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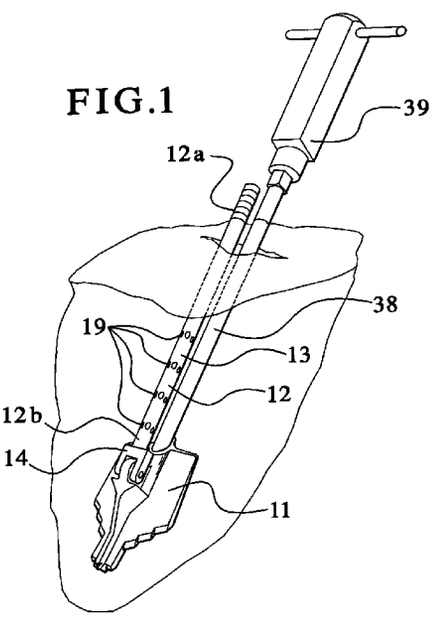
(54) Ground anchor assembly and method for installing same

(57) A ground anchor assembly and method for installing same are disclosed. The ground anchor assembly is composed of an anchor member (11) adapted for penetration of the ground (g) and a pull member (12) connected to the anchor member (11) and adapted for permitting an embedding medium (17) to be poured into the pull member (12) so that it is distributed to completely surround and encapsulate the pull member (12) and the anchor member (11) within a hole (H) in the ground (g). The embedding medium (17) allows the ground anchor assembly to support tensile and compressive loads and reduces stresses on the connection between the anchor member (11) and pull member (12). In addition, the embedding medium (17) is preferably water impermeable and seals the anchor member (11) and pull member (12) from moisture and other elements which could cause corrosion.

FIG.1



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Description

BACKGROUND OF THE INVENTION

This invention relates to the art of plate or wing-type ground anchors which are driven lengthwise into the ground and then pulled when reaching an optimum depth to tilt the anchor into a flat transverse position within the hole for anchoring guy rods, cables or the like. In particular, this invention relates to a ground anchor assembly composed of a rigid anchor member and an elongated pull member used in combination with an embedding medium which encapsulates the anchor member and pull member within the ground.

Ground anchors for securing guy rods, cables and the like are well-known in the art and examples of such ground anchors are described in co-owned U.S. Patent Nos. 4,044,513 and 4,802,317. The '513 patent describes a tubular ground anchor and a flexible steel cable is tied to the ground anchor for tilting it in the ground. The steel cable is then used to secure guy rods, cables or the like to the ground anchor. Alter the anchor is placed in the ground, concrete is slowly poured through the ram which drives the anchor into the ground and the ram is then slowly removed from the hole to evenly distribute the concrete throughout the hole.

The '317 patent shows a more recent type of ground anchor which is generally referred to as a plate or wing-type ground anchor. The ground anchor includes a central tubular body, a pair of wings radiating laterally along the length of the body, and a cruciform leg positioned at the front of the body which operates like a star drill or chisel for facilitating penetration of the ground. The leading edges of the wings and cruciform leg are sharpened to facilitate passage of the ground anchor to an optimum depth within the ground. Once the ground anchor is positioned at the optimum depth, a pull member which is secured to body portion of the ground anchor is pulled so that the ground anchor is tilted within the ground and adopts a position generally transverse to the hole in the ground.

While both the '513 and '317 patents describe effective ground anchors and methods for installing same, it would be an improvement in this art to provide a ground anchor and method for installing same which provide even more secure positioning of the ground anchor in the ground. It would also be an improvement to provide a ground anchor which would support both compressive and tensile loads.

It would also be an improvement in this art to reduce stresses applied to the connection between the ground anchor and pull member and to provide means for protecting that connection from moisture and other elements within the ground which cause corrosion.

SUMMARY OF THE INVENTION

An important aspect of this invention therefore lies in providing a ground anchor and method for installing same in which the ground anchor is securely positioned within the ground and can support compressive as well as tensile loads. In addition, the ground anchor is installed so that stresses on the connection between the ground anchor and pull member are reduced. That connection is also protected from moisture and other elements in the ground which cause corrosion. Such results are achieved by providing a ground anchor composed of two main components: (1) an anchor member adapted for being driven through the ground; and (2) a pull member having one end secured to the anchor member and being adapted for introducing an embedding medium into the hole so that the embedding medium completely encapsulates the anchor member and pull member within the ground. The pull member includes a hollow cylindrical wall having a plurality of transverse apertures, and the pull member extends between the anchor member and the entrance to the hole. Once the assembly is installed, an embedding medium is poured into the top of the pull member and the embedding medium is then distributed through the apertures in the pull member to fill the hole so that the medium completely encapsulates the anchor and pull members. The embedding medium then cures to form a bond between the anchor member, pull member and ground.

Once the assembly is installed and the embedding medium is cured, the hardened embedding medium extends through the apertures in the pull rod and forms a bond with the ground which increases the amount of tensile strength that can be applied to the anchor. In addition, the embedding medium allows the ground anchor assembly to support compressive loads.

The embedding medium also reduces stresses on the connection between the anchor member and pull member since the embedding medium bonds the pull member to the ground which reduces stresses exerted upon the mechanical joint between the pull member and anchor member. By totally encapsulating the anchor member and the pull member, the embedding medium also seals the components from moisture and other elements which cause corrosion.

Other objects, features, and advantages of the present invention will become apparent from the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front and side perspective view, with parts broken away, illustrating the instillation of the ground anchor assembly embodying the present invention.

FIG. 2 is similar to FIG. 1 but illustrates a pulling operation for setting and tilting the ground anchor at a desired depth within the ground.

FIG. 3 is a view similar to FIG. 1, but illustrates pouring an embedding medium into the pull member of

the assembly until the embedding medium fills the hole in the ground.

FIG. 4 is a front and side perspective view of one embodiment of an anchor member which may be used with this invention and which is described in U.S. Patent No. 4,802,317.

FIG. 5 is a front and side perspective view of another embodiment of an anchor member which may be used with this invention and which is described in a concurrently filed patent application entitled "Ground Anchor".

FIG. 6 is a top plan view of the anchor member shown in FIG. 5.

FIG. 7 is a side elevational view of the ground anchor shown in FIGS. 5 and 6.

FIG. 8 is a front elevational view of the anchor member shown in FIGS. 5-7.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, the numeral 10 generally designates the ground anchor assembly embodying the present invention. The assembly 10 includes a plate or wing-type ground anchor 11 and an elongated hollow tubular anchor rod or pull member 12. Ground anchor 11 is generally shown in the form of a plate or wing-type earth or ground anchor. However, it will be understood that the particular type of anchor member 11 may vary considerably within the scope of this invention. Two particular wing-type anchor members which are believed to be particularly advantageous for use with this invention are described in more detail hereinafter.

Referring to FIG. 3, anchor member 11 and pull member 12 are shown alter installation in the ground. The pull member 12 includes first and second ends 12a and 12b and is generally comprised of a cylindrical wall 13. The first end 12a of the rod is threaded for connection to a pulling tool and then to a conventional fitting (not shown) for securing a guy rod, cable or the like to the pull member 12. The other end 12b of the pull member and is secured by connection means to a body portion 11a of anchor assembly 11. In the embodiment shown in the illustrations, the connection means comprises a U-shaped shackle 14 which is threadably secured to the second end 12b of the pull member and is secured to the body portion 11a of the anchor 11 by a pin 15 which extends through an eye portion 16 of the anchor 11. However, it will be understood that the anchor member 11 and the means for connecting it to the pull member 12 may vary considerably within the scope of this invention.

The cylindrical wall 13 of the anchor rod 12 defines means for permitting an embedding medium 17 to be pumped into the interior 18 of the pull member 12 so that it will flow transversely through the cylindrical wall 13 and fill the hole H in the ground g. It will be understood that anchor member 11 forms hole H which will closely follow the shape of anchor member 11, even though the hole H is shown in an exaggerated size in the drawings for purposes of illustration. In the embodiment given in the illustrations, the flow means comprises a plurality of transverse apertures 19 are defined by cylindrical wall 13 of pull member 12. Preferably, the majority of the apertures 19 are positioned near the second end 12b of the pull member for directing the embedding medium 17 into the bottom of the hole H. As shown by arrows 20 and 21, the embedding medium 17 is pumped under pressure from pump P into the first end 12a of the pull member and flows through the interior 18 of the cylindrical wall 13 and out through the apertures 19 into hole H. Since the embedding medium is pumped into the hole under pressure, the embedding medium will enlarge hole H by compacting the soil, which results in better positioning of the anchor member 11. As shown, The embedding medium 17 completely surrounds and encapsulates the anchor member 11 and pull member 12 for forming a secure bond with the ground g. In particular, the embedding medium 17 bonds pull member 12 to the soil so that it can support both tensile and compressive loads and the embedding medium also secures the anchor member 11 to the soil for supporting tensile and compressive loads. The bond between the pull member 12 and the soil also reduces stresses applied to the connection means between the pull member 12 and anchor member 11 since the embedding medium extends through apertures 19. In addition, the embedding medium 17 seals and totally encapsulates the pull member 12 and anchor member 11 for protecting those components from moisture and other elements which can cause corrosion.

In the drawings, pull member 12 is shown as a single rod. However, it will be understood that pull member 12 may be made up of several rods that are screwed or otherwise connected together. Some of the rod sections may include aperture 19 while some do not include such apertures. In any event, the rod sections or the portion of pull member 12 nearest to anchor member 11 will preferably include such apertures for directing the embedding medium into the bottom of the hole.

The embedding medium 17 may take the form of any one of a number of commonly available embedding mediums which can be easily pumped into pull member 12 and then cured to form a hardened column which totally encapsulates the pull member 12 and anchor member 11. The embedding medium, for example, may take the form of a cementious grout, a curable epoxy, a curable resin, or other suitable materials having similar properties. In particular, the embedding medium may take the form of cementious grouts sold under the designations S5ZWIL-Z (B) and S4ZWIL-QUICKSET (A) by Williams Form Engineering Corporation of Grand Rapids, Michigan. While cementious grout and other similar materials may readily be used, it is believed that curable epoxies and resins are preferable since they are generally water impermeable and will provide for more effec-

tive sealing about the anchor member 11 and pull member 12.

Referring to FIG. 4, an alternate embodiment of an anchor member 11' which may be used in combination with pull member 12 in this invention is shown. The anchor member 11' is fully described in co-owned U.S. Patent No. 4,802,317, which is hereby incorporated by reference. Briefly, anchor member 11' includes a central longitudinal or axial tubular body 22, a pair of wings 23 which radiate laterally along the length of body 22, and a projecting cruciform-shaped leg portion 24 which operates like a star drill for piercing the ground. The leg portion 24 includes sharpened leading edges 25, and wings 23 include sharpened leading edges 26. The tubular body 11 includes a projecting rib 27 along its upper surface which extends rearwardly from leg portion 24 to an eye portion 28. Pull member 12 is connected to anchor member 11' by securing shackle 17 to eye portion 28 with pin 15. For a more detailed description of anchor 11', reference may be had to co-owned U.S. Patent No. 4,802,317.

FIGS. 11-3 and 5-8 show the preferred embodiment of anchor member 11 and anchor member 11 is described in detail in a concurrently filed patent application entitled "Ground Anchor", which is hereby incorporated by reference. Briefly, anchor member 11 includes a central body portion 11a, a pair of wings 30 which radiate laterally outward from the body portion 11a, and a projecting cruciform-shaped leg 31 that operates like a star point drill for penetrating the ground. The leg portion 31 includes four sides 32, and each of the sides 32 includes a plurality of sharpened leading side edges 33 which are longitudinally offset with respect to each other. As shown, one set of the side edges 33a are positioned forwardly of the second set 33b, and the second set 33b extends laterally outward from leg portion 31 a greater distance than the first set 33a. The multiple sharpened leading side edges 33 which are longitudinally offset with respect to each other penetrate hard soils easier than if only one sharpened leading edge were provided on each of the sides.

Each of the wings 30 also includes a plurality of sharpened leading wing edges 34 which are longitudinally offset with respect to each other. The individual edges 34a, 34b, and 34c are inclined or extend rearwardly with respect to body portion 11 and are staggered so that the smaller leading wing edges are advanced first as anchor member 11 is driven into the ground. To further reduce the driving force required to drive anchor 11 through the ground, the wings 30 have a thickness t which diminishes from and tapers between the leading edges 34 and trailing edges 35 of the wings as shown most clearly in FIGS. 5 and 7. By advancing the thicker leading edges 34 first, frictional contact between the top and bottom faces 30a and 30b of wings 30 and the ground is greatly reduced.

Referring to FIG. 7, the body portion 11a has first and second depending curved lip portions 36 and 37. The curved lip portions dig into the ground when anchor member 11 is tilted and provide a fulcrum for facilitating such tilting. In addition, the second curved lip portion 37 is positioned along body portion 11a at its widest profile for balancing ground anchor 11 so that it maintains a linear drive path as it is driven into the ground. The second curved lip portion 37 is also smaller than the other curved lip portion 36 so that the smaller portion is advanced first to facilitate passage of the later and larger lip portion 36 through the ground. The opening 16 which connects to the pivot pin 15 and shackle 17 also takes the form of an elongated slot 38 which allows the pull member 12 to freely move with respect to the anchor member 11 to reduce stresses on their connection. For a more detailed description of anchor member 11, reference may be had to the co-pending patent application entitled "Ground Anchor".

Referring to FIGS. 11-3, the ground anchor assembly 10 is installed by first driving anchor member 11 and pull member 12 into the ground with a drive rod 38 and a jackhammer 39 as shown in FIG. 11. The drive rod 38 is inserted into socket 40 of anchor member 11 (or socket 41 of anchor member 11') during the driving procedure and then is readily removed. A pull tool (not shown) is then connected to the first end 12a of pull member 12 for exerting a pulling force on anchor member 11 as shown in FIG. 2. The pulling force causes anchor member 11 to tilt within the ground and adopt a position which is generally transverse to the length of hole H. As shown in FIG. 3, the embedding medium 17 is then poured into the top end 12a of pull member 12 as represented by arrow 20 and the embedding means 17 then flows out apertures 19 as illustrated by arrows 21 to fill hole H and completely surround and encapsulate both the anchor member 11 and pull member 12. The embedding medium 17 is then allowed to cure and form a bond with the soil. Once the embedding medium is cured, the ground anchor assembly 10 can support both compressive and tensile loads, and stresses on the connection between pull member 12 and ground anchor 11 are greatly reduced. In addition, the embedding means 17 is preferably water impermeable to seal pull member 12 and anchor member 11 from moisture and other elements in the ground which could otherwise cause corrosion.

While in the foregoing specification, embodiments of the present invention have been described in considerable detail for purposes of illustration, it would be understood by those skilled in the art that the details given herein may vary considerably within the spirit and scope of the present invention.

Claims

1. A ground anchor comprising an anchor member having a rigid body and being adapted for penetration of the ground; an elongated hollow and tubular pull member having first and second ends and a

cylindrical sidewall; and means for connecting one of said first and second ends of said pull member to the rigid body of said ground anchor said cylindrical sidewall defining means for permitting an embedding medium to flow transversely through said cylindrical sidewall; whereby, when said anchor member is positioned at a predetermined depth within a hole in the earth and said pull member extends along a length of said hole, said embedding medium can be pumped into an interior of said cylindrical wall so that the embedding medium flows through said cylindrical wall and fills said hole to surround and encapsulate said anchor member and said pull member.

2. The ground anchor of claim 1 in which said flow means comprises a plurality of apertures defined by said cylindrical wall of said pull member.

3. The ground anchor of claim 1 in which the anchor member includes a longitudinal central body portion, wings radiating laterally from the body portion along the length thereof, and a cruciform shaped leg on the body portion extending forwardly from the wings for piercing the ground, said body portion having a raised longitudinal rib diverging rearwardly from the cruciform leg portion to an eye portion.

4. The ground anchor of claim 3 in which said pull member includes a U-shaped shackle straddling the eye portion of the body, and a pivot pin extends through the eye portion and is secured to the shackle.

5. A ground anchor formed in situ in the earth comprising, in combination with a hole formed in the earth, an elongated hollow tubular pull member extending along a depth of said hole and having a first end at an entrance to said hole and a second end at a desired depth within said hole, an anchor member positioned at said desired depth within said hole and having a rigid body secured to said second end of said pull member, and an embedding medium which fills an interior of said pull member and said hole so that said embedding medium surrounds and encapsulates the length of said pull member and said anchor member, said pull member defining a plurality of apertures with said embedding medium extending through said apertures from said interior of said pull member and into said hole.

6. The ground anchor of claim 5 in which said plurality of apertures defined by said cylindrical wall are arranged in intervals along the length of said pull member.

7. The ground anchor of claim 5 in which the anchor member includes a tubular longitudinal central body portion, wings radiating laterally from the body portion along the length thereof, and a cruciform shaped leg on the body portion extending forwardly from the wings for piercing the ground, said body portion having a raised longitudinal rib diverging rearwardly from the cruciform leg portion to an eye portion.

8. The ground anchor of claim 7 in which said pull member includes a U-shaped shackle straddling the eye portion of the body, and a pivot pin extends through the eye portion and is secured to the shackle.

9. The ground anchor of claim 5 in which said embedding medium comprises cementious grout.

10. The ground anchor of claim 5 in which said embedding medium comprises a curable epoxy.

11. The ground anchor of claim 5 in which said embedding means comprises a curable resin.

12. The ground anchor of claim 5 in which said embedding medium is water impermeable.

13. A method of installing a ground anchor assembly comprising the steps of:

providing a ground anchor including an anchor member and an elongated tubular pull member secured at one end to said anchor member, said pull member having a cylindrical wall defining an interior and a plurality of apertures;
driving said ground anchor into the ground so that said anchor member forms a hole in the earth and said anchor member is positioned at a desired depth within said hole and said pull member extends along a length of said hole;
exerting a pulling force on said pull member so that said anchor member tilts within said hole so that it extends in a direction generally transverse to the length of said hole; and
pouring an embedding medium into the interior of said pull member so that it flows down the lenght of said pull member and out the plurality of apertures in the cylindrical wall of said pull member and out the plurality of apertures in the cylindrical wall of said pull member so that said embedding medium fills said hole and surrounds and encapsulates said anchor member and said pull member.

14. The method of claim 13 including the further step of allowing said embedding medium to cure into a hardened state about said anchor member and said pull member.

15. The method of claim 13 in which said embedding medium comprises a grout.

16. The method of claim 13 in which said embedding medium comprises a curable epoxy.

17. The method of claim 13 in which said embedding medium comprises a curable resin.

18. The method of claim 13 in which said embedding medium is water impermeable.

FIG.1

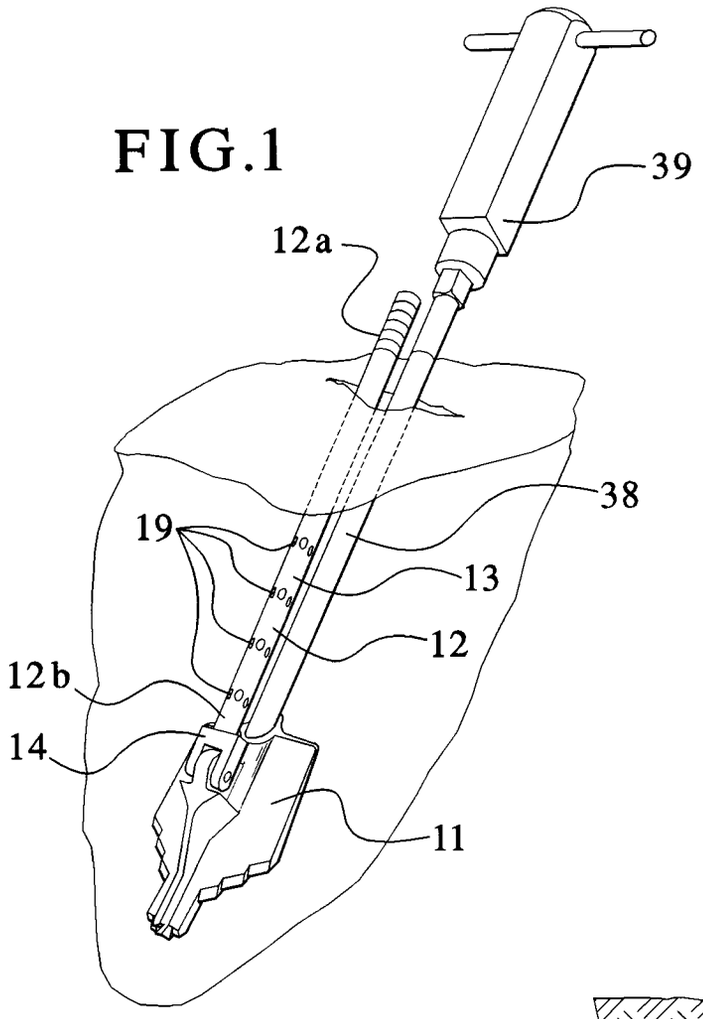


FIG.2

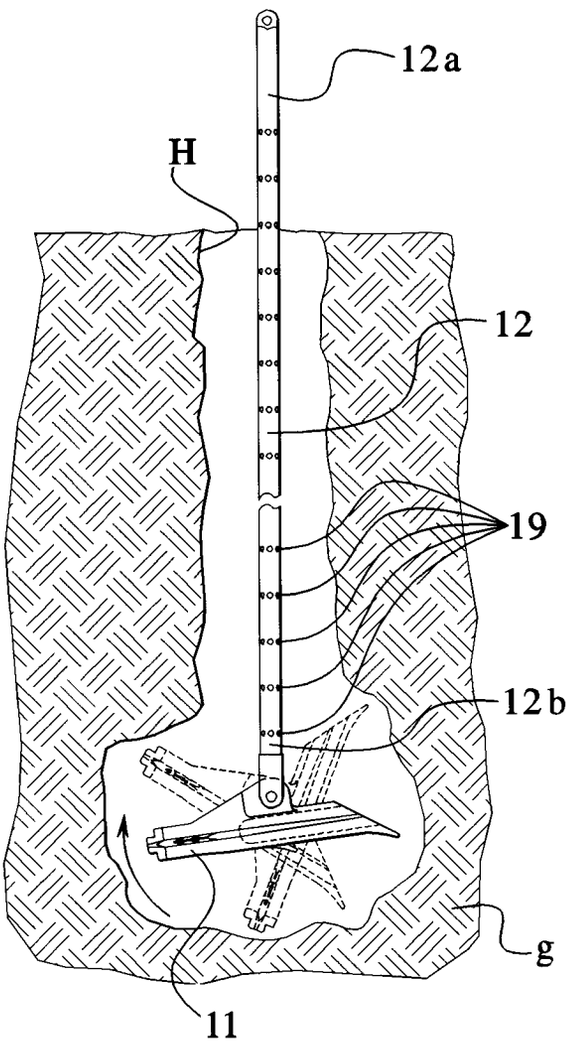


FIG.3

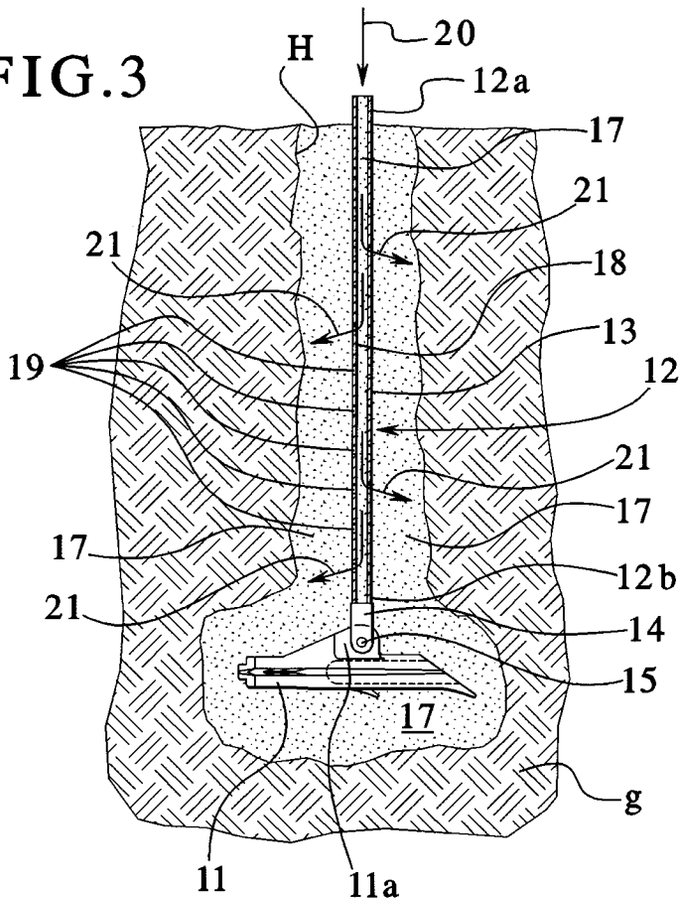


FIG.4

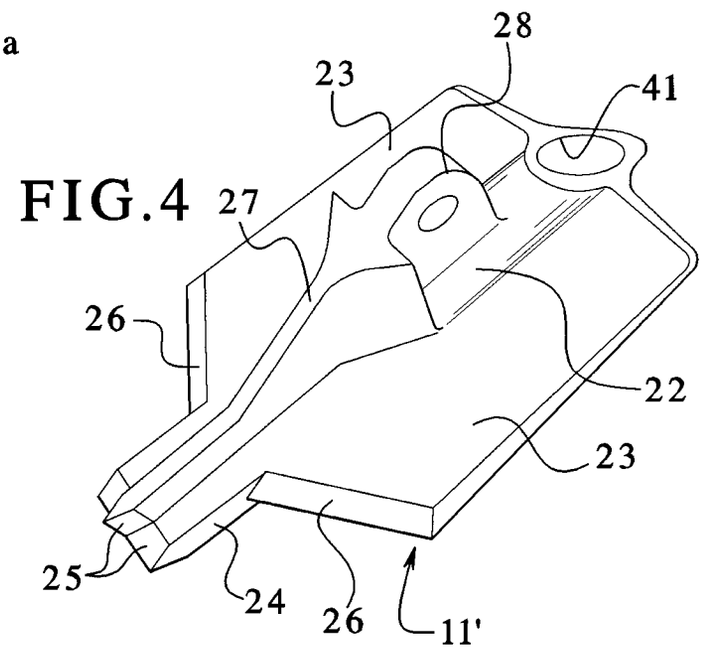


FIG.8

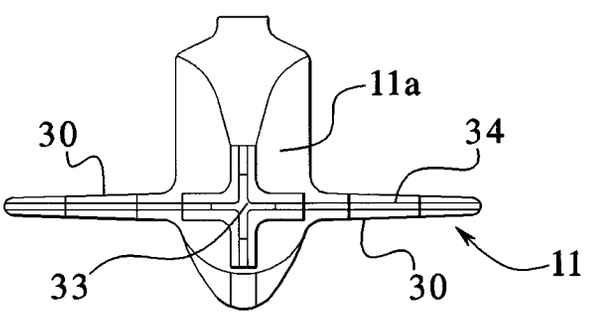


FIG.5

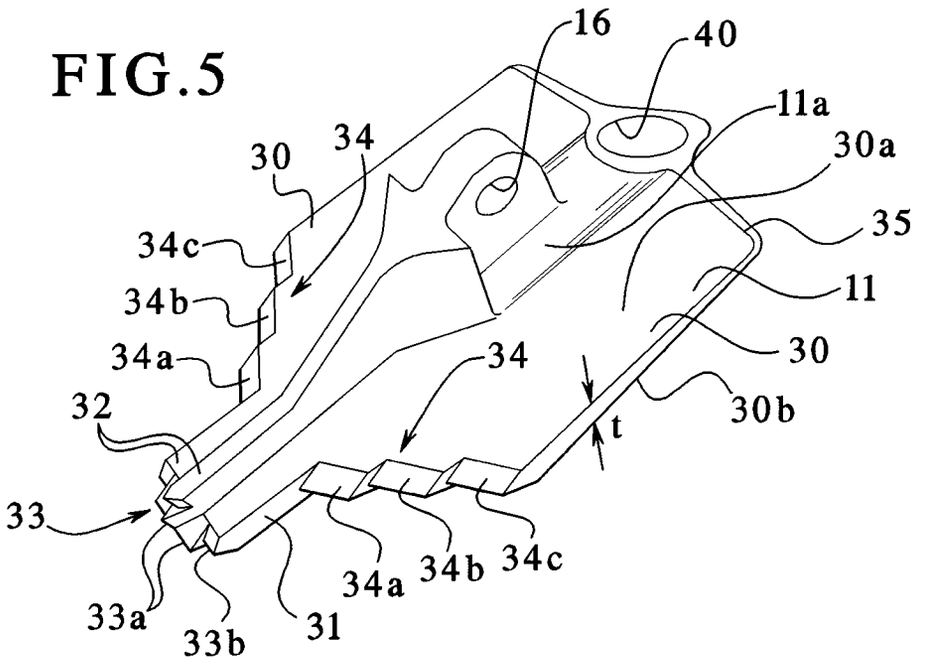


FIG.6

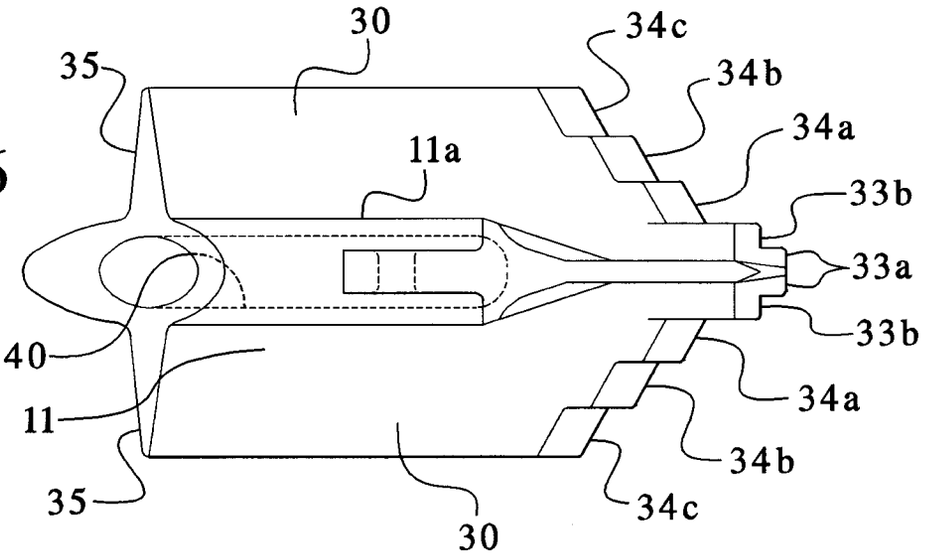
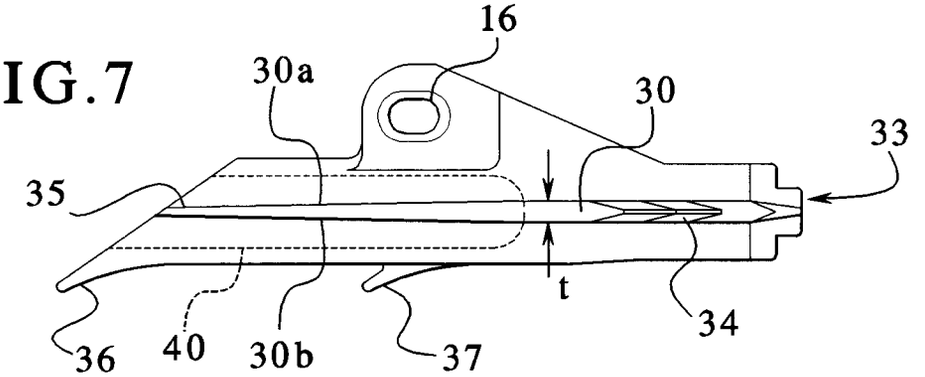


FIG.7



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 10 3523

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.6)
Y A	EP 0 665 337 A (HOLLANDSCHE BETONGROEP NV) 2 August 1995 * column 3, line 15 - column 6, line 31; figures 1-9 *	1,2,5,6, 9,12 3,7,10, 11,13-18	E02D5/80 E02D5/74
Y A	DE 936 082 C (WEGHUBER) 12 July 1956 * the whole document *	1,2,5,6, 9,12 13-18	
A	GB 831 740 A (VERUSCHACHT VEREINIGTE UNTERTAG- UND SCHACHTBAU GMBH) 30 March 1960 * page 2, line 1 - line 64; figures 1-3 *	1,5,6,9, 12-18	
D,A	US 4 802 317 A (CHANDLER DAVID R) 7 February 1989 * the whole document *	1-18	
A	EP 0 259 755 A (GD ANKER GMBH & CO KG) 16 March 1988 * column 6, line 45 - column 11, line 15; figures 1-5 *	1,2,5,6, 13	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

E02D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 July 1997	Tellefsen, J

CATEGORY OF CITED DOCUMENTS

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