening element can be detached from the rest of the packer, so it can be used several times.

Patent specification CH-A-644662 and patent applications WO-A-84/01601 and FI-A-821905 present packers which, in respect of both structure and operation, substantially correspond to the one described above.

The worst problem with prior-art packers is that they have a complicated construction and are therefore expensive. The task of connecting the fixing tube to the packer and especially detaching it from it, often in difficult working conditions, significantly retards the injection job. Depending on the job, as many as thousands of packers are needed, so their use should be as quick and simple as possible; being used in large quantities, they involve significant additional costs if they are expensive.

The object of the present invention is to eliminate the drawbacks referred to above. A specific object of the invention is to produce a new type of packer which, both in respect of construction and use, is as simple as possible and reliably seals and closes the hole in all possible pressure conditions.

As for the features characteristic of the invention, reference is made to the claims.

The packer of the invention comprises a packer body designed to be inserted into a hole drilled in a structure to be mended, said packer body having a part with a conical outer surface, a seal being provided around the packer body. Moreover, the packer comprises a fixing tube which, when the packer is in the hole, protrudes out of the hole, and in the packer body a check valve which, with respect to the fixing tube, is located on the opposite side of the seal and opens into the hole, said check valve communicating with the outer end of the fixing tube via a hole going through the packer body and the fixing tube.

According to the invention, the packer body and the fixing tube are implemented as a single, continuous integral body, preferably fabricated from plastic by the injection moulding technique. Furthermore, according to the invention, the seal is as simple as possible in construction, in other words, it consists of an elastic tube of constant circular cross-section which can slide between and around the fixing tube and the conical part of the packer body, in other words, the seal is a straight piece of elastic tube.

The outer end of the fixing tube is preferably provided with a draw stop, such as a lobe, set-off, indentation or other irregularity or relief of surface allowing the packer to be gripped firmly with a suitable tool so that it can be vigorously pulled outward from the hole while the seal is being held in place in the hole. Preferably the outer end of the fixing tube is so shaped that the nozzle of the injection device can be tightly connected to the packer without a separate injection cock or grease nipple.

The inner end of the conical packer body of the packer, i.e. the body end pointing toward the check valve, is preferably provided with a limit stop, such as an annular collar, which forms a stopper that hits the stationary seal when the packer is being pulled outwards from the hole. Thus, the limit stop prevents the packer from being pulled out too far. The flange receives the counterpressure generated in the course of the injection work and utilizes this pressure to squeeze the packer more tightly in the bore hole.

The valve at the inner end of the body is formed by a transverse aperture in the body, the packer body being provided with a longitudinal hole extending from its outer end towards the inner end down to this transverse aperture, and by an elastic sheath placed on the outlet or outlets of the transverse aperture. Due to its elasticity,

this sheath blocks the outlet or outlets in normal conditions, thus acting as a check valve during injection. The elastic sheath preferably also consists of a straight piece of elastic tube.

In the injection procedure of the invention, the above-described packer according to the invention is used. In the procedure, the unitary integral body formed by the fixing tube and the packer body is inserted, with a grip by the fixing tube, into a hole drilled in the structure to be repaired. The integral body is tightened in the hole by holding the seal around it immovable in the hole and pulling at the fixing tube by its outer end, causing the seal to be squeezed between the interior surface of the hole and the conical part of the packer. After this, packing material can be pumped through the packer into the hole. Either immediately thereupon or later after the injected mass has settled down, the part of the fixing tube remaining outside the hole is broken off e.g. by simply applying a transverse blow to the base of the fixing tube, whereupon the hole can be patched up.

The packer and injection method of the invention have significant advantages as compared with prior art. The invention is very simple in construction, only consisting of a body piece, which can be fabricated in a simple manner e.g. by the injection moulding technique, and two tubular sheaths of elastic material placed around it. Thus, the packer is very cheap to manufacture. Moreover, the packer is easy to use and it can be mounted in place using a suitable tool with one hand and only a small effort. In addition, the packer can be easily broken off from the hole, leaving the pressure in the structure, so the hole can be capped even in connection with the same operation.

In the following, the invention is described in detail by the aid of the attached drawings, in which

Fig. 1 presents a packer as provided by the invention, partially sectioned,
Fig. 2 shows how the packer of Fig. 1 is inserted into a hole, and
Fig. 3 shows the packer of Fig. 1, mounted in a hole and ready for use.

A packer according to the invention as shown in Fig. 1 comprises an elongated packer body 1 having a relatively pointed inner end 3 and a tubular fixing tube 13 forming a straight and seamless extension of the packer body and provided with an outer end 4 having a round shape resembling a grease nipple. Inside the packer body and fixing tube there is a longitudinal hole 5 extending from the outer end 4 to a point close to the inner end 3 of the packer body, opening to the exterior surface of the packer body via a transverse aperture 11.

Disposed around the transverse aperture 11 is an elastic rubber sheath, covering the outlets of the aperture 11. Thus, the transverse aperture 11 and the sheath 12 form a check valve that permits outward flow from the hole 5 through the aperture 11 and out from under the sheath 12 while preventing reverse flow back into the hole 5.

The packer body 1 comprises a conical part 8 of circular cross-section, extending from the valve towards the outer end of the packer body and tapering towards the outer end and the fixing tube. After the conical part there is a fixing tube 13 of uniform thickness, ending at a shoulder or draw stop 9. The conical part 8 thus widens towards the inner end 3 of the packer body 1, ending before the valve at an expansion of the packer body, a ring-like collar forming a limiter 10. A ring-shaped collar is also formed in the packer body 1 on the side facing towards the check valve 6, so that the pressure prevailing in the hole is applied to this collar, pressing the packer body outwards and tightening the packer in a manner to be described later on. Fitted around the straight fixing tube 13 and the conical part 8 is a seal 7 made of elastic and flexible material, e.g. a piece of rubber hose, which is of a size that allows it to slide on both the straight part and the conical part between the draw stop 9 and the limiter 10. The length of the seal 7 is substantially shorter than the lengths of the fixing tube 13 and the conical part 8 together.

Referring to Fig. 2 and 3, the packer presented in Fig. 1 is used as follows. A hole 2 has been drilled in the structure to be treated. In concrete structures, the mouth of the hole is generally more or less ragged. The packer is inserted into the hole with the seal 7 substantially in the area of the straight fixing tube 13. The packer is inserted to a depth such that the seal 7 lies completely in the undamaged hole area, somewhat sunk in from the mouth of the hole. Next, a pressure is applied to the upper edge of the seal 7 in the direction of arrows A to hold it in position while at the same time gripping the draw stop 9 at the outer end 4 and drawing it straight outwards as indicated by arrow B. The packer is preferably mounted using a special mounting tool by means of which the seal can be held in position and a pull exerted on the draw stop at the same time. When this is done, the conical part 8 of the packer body 1 is thrust into the seal 7, pressing the seal against the interior surface of the hole. The pulling action B is continued until the limiter 10 hits the lower edge of the seal 7. In this way, the seal has been squeezed very tightly between the conical surface 8 and the interior surface of the hole 2, whereupon it is possible, in a manner known in itself, to attach a hose or connector to the outer end 4 of the packer body 1 to inject suitable packing material into the hole 2 while the check valve 6 prevents the mass from flowing back into the hole 5. The conical shape of the body ensures that the packer cannot be pushed out of the hole by the counterpressure generated in the hole and the crack, because the pressure is applied to the body 1 and especially to the flange 10, which is pressed against the seal 7, thus squeezing it more tightly in the hole.

The packer is preferably fabricated from a suitable plastic material e.g. by the injection moulding technique, and the part of the packer remaining above the seal 7

can easily be broken off from the hole 2 and the hole can be capped using suitable material. According to the tests carried out, the packer of the invention is fully pressure-proof, having a pressure resistance of at least 250 bar, yet it performs perfectly in low-pressure injection as well, which may involve the use of pressures below 10 bar.

The invention has been described above by presenting an example by the aid of the attached drawings, but different embodiments of the invention are possible within the framework of the claims.

Claims

1. Packer for filling cracks in concrete structures with packing material pumped into the crack, said packer comprising

   - a packer body (1) designed to be inserted into a hole (2) drilled in the structure to be repaired, said packer body having a part (8) with a conical outer surface, a seal (7) being provided around the packer body,
   - a fixing tube (13) which, when the packer is in the hole, protrudes out of the hole,
   - a check valve (6) in the packer body, located on the opposite side of the seal with respect to the fixing tube, said check valve opening into the hole and communicating with the outer end (4) of the fixing tube via a hole (5) going through the packer body and the fixing tube,

   characterized in that the packer body and the fixing tube form a single, continuous cast integral body and the seal (7) consists of an elastic tube of constant circular cross-section, slidable between and around the fixing tube and the conical part (8) of the packer body.

2. Packer as defined in claim 1, **characterized** in that the outer end of the fixing tube (13) is provided with a draw stop (9), by which it can be drawn outwards.

3. Packer as defined in claim 2, **characterized** in that the draw stop (9) consists of a boss at the outer end of the fixing tube.

4. Packer as defined in any one of claims 1 - 3, **characterized** in that the wider end of the conical part (8), the end pointing toward the check valve, is provided with a limiter (10), which is drawn up into contact with the edge of the seal (7) when the packer is being mounted in the hole.

5. Packer as defined in any one of claims 1 - 4, **characterized** in that the check valve (6) is formed by an outlet aperture (11) transverse with respect to the longitudinal direction of the hole (5) and an elastic sheath (12) covering it.

6. Packer as defined in claim 5, **characterized** in that the elastic sheath (12) consists of a straight elastic tube of constant circular cross-section.

7. Packer as defined in claim 1, **characterized** in that the integral body is a plastic body produced by the injection moulding technique.

8. Packer as defined in claim 1, **characterized** in that the fixing tube (13) forms a straight extension of uniform thickness to the conical part (8) of the packer body (1).

9. Injection method for filling cracks in concrete structures with packing material pumped into the crack via a packer comprising

   - a packer body (1) designed to be inserted into a hole (2) drilled in the structure to be repaired, said packer body having a part (8) with a conical outer surface and a seal (7) around the packer body,
   - a fixing tube (13) which, when the packer is in the hole, protrudes out of the hole,
   - a check valve (6) in the packer body, located on the opposite side of the seal with respect to the fixing tube, said check valve opening into the hole and communicating with the outer end (4) of the fixing tube via a hole (5) going through the packer body and the fixing tube,

   characterized in that the method involves performing the following steps:

   - the unitary, injection-moulded integral body formed by the fixing tube (13) and the packer body (1) is inserted into the hole (2),
   - the integral body is tightened in the hole by holding the seal (7) immovable in the hole and pulling outwards by the fixing tube,
   - packing material is pumped through the packer into the hole,
   - the part of the fixing tube remaining outside the hole is broken off, and
   - the hole is patched up.

Patentansprüche

1. Stopfen zum Füllen von Rissen/Spalten in Betonstrukturen, wobei Dichtungsmaterial in den Riß/die Spalte gefüllt wird, wobei der Stopfen umfaßt

   - einen Stopfenkörper (1), der ausgebildet ist, in ein Loch (2), das in die zu reparierende Struktur

gebohrt wird, eingeführt zu werden, wobei der Stopfenkörper einen Abschnitt (8) mit einer konischen äußeren Fläche aufweist, wobei um den Stopfenkörper eine Dichtung (7) vorgesehen ist,

- ein Befestigungsrohr (13), das, wenn sich der Stopfen in dem Loch befindet, aus dem Loch hervorsteht,
- ein Prüfventil (6) in dem Stopfenkörper, das im Verhältnis zum Befestigungsrohr an der gegenüberliegenden Seite der Dichtung angeordnet ist, wobei sich das Prüfventil in das Loch öffnet und mit dem äußeren Ende (4) des Befestigungsrohres über ein Loch (5), das durch den Stopfenkörper und das Befestigungsrohr geht, in Verbindung steht,

dadurch gekennzeichnet, daß der Stopfenkörper und das Befestigungsrohr einen einzigen, kontinuierlich gegossenen Integralkörper bilden und die Dichtung (7) aus einem elastischen Schlauch/Rohr von konstantem kreisförmigem Querschnitt besteht, der zwischen dem Befestigungsrohr und dem konischen Abschnitt (8) des Stopfenkörpers und um diese herum gleit-/schiebbar ist.

2. Stopfen, nach Anspruch 1, **dadurch gekennzeichnet,** daß das äußere Ende des Befestigungsrohres (13) mit einem Ziehanschlag (9) versehen ist, an dem es nach außen gezogen werden kann.

3. Stopfen nach Anspruch 2, **dadurch gekennzeichnet,** daß der Ziehanschlag (9) aus einem Vorsprung am äußeren Ende des Befestigungsrohres besteht.

4. Stopfen nach einem der Ansprüche 1-3, **dadurch gekennzeichnet,** daß das weitere Ende des konischen Abschnitts (8), das Ende, das auf das Prüfventil zeigt, mit einem Begrenzer (10) versehen ist, der nach oben in Berührung mit dem Rand der Dichtung (7) gezogen wird, wenn der Stopfen in dem Loch angebracht wird.

5. Stopfen nach einem der Ansprüche 1-4, **dadurch gekennzeichnet,** daß das Prüfventil (6) von einer Auslaßöffnung (11), transversal im Verhältnis zur Längsrichtung des Loches (5), ausgebildet ist und daß eine elastische Umhüllung (12) es bedeckt.

6. Stopfen nach Anspruch 5, **dadurch gekennzeichnet,** daß die elastische Umhüllung (12) aus einem geraden elastischen Schlauch von konstantem kreisförmigem Querschnitt besteht.

7. Stopfen nach Anspruch 1, **dadurch gekennzeichnet,** daß der Integralkörper ein Plastikkörper ist, der mittels Spritzgußtechnik hergestellt wird.

8. Stopfen nach Anspruch 1, **dadurch gekennzeichnet,** daß das Befestigungsrohr (13) eine gerade Erstreckung einheitlicher Stärke bis zu dem konischen Abschnitt (8) des Stopfens (1) bildet.

9. Einspritzverfahren zum Füllen von Rissen/Spalten in Betonstrukturen, wobei Dichtungsmaterial über einen Stopfen in den Riß/die Spalte gefüllt wird, umfassend

- einen Stopfenkörper (1), der ausgebildet ist, in ein Loch (2), das in die zu reparierende Struktur gebohrt wird, eingeführt zu werden, wobei der Stopfenkörper einen Abschnitt (8) mit einer konischen äußeren Fläche unf eine Dichtung (7) um den Stopfenkörper aufweist,
- ein Befestigungsrohr (13), das, wenn sich der Stopfen in dem Loch befindet, aus dem Loch hervorsteht,
- ein Prüfventil (6) in dem Stopfenkörper, das an der gegenüberliegenden Seite der Dichtung im Verhältnis zum Befestigungsrohr angeordnet ist, wobei sich das Prüfventil in das Loch öffnet und mit dem äußeren Ende (4) des Befestigungsrohres über ein Loch (5), das durch den Stopfenkörper und das Befestigungsrohr geht, in Verbindung steht,

dadurch gekennzeichnet, daß das Verfahren die Durchführung der folgenden Schritte umfaßt:

- der einheitliche, spritzgegossene Integralkörper, der von dem Befestigungsrohr (13) und dem Stopfenkörper (1) gebildet wird, wird in das Loch (2) eingeführt,
- der Integralkörper wird in dem Loch durch unbeweglich Halten der Dichtung (7) in dem Loch und nach außen Ziehen von dem Befestigungsrohr abgedichtet,
- das Dichtungsmaterial wird durch den Stopfen in das Loch gepumpt,
- der Abschnitt des Befestigungsrohres, der außerhalb des Loches zurückbleibt, wird abgebrochen, und
- das Loch wird ausgebessert.

Revendications

1. Dispositif de remplissage pour combler des fissures dans des structures de béton avec un matériau de remplissage pompé dans la fissure, ledit dispositif de remplissage comprenant

- un corps de dispositif de remplissage (1) conçu pour être inséré dans un orifice (2) foré dans la structure à réparer, ledit corps ayant une partie (8) avec une surface externe conique, un joint

(7) étant prévu autour du corps du dispositif de remplissage,

- un tube de fixation (13) qui, lorsque le dispositif de remplissage est dans l'orifice, fait saillie hors de cet orifice,
- un clapet de non-retour (6) dans le corps du dispositif de remplissage, situé du côté opposé au joint par rapport au tube de fixation, ledit clapet de non-retour ouvrant dans l'orifice et communiquant avec l'extrémité externe (4) du tube de fixation via un orifice (5) traversant le corps du dispositif de remplissage et le tube de fixation,

caractérisé en ce que le corps du dispositif de remplissage et le tube de fixation forme un seul corps entier, obtenu par moulage continu et le joint (7) consiste en un tube élastique de section transversale circulaire constante, glissant entre et autour du tube de fixation et de la partie conique (8) du corps du dispositif de remplissage.

2. Dispositif de remplissage selon la revendication 1, caractérisé en ce que l'extrémité externe du tube de fixation (13) est prévue avec un arrêt d'extraction (9), par lequel il peut être retiré.

3. Dispositif de remplissage selon la revendication 2, caractérisé en ce que l'arrêt d'extraction (9) consiste en une protubérance à l'extrémité externe du tube de fixation.

4. Dispositif de remplissage selon l'une quelconque des revendications 1 - 3, caractérisé en ce que l'extrémité plus large de la partie conique (8), dirigée vers le clapet de non-retour, est équipé d'une butée (10) qui est montée au contact du bord du joint (7) lorsque le dispositif de remplissage est monté dans l'orifice.

5. Dispositif de remplissage selon l'une quelconque des revendications 1 - 4, caractérisé en ce que le clapet de non-retour (6) est formé par une ouverture de sortie (11) transversale par rapport à la direction longitudinale de l'orifice (5) et une gaine élastique (12) la recouvrant.

6. Dispositif de remplissage selon la revendication 5, caractérisé en ce que la gaine élastique (12) consiste en un tube élastique rectiligne de section transversale circulaire constante.

7. Dispositif de remplissage selon la revendication 1, caractérisé en ce que le corps entier est un corps de plastique produit par la technique de moulage par injection.

8. Dispositif de remplissage selon la revendication 1, caractérisé en ce que le tube de fixation (13) forme une extension rectiligne d'épaisseur uniforme vers la partie conique (8) du corps du dispositif de remplissage (1).

9. Méthode d'injection pour combler des fissures dans des structures de béton avec un matériau de remplissage pompé dans la fissure via un dispositif de remplissage comprenant

- un corps de dispositif de remplissage (1) conçu pour être inséré dans un orifice (2) foré dans la fissure à réparer, ledit corps ayant une partie (8) avec une surface externe conique et un joint (7) autour du corps du dispositif de remplissage,
- un tube de fixation (13) qui, lorsque le dispositif de remplissage est dans l'orifice, fait saillie hors de cet orifice,
- un clapet de non-retour (6) dans le corps du dispositif de remplissage, situé du côté opposé au joint par rapport au tube de fixation, ledit clapet de non-retour ouvrant dans l'orifice et communiquant avec l'extrémité externe (4) du tube de fixation via un orifice (5) traversant le corps du dispositif de remplissage et le tube de fixation,

caractérisé en ce que la méthode implique de réaliser les étapes suivantes :

- le corps entier, unique, obtenu par moulage par injection, formé par le tube de fixation (13) et le corps du dispositif de remplissage (1) est inséré dans l'orifice (2),
- le corps entier est bloqué de façon étanche dans l'orifice en maintenant le joint (7) immobile dans cet orifice et en tirant vers l'extérieur par le tube de fixation,
- le matériau de remplissage est pompé dans le trou à travers le dispositif de remplissage,
- la partie du tube de fixation restant hors de l'orifice est cassée et retirée et
- l'orifice est refermé.

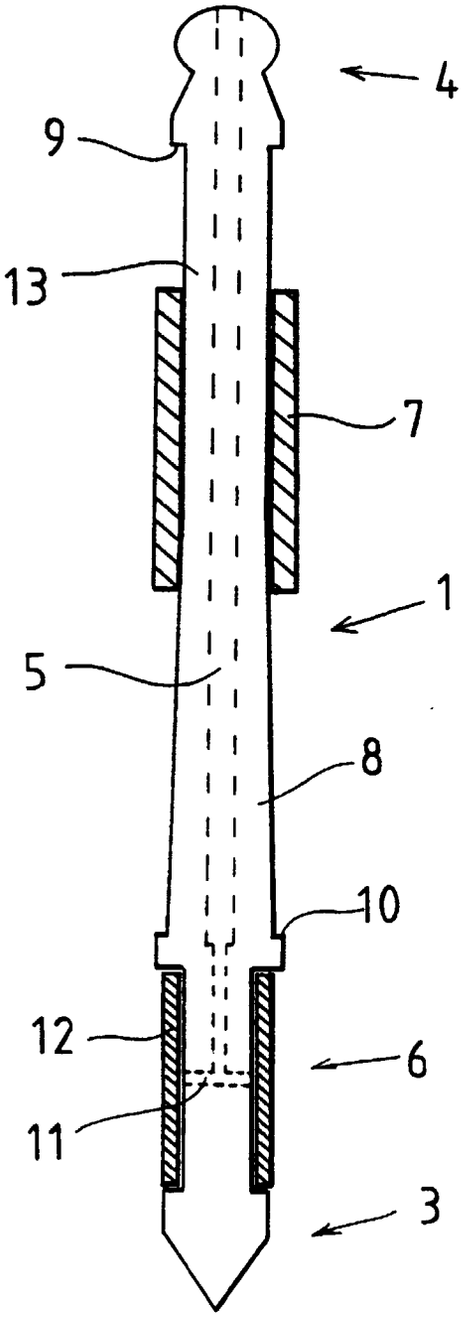

Fig 1

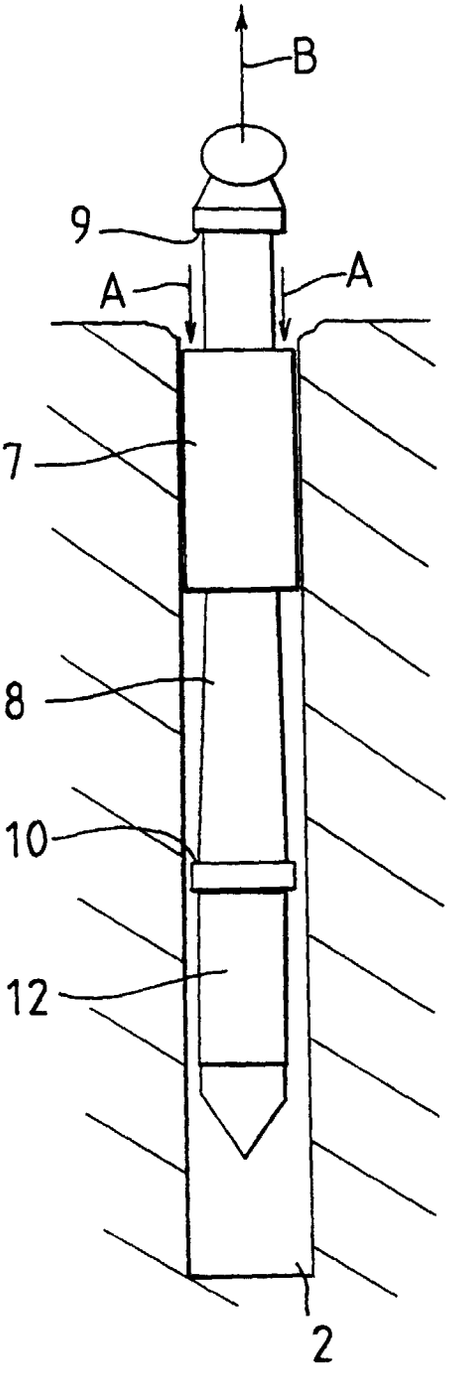

Fig 2

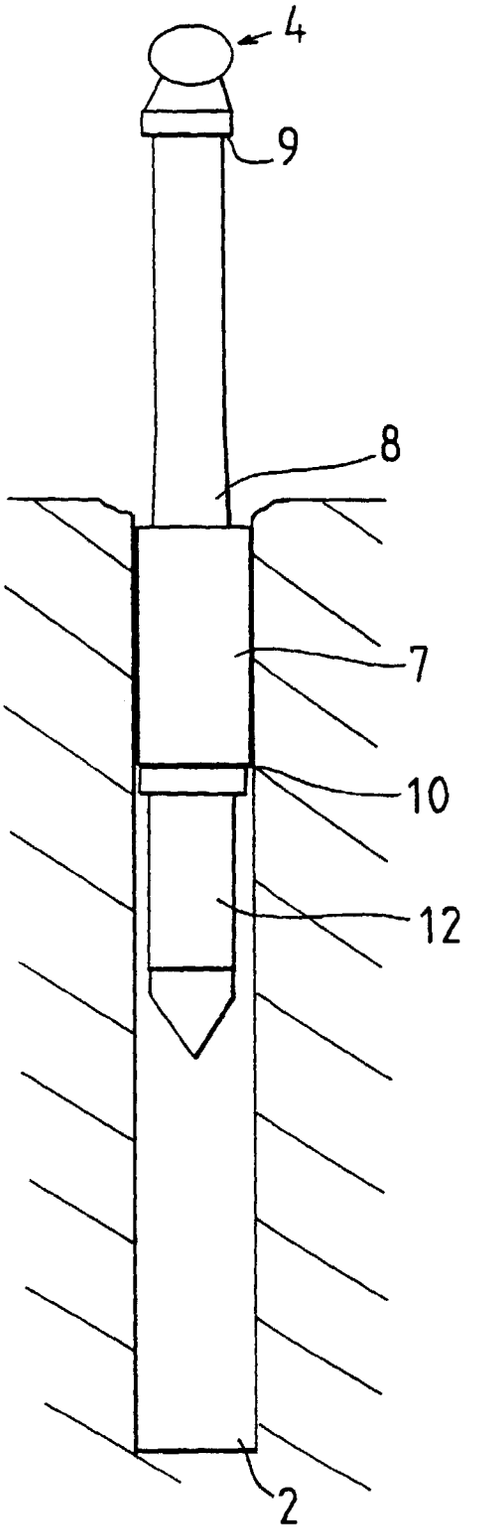

Fig 3