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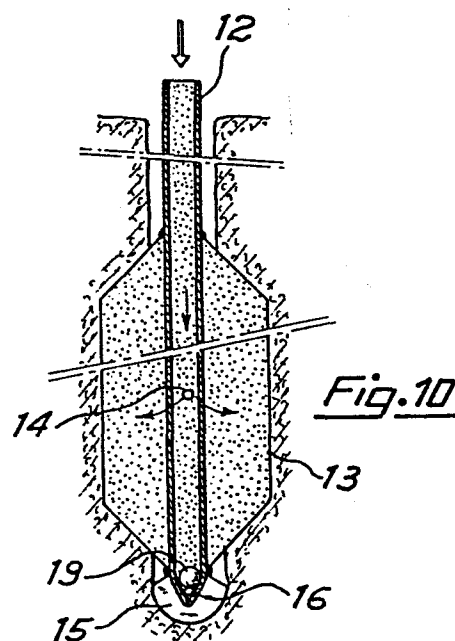
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54 Anchor element for tie bars in civil works.

57 The anchor element according to the invention comprises a tubular body (2) and an expandable jacket (3) associated to the tubular body (2) near its lower end and communicating with the inside of the tubular body by means of at least a through hole (4). Said expandable jacket (3) can be filled with cement mortar at the fluid state which causes swelling of the expandable jacket (3) itself thus forming an anchor block directly in the ground.



1 The present invention concerns an anchor element for tie
bars in civil works, particularly suitable for soils of
poor solidity, as well as process for the installation of
said anchor element.

5 As it is well known, when it is necessary to perform ancho
rages for tie bars in civil works in soils of poor solidi-
ty and, in any case, in scarcely cohesive soils blocks of
concrete are introduced into the ground to form an anchor
mass. Said blocks are introduced into the ground by digging
or they are formed directly in the ground by injecting ce-
10 ment mortar into proper cavities created in the soil.

This method, however, is extremely antieconomic specially
in the cases where, due to the soil poor resistance to cut
ting, it becomes necessary to introduce or form in the gro
und blocks of large size.

15 In particular in the case where anchor blocks are to be u-
sed in protection works in the mountains such as guards
for rocks or avalanches, the imperviousness of the places
and the morphology of the ground make the laying under-
ground or formation of the anchor blocks extremely complex
20 and heavy.

A main object of the present invention is therefore to pro
pose an anchor element particularly suitable for grounds
of poor solidity, which is structurally simple and easy to be
installed and which allows to obtain, rapidly and at ex-
25 tremely low costs, a steady and safe anchor block capable
of supporting considerable stretches.

Another object of the present invention is to obtain an
anchor element easy to be formed using elements and mate-
rials commonly available on the market and moreover, which
30 is convenient from the economic viewpoint.

1 Said objects are achieved by means of an anchor element
for tie bars in civil works, characterized in that it compr
prises a tubular body near its lower end and communicating
with the inside of the tubular body by means of at least
a through hole, said expandable jacket being capable of
5 receiving cement mortar at the fluid state.

According to an advantageous embodiment of the invention,
the anchor element presents, in correspondence to its low
wer end, a drilling head coaxially fixed to the tubular bod
dy and one or more through holes capable of putting the insi
10 side of the tubular body in communication with the external
area near the drilling head, said tubular body being able to
be connected to a drill and to a source of fluid under presu
sure. The invention also foresees a method for the installati
tion of said anchor element, the process being characterized
15 by the following steps: connection of the anchor element
to a drill and to a source of fluid under pressure; ground
drilling by means of a drilling head mounted at the lower
end of the anchor element, with simultaneous introduction
of fluid under pressure into anchor element tubular body so
20 that said fluid, outcoming from the holes at the lower
end of the tubular body, in correspondence to said drilling
ling head performs the elimination of perforation rubble
pushing it outside along the hollow space between the expa
ndable jacket and the hole walls; introduction into the
25 anchor element tubular body of means capable of hydraulical
ly closing said holes for the fluid under pressure; injecti
tion of cement mortar at the fluid state and under pressure
into said tubular body so that, passing through
the holes communicating with the expandable jacket, it cau
30 ses swelling of said jacket forming the anchor block.

A main advantage of the anchor element according to the invention is its extremely rapid and easy installation. Furthermore, the dilatation of the expandable jacket associated to the tubular body causes an improvement in the compactness of the surrounding ground, thus further favouring the steadiness and safety of the anchorage.

The anchor element according to the invention and the process for its installation will be now described in detail referring to the attached drawings where:

- figure 1 is a side cross view of a first embodiment of the anchor element.
- figure 2 is a cross view of the anchor element of figure 1 with the expandable jacket in its swelled condition.
- figure 3 is a cross view of the anchor element of figure 1, according to the line A-A.
- figure 4 is a side cross view of a second embodiment of the anchor element.
- figure 5 is a cross view of the anchor element of figure 3, according to the line B-B.
- figures 6 to 10 illustrate the steps necessary for the installation of the anchor element of figure 3.

Referring first to figure 1, the anchor element essentially comprises a tubular body 2 and an expandable jacket 3 associated to the tubular body itself near its lower end and communicating with the inside of the tubular body 2 by means of one more through holes 4.

The tubular body 2 is preferably, but not necessarily, approximately 3 meters long and can be made of stainless steel. The 3-meter length of the tubular body is the one that proves to be usually sufficient, even with extremely non solid soils, to allow the anchor element to support stretches of

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1 the order of ten tons, for which it will be mainly used.
Of course, in the case where higher stretches are foreseen
or in presence of exceptionally uncohesive soils, it is
possible to screw additional tubes up to the desired length.
It must be pointed out that the tube diameter can be va-
5 ried according to contingent needs.

In correspondence to the lower end, the tubular body 2
has a drilling head 5 which allows to drive the anchor ele-
ment into the ground. The anchor element can be introduced
into the ground by driving it directly by means of a pneumatic
10 hammer, in the case in which the ground morphology allows it,
or even by performing a suitable hole into which the anchor
element is then introduced.

The expandable jacket 3 is formed by a lamina made of metal
or plastic folded over along the tube according to a cer-
15 tain number of laps which develop semicircumferentially, as
schematically shown in figure 3. In correspondence to its
upper and lower edges, the lamina is integral to the exter-
nal side walls of the tubular body so as to define, around
the tubular body 2, a hermetically closed expandable chamber
20 6 having a substantially cylindrical configuration, said
chamber 6 being in communication with the inside of the tu-
bular body 2 through the above mentioned through hole (s)
4 present in the tubular body itself. The chamber 6 can be
filled with cement mortar at the fluid state, at a relati-
25 vely low pressure, generally of 15 bar. For this reason, for
the injection operation, a small injector can be sufficient
to be connected to the upper end of the tubular body 2 and
to be actuated even manually. Due to the introduction of
the cement mortar at the fluid state, the expandable jacket
30 3 swells acquiring a substantially cylindrical shape with

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1 a diameter even 5 times larger than the starting one.

The swelling of the jacket 3 until reaching the above mentioned cylindrical configuration makes first of all the surrounding ground more compact and moreover forms an anchor block directly in the ground.

5 The cylindrical configuration of the swelled jacket 3 is particularly advantageous, in that it easily supports the back thrust of the surrounding compressed ground and remains unchanged also when the pressure of the cement mortar falls down.

10 The configuration of the jacket 3, which is tapered at the lower and upper ends, is such that the rupture thereof may occur in correspondence to the top end of the upper conical section. For this reason, the cylindrical configuration remains even after the jacket 3 breaks, which occurs with the continuous injection of the mortar into the annular jacket. Said breaking of the jacket 3 caused by the mortar is advisable, in that it allows to make the mortar itself to penetrate into the space existing between the tubular body and the upper section of the hole, so improving adherence to the ground of the anchor block which forms and also informing in a safe and immediate way of the accomplishment of the installation of the anchor element, by an outflowing of the mortar from the ground.

20 Once the mortar hardens, it constitutes the anchor bulb and makes the jacket 3 superfluous, which therefore can be made of normal steel or plastic material, with a cost decrease for the anchor element.

30 Figure 4 illustrates another embodiment of the anchor element according to the invention, which allows to easily introduce the anchor element into highly non solid ground in

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1 which penetration of the anchor element by simple hammering would be extremely slow and in which the walls of the eventual hole into which the anchor element has to be introduced would tend to slide down clogging up the hole itself.

5 For this purpose, in correspondence to its lower end, the anchor element 10 presents a drilling head 15 coaxially fixed to the tubular body 12 and one or more through holes 16.

10 The drilling head 15 has a width larger than that of the tubular body 12 and expandable jacket 13, and such as to create during ground drilling a hollow space between the hole walls and the expandable jacket 13. The upper end of the tubular body 12 presents a connection 17 in order to connect the anchor element to the spindle of a drill.

15 The tubular body 12 can be associated with an expandable jacket like the one of the anchor element of figure 1, or can be associated with an expandable jacket advantageously formed by two metal laminae 18 supported by the tubular body 12 on diametrically opposite sides, said laminae 18 being
20 soldered to each other in correspondence to their edges and to the tubular body itself. (figure 5).

In this way, the laminae 18 form a kind of metal envelope which partially contains the tubular body 12, said metal envelope being in communication with the inside of the tubular body through one or more through holes 14.
25

The expandable jacket thus formed is then rolled up around the tubular body 12 in the same rotation direction as that of the drill so that, during perforation, it does not tend to unroll interfering with the side walls of the hole.

30 Now referring to figures from 6 to 10, the anchor element

of figure 3 is installed by connecting it to a drill which makes it rotate around its own axis and simultaneously submits it to a hammering action from up downwards.

The anchor element also communicates with a source of fluid under pressure. Said fluid penetrates into the tubular body 12 and outcomes from the through holes 16, in correspondence to the drilling head 15.

The fluid under pressure, which for instance can be simply air, performs elimination of the perforation rubble, pushing it outside along the hollow space between the hole walls and the expandable jacket 13 (figure 6 and 7).

When the anchor element has reached the desired depth, a rubber ball 19 is introduced into the tubular body 12, said ball being suitable to hydraulically close the hole (s) 16 from which the fluid under pressure outflows (figures 8 and 9).

The cement grout is then introduced into the tubular body 12 and, through the holes 14, it penetrates inside the expandable jacket 13 causing its swelling (figure 10). The closing action of the holes 16 by the rubber ball 19 is assured by the thrust action exercised by the grout on the ball itself which, due to its deformation, adheres to the side walls of the tubular body 12.

The anchor element according to the two above described embodiments can have different applications. However, it is particularly suitable for the anchorage of guards for rocks, guards for avalanches, to fix telephone and electrical poles, to reduce the size of foundation plynths subject to partialization of the support section due to horizontal thrusts and very advantageously substitutes the so-called concrete ballasts.

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1 1. An anchor element for tie bars in civil works, particularly
2 suitable for soils of poor solidity, characterized in that
3 it comprises a tubular body and an expandable jacket asso-
4 ciated to the tubular body near its lower end and communica-
5 ting with the inside of the tubular body itself by means of
6 at least a through hole, said expandable jacket being able
7 to be filled with cement mortar at the fluid state.

1 2. An anchor element according to claim 1, characterized in
2 that it carries, in correspondence to its lower end, a drill-
3 ling head coaxially fixed to the tubular body and one or mo-
4 re through holes capable of making the inside of the tubular
5 body to communicate with the external area near the drilling
6 head, said tubular body being able to be connected to a drill
7 and to a source of fluid under pressure.

1 3. An anchor element according to claim 2, wherein said drill-
2 ling head has a size for making a hole into the ground having
3 a width at least sufficient to create a hollow space between
4 the walls of the hole and the expandable jacket suitable for
5 the elimination of perforation rubble.

1 4. An anchor element according to claim 1, 2 or 3 wherein said
2 expandable jacket, in correspondence to its lower and upper
3 ends, is fixed to the tubular body so as to acquire, once
4 its dilation has occurred, a mainly cylindrical configuration,
5 with conical taperings in correspondence to its upper and
6 lower ends.

1 5. An anchor element according to claim 4, wherein said ex-

2 pandable jacket, during the introduction of the anchor
3 element itself into the ground is folded on the tubular
4 element in flaps having a substantially semicircumferen-
5 tial path and superimposed to one another.

1 6. An anchor element according to claim 1, 2 or 3, wherein
2 said expandable jacket is formed by two metal laminae
3 supported by the tubular body on diametrically opposite si-
4 des, said laminae being soldered to each other in corre-
5 spondence to their external edges and to the tubular body
6 in correspondence to their edges in contact with the side
7 walls of the tubular body itself, so as to form a sort of
8 metal envelope surrounding part of the tubular body, said
9 metal envelope being in communication with the inside of
10 the tubular body through at least one through hole.

1 7. An anchor element according to claim 6, wherein said
2 metal laminae are rolled up around element in the rota-
3 tion direction of the drill.

1 8. A method for the installation of an anchor element accor-
2 ding to claim 2 or 3, characterized by the steps of :
3 connecting an anchor element to a drill and to a source
4 of fluid under pressure; ground drilling by means of a
5 drilling head at the lower end of said anchor element, with
6 simultaneous introduction of fluid, under pressure into the
7 anchor element tubular body so that said fluid, out-coming
8 from the holes at the lower end of said tubular body in
9 correspondence to its drilling head, performs eliminations
10 of perforation rubble ; introducing into said tubular body
11 an element capable of hydraulically closing said holes for

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12 fluid under pressure; injecting cement mortar at the fluid
13 state and under pressure into said tubular body so that,
14 passing through the holes communicating with the expanda-
15 ble jacket, it causes swelling of said jacket, forming the
16 anchor block.

Fig. 1

Fig. 2

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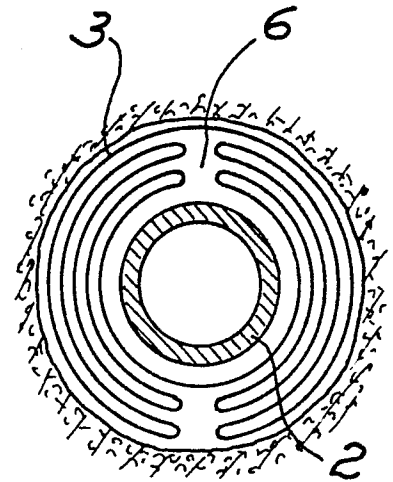
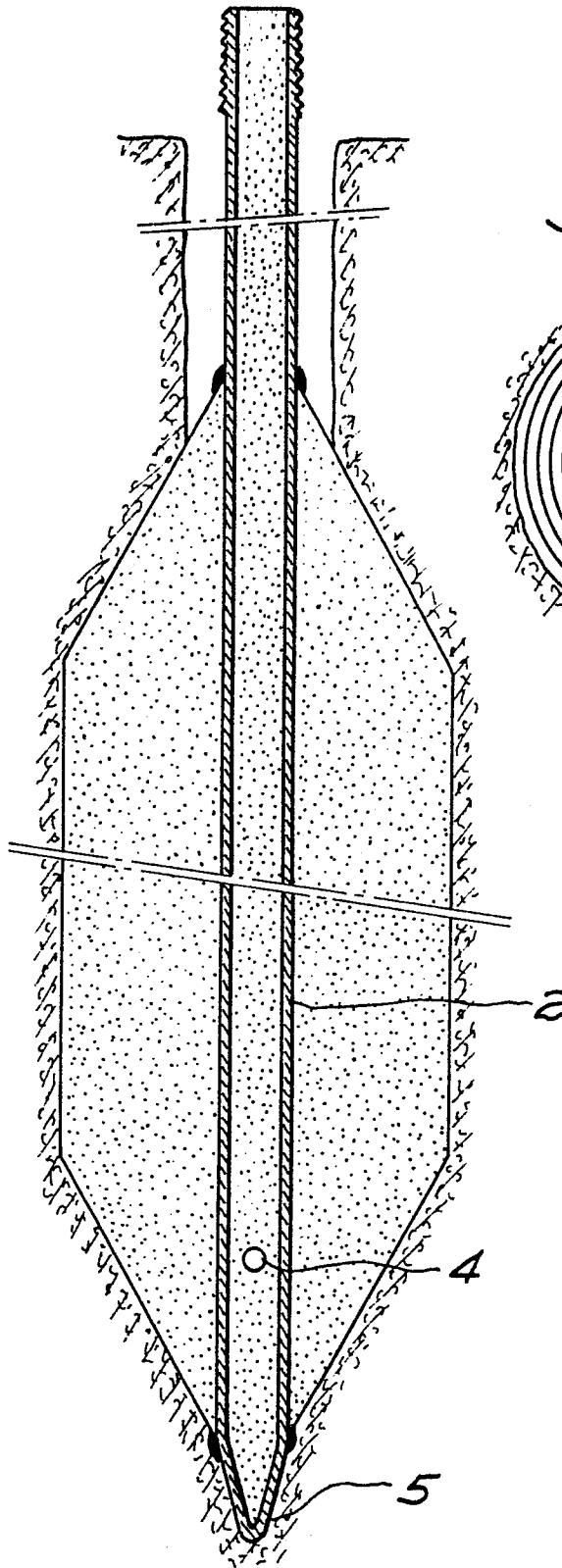
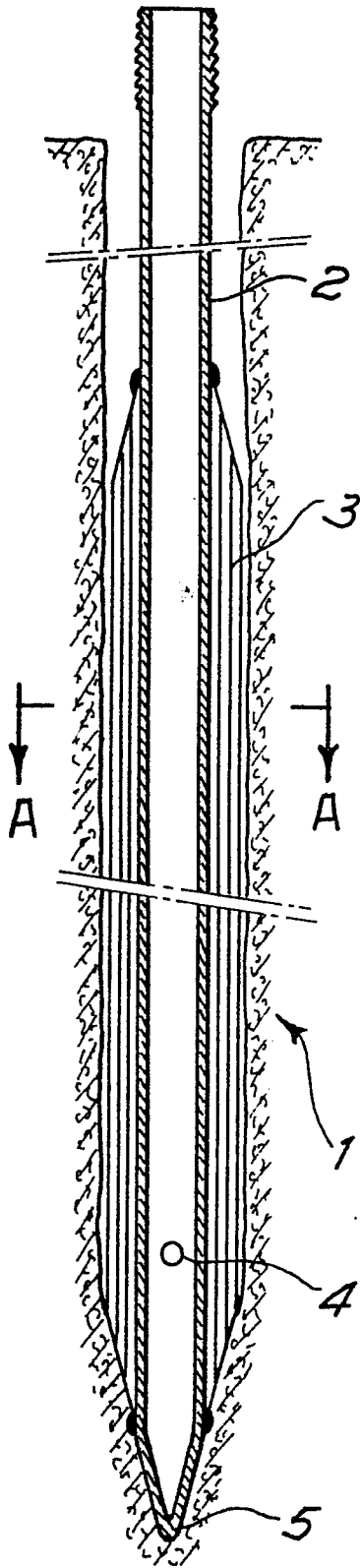


Fig. 3

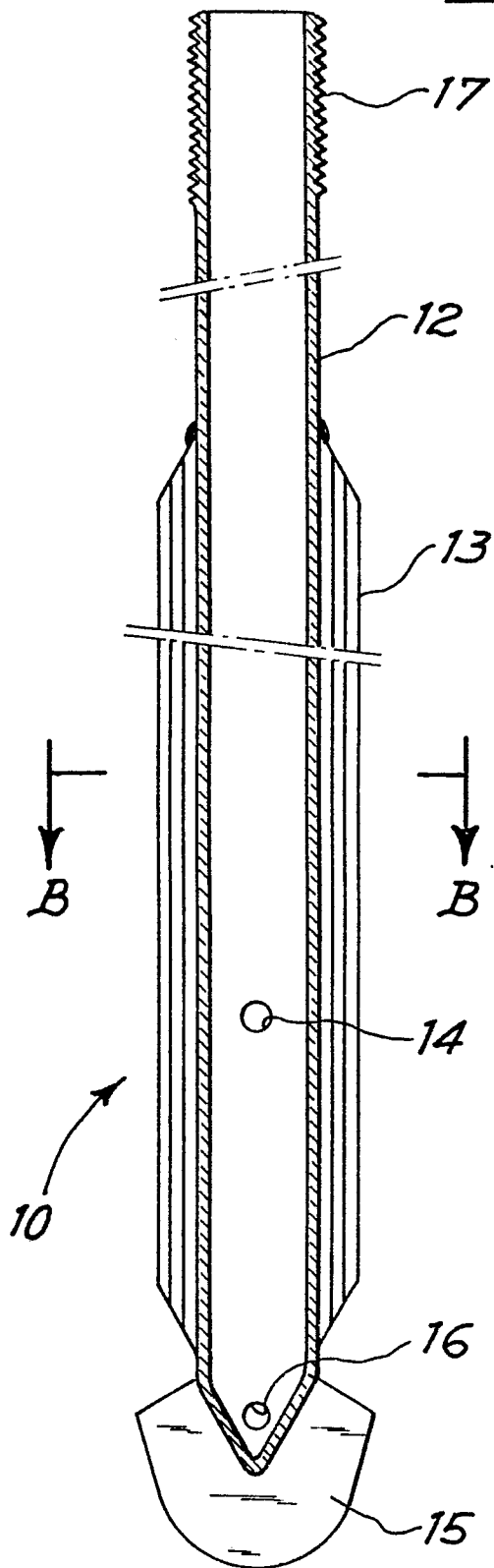
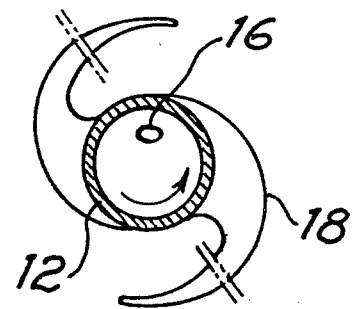
Fig. 4Fig. 5

Fig. 6

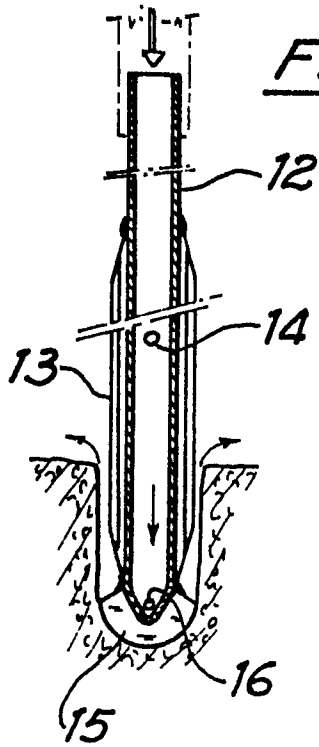


Fig. 7

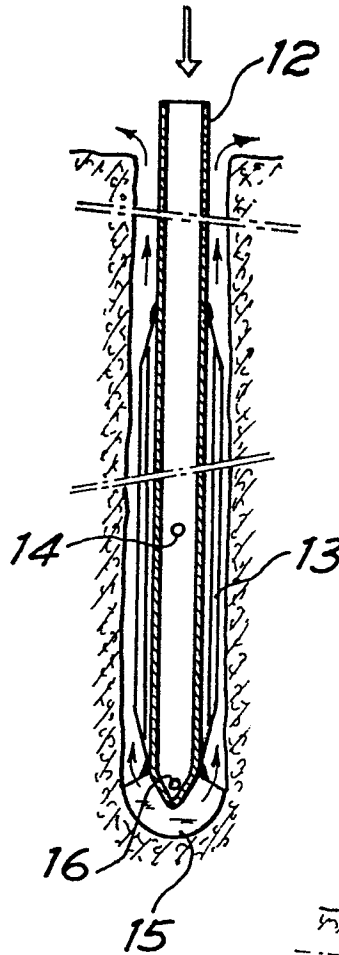


Fig. 8

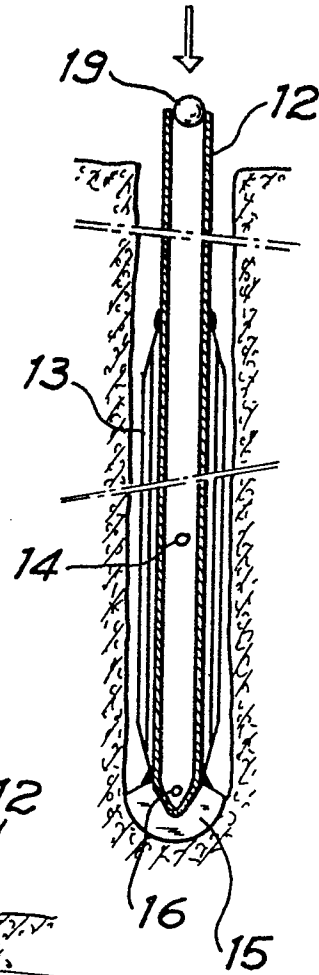


Fig. 9

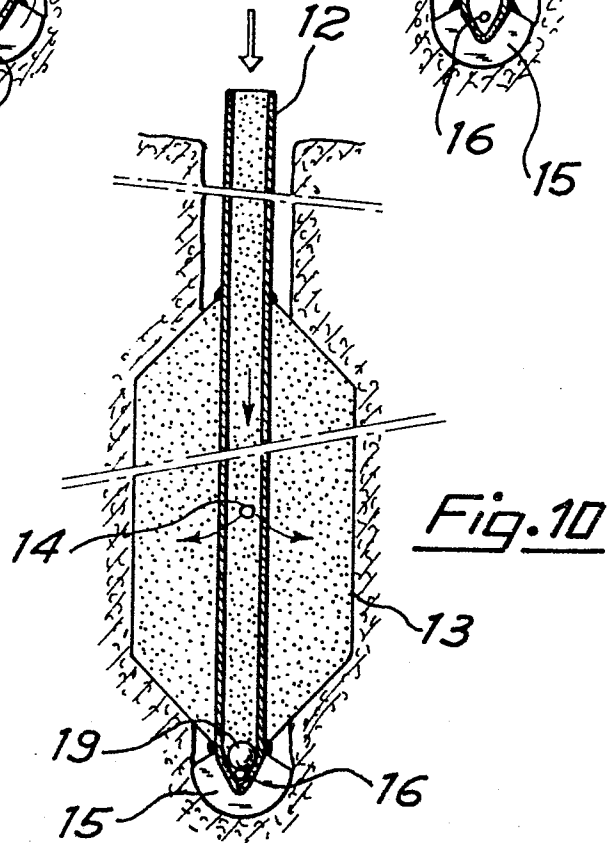
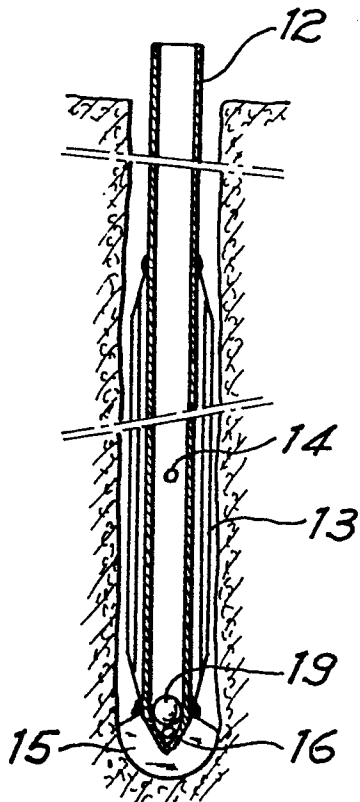


Fig. 10



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
X	US-A-3 492 823 (LAMBERTON) * Column 4, lines 54-75; column 5, lines 1-3; column 8, lines 48-75; column 9, lines 23-56; column 11, lines 59-75; column 12, lines 1-15; figures 2,3,11,12 *	1,2,5,8	E 02 D 5/80
A	US-A-3 270 469 (DEBITON) * Column 2, lines 7-17; column 3, lines 17-27; figures 1-3 *	1,2	TECHNICAL FIELDS SEARCHED (Int. Cl. 3) E 02 D
A	FR-A- 788 577 (HORNLMANN) * Page 1, lines 1-22; page 2, lines 31-38, 43-69; page 5, lines 89-91, 95-98; figures 1-6 *	4,6	
A	CH-A- 564 654 (OTTA)		
A	FR-A-2 123 821 (BRAMI)		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 21-03-1984	Examiner RUYMBEKE L.G.M.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			