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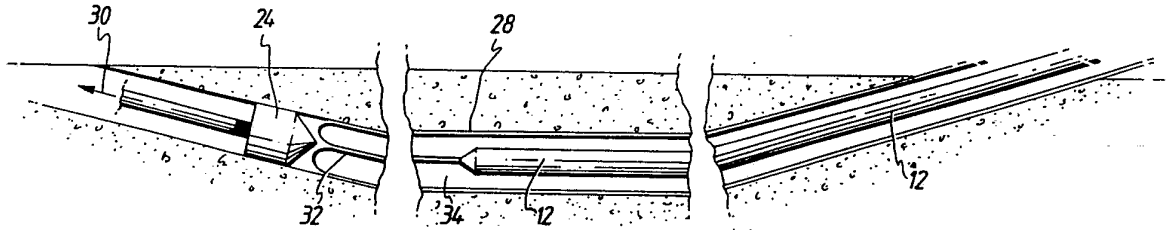

(57) Abstract

The invention provides that an underground through borehole (28) is formed with a reaming tool (24). It is filled with a viscous fluid and as soon as possible after being so filled, a flexible lining tube (32) is inserted into the borehole (28) to keep the surface from collapsing until a rigid service pipe (12) has been pulled or pushed into the borehole.

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IMPROVEMENTS RELATING TO THE PLACEMENT OF PIPES IN THE GROUND

This invention relates to the placement of pipes in the ground.

The said pipes are rigid in nature so as to be capable of supporting the loading applied thereto by the surrounding ground and water table. Typically the pipes will be of steel or other rigid metal.

When it is required to place such pipes in the ground, obviously there needs to be excavation or boring in order to provide a cavity to receive the pipe. The most usual method of placing such a pipe is to use a boring or drilling rig which comprises a reaming head or more usually a plurality of reaming heads and a drill string. The reaming head is directed by remote control along a particular drilling path under the ground. It enters the ground at a shallow angle and then travels along the path in which the pipe is to be laid, and it eventually emerges from the ground at a desired remote location. A plurality of reaming heads of increasing size are used, and the heads are passed sequentially through the bore hole. The reaming heads as appropriate may be pulled rearwards through the previously formed borehole, but in any event the hole is continually increased in size until it is of the required diameter to receive the pipe which is simply pulled into position. During the reaming operation, a relatively viscous liquid known as Bentonite is flooded into the borehole being created which serves to some extent to maintain the shape of the hole and to stop debris and chippings from collecting to too great an extent in the base of the hole, and also to assist in the cutting operation, but as can be expected rock chippings and stones become suspended in the Bentonite, and some do collect at the base of the borehole. The result of this is that when the rigid pipe is eventually pulled into position it can be obstructed by these loose materials

and if it is obstructed to too great an extent, then it is extremely difficult to pull the pipe into the desired position due to the friction forces created by these materials. Indeed, in practice it is the case that the length of pipe which can be pulled into a borehole is limited by these friction forces.

The rigid pipe may typically be a pipe for carrying fluid, or it may be a pipe for carrying other pipes some of which may be fluid pipes and others of which may be service pipes carrying electrical cables or telephone cables. Indeed the pipe can itself carry electrical cables.

The present invention seeks to enhance the laying operation to enable the pipe to be inserted more easily and to enable longer lengths of the pipe to be installed without difficulty.

In accordance with the present invention, in a boring operation wherein a rigid pipe is placed in the borehole, a support lining tube of a flexible nature is used to support the surface of the bored hole by the use of fluid pressure urging same against the surface, and the rigid pipe is inserted into the flexible lining tube.

A flexible lining preferably is everted into and along the borehole immediately behind the last reaming head, and the rigid pipe may be pulled into the lining tube by being connected to the trailing end of same.

Preferably, water is used for the urging of the lining tube onto the borehole surface so that the rigid pipe is pulled into the inflating water.

By the use of a lining tube which will require to be of

pressure, so the chippings and cuttings formed by the reaming operation are kept urged on the borehole surface, especially if the eversion takes place immediately behind the reaming head or the reaming head is moved through the borehole.

The everting face of the lining tube will also divert any Bentonite remaining in the borehole.

The lining tube may comprise a tube formed from a laminate made of a fibrous felt material such as a needle polyester felt one side of which is coated with an impermeable membrane, the laminate being formed into tubular configuration with the butting edges secured and sealed together, or it may comprise a fabric which is coated with a synthetic plastic resin so that it is strong enough to withstand the everting pressure. It is possible to apply the lining tube after the last reaming head is removed from the borehole, but this would mean that there will be a significant time period during which the borehole is full of the Bentonite and chippings, which would have to be displaced by the insertion of the lining tube which may cause problems.

The lining tube may be made up of inner and outer sections, and the outer section may be pulled into the borehold behind the reaming head, and the inner section may be everted into the outer section after it is placed in positon.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying diagramatic drawings, wherein:-

Fig. 1 shows how a borehole is formed in the ground, such borehole being for receipt of a rigid pipe;

Fig. 2 shows a later stage of the boring process; and

Fig. 3 shows how the lining tube and the rigid pipe are placed in the borehole in accordance with the preferred method of the invention.

Referring to the drawing, reference (10) indicates the ground level, and under the portion of ground shown there is provided an underground borehole in which is to be inserted a steel or other rigid pipe (12) (Fig. 3) which may be a fluid carrying pipe such as a water or gas pipe, or may be for carrying service pipes and cables.

In the figures, different sections of the ground (10) are shown because one must remember that this borehole to be provided in the ground will be of substantial length. The borehole tapers at the respective ends thereof to a level at which the pipe will be installed.

In the formation of these boreholes, typically a drilling string is used comprising a reaming head (14) which is propelled by a rod or drill string (16) so that an initial borehole (18) is formed.

Progressively, larger reaming heads (20) are passed through the previously formed borehole (18) to form larger bores (22).

The process is repeated as many times as necessary, and the reamer may be entered from either end of the bore hole and it may be pushed through forwardly or pulled through in reverse.

In the normal method, after the largest reamer (24) (Fig. 3) has passed through the borehole creating the final size, the pipe (12) is pushed into the formed borehole to take its final position.

During the reaming operation, there issues from the drill string, typically the reaming head, a flow of a liquid support material which is a highly viscous liquid known by the name Bentonite. The Bentonite tends to maintain the integrity of the formed borehole, and also keeps particles and chippings form falling into the formed borehole. The Bentonite is effective only to a limited extent however, and particles do become suspended in the Bentonite or fall to the base of the borehole as shown at (26) in Fig. 2.

The result of this is that when the pipe (12) is finally pushed into the bore behind the largest reamer (24), the pipe does tend to catch on the chippings and debris in the bore and this makes forcing of the pipe through the bore difficult. Indeed this has a limiting effect on the length of pipe which can be inserted into the bore and therefore has a limiting effect on the length of bore which can be provided.

Obviously, it is desirable to be able to make the borehole as long as possible so that a maximum length of pipe can be inserted, and this invention is concerned with a method whereby the insertion of extended lengths of pipe can be performed without difficulty.

In accordance with the invention a flexible lining tube (32) is applied to the borehole (28) when it is at its final size prior to the insertion of the tube (12).

As shown in Fig. 3, the borehole (28) behind the final reaming head (24) which is being removed as indicated by arrow (30), is lined by everting a flexible lining tube (32) into the borehole (28), inversion being performed typically by means of water filling the tube in the region (34) and performing the eversion.

To the end of the lining tube (34) the pipe (12) may be attached so that it is pulled into the borehole by the everting lining tube.

The lining tube (32) keeps the loose chippings and debris from the wall of the borehole in position at the borehole surface, so the resulting surface through which the pipe (12) can pass is much more smooth and is more regular.

The lining tube (32) may be constructed of any suitable material. For example it may be a tube of fibrous felt material having on its inner surface a coating of impermeable material. By inverting such a lining into the borehole (28) the felt will eventually lie to the inside, and the film will lie to the outside of the borehole.

In another arrangement, the tube in flattened form may be pulled into the borehole (28) behind the reaming head (24), and the lining tube may be inflated by another tube which is everted into the first mentioned tube.

Eversion of felt tubes with coatings is known in lining processes wherein the felt material is soaked with curable synthetic resin. Such tubes may be used in this method, but of course it is not necessary and indeed it is undesirable that curable synthetic resin should be provided. The felt tube will in fact be dry.

The lining tube (32) performs only a temporary holding function, because after the rigid pipe (12) has been inserted, the function of the tube (32) is to a large extent terminated. If the ground subsequently subsides therefore around the pipe (12), this will be of no significance because the rigidity of the pipe is inherent in the material used for same which typically will be steel or other metal, although other materials can be

used.

The invention provides an extremely effective means of ensuring that long lines of rigid pipe can be inserted in underground bores.

In a modified form of the invention, instead of the pipe (12) being pulled into the borehole (28) by means of the everting tube (32) a strong rope, e.g. nylon, may be pulled through the borehole (28) by the lining tube or other means, and the rope then is used to pull the pipe (12) into position in the borehole (28). This modification is of particular use when the material of the lining tube (32) may not be of sufficient tensile strength to pull the pipe (12) into position.

CLAIMS

1. A method of placing a rigid pipe in a borehole, wherein a support lining tube of a flexible nature is used to support the surface of the borehole by the use of fluid pressure which urges the lining tube against said surface, and the rigid pipe is inserted into the flexible lining tube.

2. A method according to claim 1, wherein the flexible lining tube is everted into and along the borehole immediately behind a reaming head used for boring the borehole.

3. A method according to claim 2, wherein the rigid pipe is connected to the trailing end of the flexible lining tube so as to be pulled into the borehole thereby.

4. A method according to claim 2, wherein a pull rope is attached to the trailing end of the lining tube so as to be pulled thereby into the borehole, and subsequently, the rope is used for pulling the rigid pipe into the borehole.

5. A method according to any preceding claim, wherein the borehole is filled with a viscous fluid before the lining tube is inserted thereinto.

6. A method according to any one of the preceding Claims, wherein the lining tube comprises a laminate comprising a layer of fibrous material and a plastic material film or a coating on the felt, arranged so that the felt fibrous layer lies closer to the borehole surface than the film or coating.

7. A method according to any preceding claim, wherein the lining tube is made up of inner and outer

sections, and the outer section is pulled into the borehole and the inner section is everted into the outer section.

FIG.1

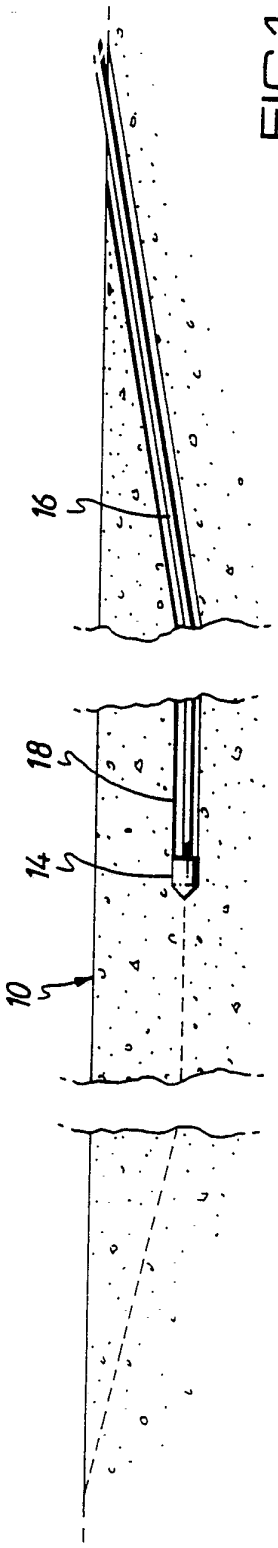


FIG.2

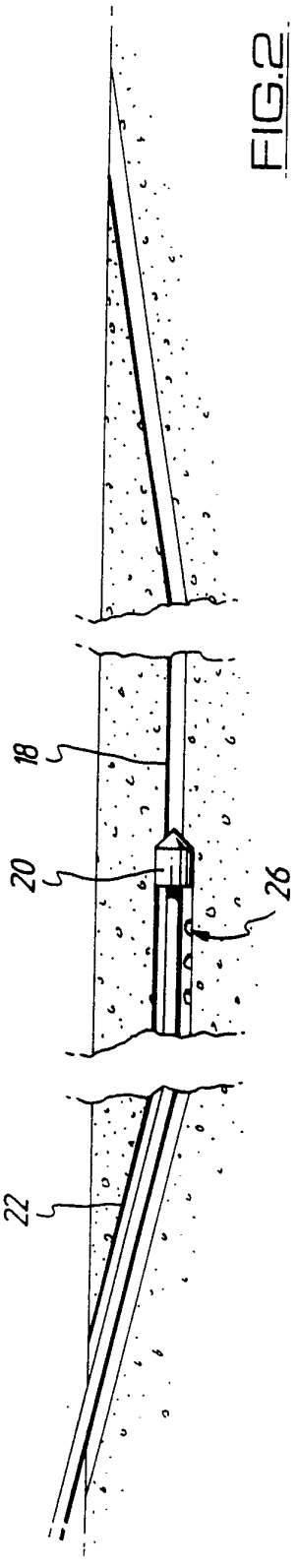
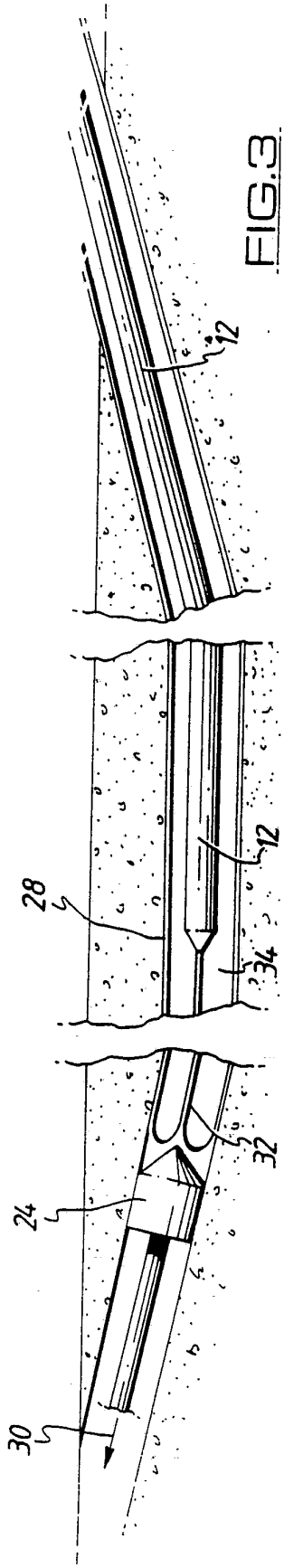


FIG.3



INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 92/01878

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 E21B43/10; F16L55/165

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	E21B ; F16L

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
X Y	EP,A,0 044 706 (DICKINSON) 27 January 1982 see page 3, line 1 - page 4, line 21 see page 12, line 21 - line 26 see page 18, line 2 - line 11; figures 1,2,4	1,3,5,7 2,4,6
Y	WO,A,9 010 173 (WOOD) 7 September 1990 see the whole document	2,4,6
X A	FR,A,2 654 487 (BOUYGUES) 17 May 1991 see the whole document	1,5 2,3,4

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
22 JANUARY 1993	- 5. 03. 93
International Searching Authority	**Signature of Authorized Officer**
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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

GB 9201878
SA 65911

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 22/01/93
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