

[54] **ROCK ANCHOR**
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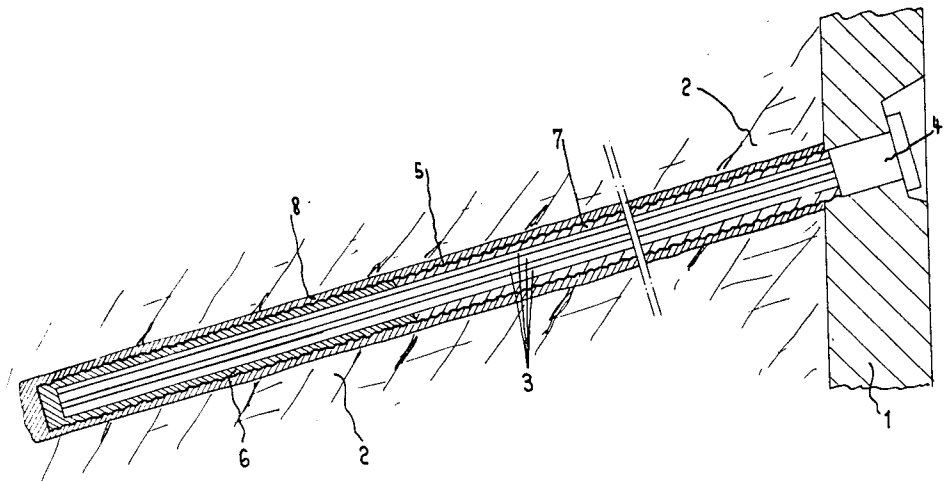
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[57] **ABSTRACT**

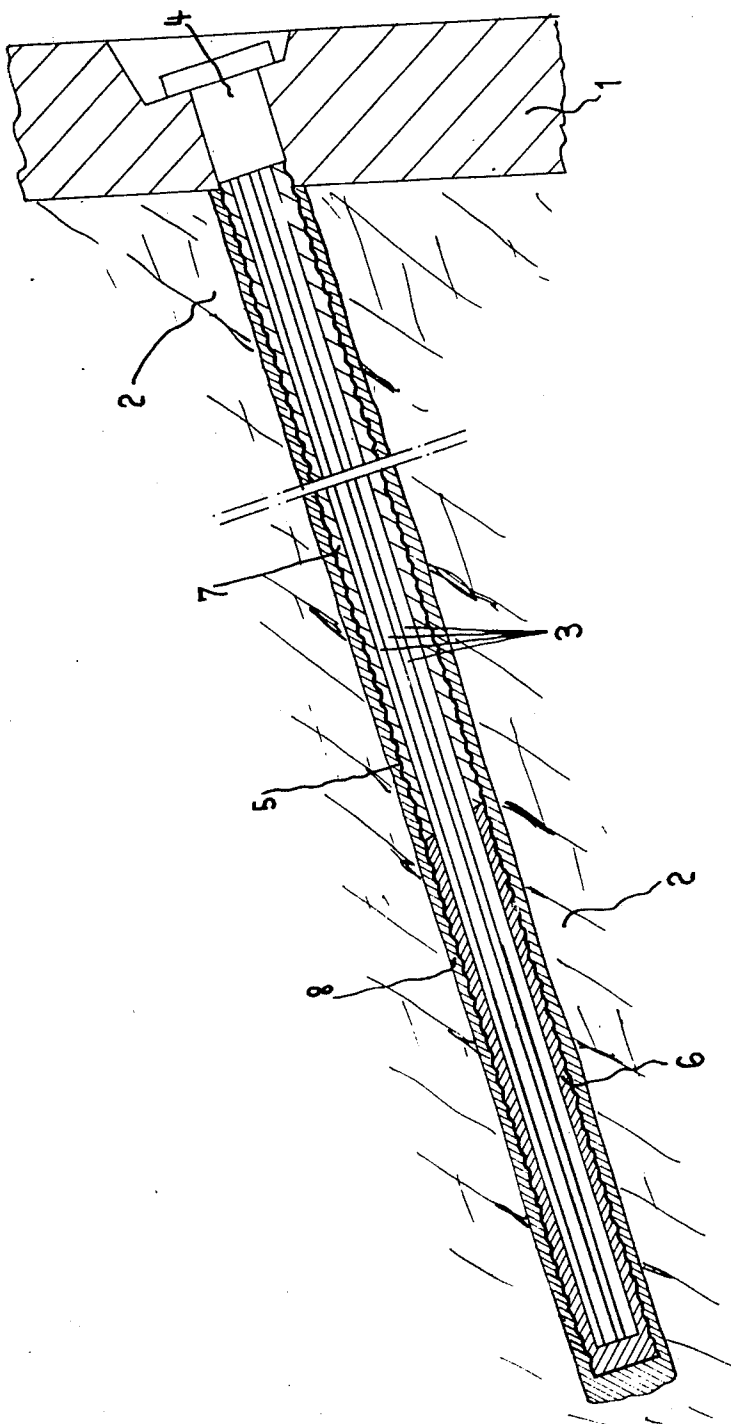
A rock anchor comprising a corrugated tube sealed closed at one end and axially receiving a stressing cable with cast material such as grout received between the tube and cable for transmitting forces from the cable to the tube. The tube is received in a bore in rock and the space between the tube and the rock wall of the bore is filled with settable material such as grout for transmitting forces from the tube to the rock. A spanning head closing the other end of the bore is secured to the end of the cable for anchoring to the rock, an object such as a retaining wall engaged by the spanning head.

16 Claims, 1 Drawing Figure



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ROCK ANCHOR

SUMMARY OF INVENTION

This invention relates to a novel rock anchor or alluvial anchor including a prestressed bracing cable anchored in an inner adhesion section in injection material. Additionally, the present invention relates to a novel method of fabricating and installing the anchor.

Although prior rock anchors and alluvial anchors including prestressed bracing cables are completely imbedded into the injection material on their inner adhesion section, and the spanning section of such cables is usually enclosed by a tube of plastic material, corrosion of the bracing cable is a serious problem for which no satisfactory solution has been found in the part. Leaks in the injection material may result in at least local corrosion of the bracing cable whereby the cable may unduly be weakened.

This invention aims in avoiding said disadvantage and substantially increasing the reliability and lifetime of rock anchors and alluvial anchors. In accordance with this invention, this aim is achieved by enclosing said bracing cable on its full length by a corrosionproof sealing jacket designed at least in said adhesion section for transmission of forces between said bracing cable and the ground. Preferably said jacket may be a corrugated tube of plastic material such as hard PVC. Experiments have shown that when using such a tube or jacket sufficient forces may be transmitted in the adhesion section or anchoring section without any danger of damaging the tube. Therefore, full and reliable sealing of the bracing cable against corrosion may be obtained on the full length of the anchor without any loss of loading capacity.

For building the anchor the bracing cable is usually first assembled with the jacket in the adhesion section by filling injection material into the jacket, the so assembled parts are then inserted into a bore prepared in the rock or alluvium, and injection material is filled between the jacket and the wall of the bore, whereafter the bracing cable is spanned, and after this the remaining space in the jacket is filled with injection material. As will be explained below additional advantages are brought by this method over methods for building prior anchors.

This invention will now be explained in detail with reference to the accompanying drawing illustrating a longitudinal section of a rock anchor.

DETAILED DESCRIPTION

The illustrated anchor serves for anchoring a retaining wall 1 or the like in the rock 2. The anchor seated in a bore includes a bracing cable 3 anchored in a spanning head 4 of any suitable type abutting against a recessed surface in wall 1 extending transversely relative to cable 3. The bracing cable 3 is accommodated in a corrugated tube 5 of hard PVC having a wall thickness of 1 mm. and a corrugation depth of 5 mm. as an example. Two portions of injection material such as cement, grout or any other suitable material, cast during succeeding stages of the building procedure are located between the cable 3 and tube 5, namely a portion 6 in the adhesion or anchoring section of the cable and a portion 7 in the spanning or stressing section of the cable. Portions 6 and 7 are illustrated in the drawings with different sectional lines. The inner end of tube 5 is tightly sealed. The space between the tube 5 and the wall of the bore is filled with injection material 8. The tube 5 is connected to the spanning head 4 in sealing condition. In this way the space enclosed by tube 5 is tightly sealed and since the tube is made of a corrosionproof material no leaks will produce in the tube by which the tube might lose its protecting effect. Therefore, no corrosive liquids may leak in to the bracing cable whereby high lifetime, reliability and loading capacity is warranted. The forces are transmitted from the bracing cable to the rock through injection material 6, tube 5 and injection material 8. Transmission through the tube 5 is highly improved by the corrugation of the same whereby the tube wall is only loaded by pressure and possibly some pull

while the annular ribs of the injection material formed in the corrugation of the tube 5 are loaded by shearing forces. The elasticity of the tube 5 of plastic material avoids tearing of the tube even under possible pulling stress.

The design of an alluvial anchor is practically the same with the usual modifications in the adhesion section. In order to improve the adherence, the strands of the bracing cable may be alternatively spread and bundled to form a waved or corrugated structure in the adhesion section. Jackets of other suitable plastic materials, stainless steel or other corrosionproof materials may be used, although hard PVC provides very good results.

For building the anchor, the prefabricated bracing cable is first inserted into the tube 5 whereafter the injection material 6 is filled in whereby the cable is assembled with the tube. This stage of the procedure may preferably be executed in a workshop remote from the building site with the tube in vertical position. After setting of the injection material 6 the assembly is transported to the building site and is inserted into the bore. Thereafter the space between tube 5 and the wall of the bore is filled with injection material 8. After setting of the latter the adhesion section is terminated and the anchor may be prestressed as soon as the spanning head 4 has been mounted. As a last operation, injection material 7 is cast into the spanning section of the cable.

While in prior methods, wherein a smooth protecting tube was provided in the spanning section only, the fore end of this tube had to be sealed during casting of the injection material into the adhesion section and outside this tube, such sealing is no longer necessary with the anchor and building method as set out above.

The corrugation of tube 5 is only a functional importance in the adhesion section of the anchor. Therefore, a corrugated tube might be provided for the adhesion section only, this tube being tightly connected to a smooth tube in the spanning section, instead of providing a corrugated tube on the full length of the anchor. Instead of a corrugated tube, a tube having surfaces roughened by sandblast or other methods may be used as long as the resulting surface projections and depressions are of sufficient size.

I claim:

1. An anchor assembly to be embedded and fixed in anchoring material such as rock or alluvium, the anchor assembly comprising in combination, an elongated tubular sealing jacket sealed closed at one end, a stressing cable axially received in and enclosed by said sealing jacket substantially throughout the entire length of the cable, said sealing jacket having a plurality of projections on both its external and internal surfaces over at least a first longitudinal portion thereof starting adjacent the sealed end of the jacket and extending towards the other end of the jacket, a hard cast material filling all the space between said cable and said jacket throughout said first portion of the jacket for transmitting forces from said cable to said jacket when the assembly is placed into use, said tube with the cable cast therein adapted to be inserted in a bore in the anchoring material such as rock or alluvium and secured therein by introducing settable cement material in the space between the jacket and the bore and between the remaining space between the cable and the jacket to close the other end of the jacket and permanently seal the cable in the jacket for transmitting forces from the cable to the anchoring material.

2. The anchor assembly defined in claim 1 wherein said jacket is a corrugated tube.

3. The anchor defined in claim 2 wherein said jacket is made from hard PVC.

4. The anchor defined in claim 1 wherein the projections radially extend approximately 5 mm. from the body of the jacket.

5. The anchor defined in claim 4 wherein the jacket has a thickness of approximately 1 mm.

6. An anchor assembly embedded and fixed in anchoring material such as rock or alluvium having an elongated bore,

the assembly comprising in combination, an elongated tubular sealing jacket sealed closed at one end, a tension-stressing cable axially received in and enclosed by said sealing jacket substantially throughout the entire length of the cable, said sealing jacket having a plurality of projections on both its external and internal surfaces over at least a first longitudinal portion thereof starting adjacent said sealed end of the jacket and extending towards the other end of the jacket, a hard cast material filling all the space between said cable and said jacket including the spaces between said internal projections throughout said first portion of the jacket for transmitting forces from said cable to said jacket, said tube with the cable cast therein being inserted axially in said bore in the anchoring material, and hard cast material filling the space between the jacket and said bore and the remaining space between the cable and the jacket closing the other end of the jacket to permanently seal the cable in the jacket and to permit tension forces on the cable to be transmitted from the cable to said jacket first through said hard cast material in the jacket and then to said anchoring material through the hard cast material between the jacket and the anchoring material.

7. The assembly defined in claim 6 wherein said jacket is a corrugated tube.

8. The assembly defined in claim 7 wherein said tube is made from hard PVC.

9. The assembly defined in claim 7 wherein said tube is made from stainless steel.

10. The assembly defined in claim 6 further including a spanning head located at and closing the other end of said jacket with the cable anchored to said spanning head, said spanning head abutting against a surface of an object which is anchored to said anchoring material by said assembly.

11. A method of forming an anchor in anchoring material

such as rock comprising the steps of: forming an elongated passage in the rock, inserting in said passage a tubular jacket having projections extending radially from the external and internal surfaces thereof at a forward longitudinal section thereof, inserting in said jacket a stressing cable to enclose the cable substantially throughout its entire length, introducing settable material into the spaces between the cable and the jacket at least throughout the forward longitudinal section thereof, and introducing settable material in the space between the jacket and the rock wall defining said rock passage.

12. The method defined in claim 11 further including the steps of attaching a spanning head to the end of the cable and then introducing settable material into the remaining space between the cable and the jacket to fill the same.

13. The method defined in claim 11 wherein said cable is assembled in said jacket by introducing said settable material in said forward section before insertion of the jacket into the passage of the rock.

14. The method defined in claim 13 wherein the cable is assembled in said jacket with the settable material inserted in said forward section at a site remote from the anchoring site and then the cable assembled in the jacket is transported to the anchoring site for insertion into the passage of the rock.

15. The method defined in claim 13 wherein after the settable material is introduced between the jacket and the rock wall defining the passage, a spanning head is secured to the end of the cable and the settable material is introduced into the remaining space between the cable and the jacket.

16. The method defined in claim 11 wherein said projections are formed by roughening the surface of said jacket prior to insertion of said cable.

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