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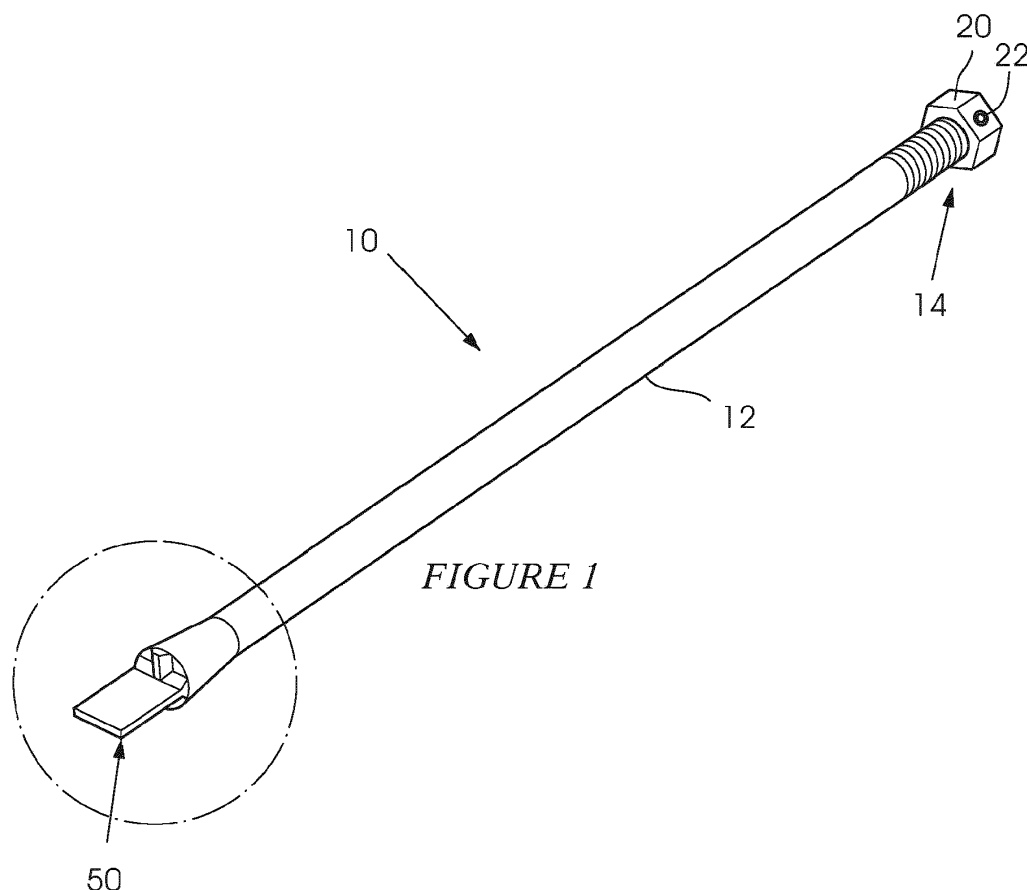
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(54) **Rock bolt**

(57) A rock bolt (10) which has a rectangular blade (42), which can pierce and shred a flexible housing, extending from cross-shaped mixing formations (44) at one end of an elongate rod (12).



Description

BACKGROUND OF THE INVENTION

[0001] This invention relates to a rock bolt and is particularly concerned with a rock bolt which can be used with an anchoring composition.

[0002] The expression "anchoring composition" is herein used to refer to a resinous mixture, a cementitious mixture or an equivalent mixture which is usable, as is known in the art, to secure a rock bolt in a borehole.

[0003] An anchoring composition is normally provided in two parts enclosed in separate frangible containers which can be broken by mechanical action of a rock bolt. The contents of the containers are mixed, in situ, by rotation of the rock bolt whereafter a setting process takes place. The rock bolt is then adhered in position to a surface of a borehole in which the composition and rock bolt are located.

[0004] The container, made from an appropriate flexible material, is pushed into the borehole and this is followed by insertion of the rock bolt into the borehole. The flexible material can normally be penetrated with ease by a leading end of the rock bolt. The material should be adequately shredded so that a maximum release of its contents occurs. Some materials which are used are, however, resistant to shredding. In one instance a fabric-type material is used and it can occur that as the rock bolt is inserted into the borehole the fabric is pushed by the rock bolt to a blind end of the hole. A build-up of the fabric at this end of the borehole can prevent complete insertion of the rock bolt into the borehole. Also, it might occur that the anchoring composition is not fully released from the flexible material. Another problem which can arise is that the flexible material is pierced by the rock bolt but then wraps around a shank of the rock bolt and prevents the anchoring composition from bonding directly to the rock bolt.

[0005] An object of the present invention is to provide a rock bolt which attempts to address the aforementioned factors.

SUMMARY OF INVENTION

[0006] The invention provides a rock bolt which includes an elongate shank with a leading end and a trailing end, a shear device fixed to the trailing end, the shank including a frusto-conical section at the leading end, and a shredding and mixing structure which extends from the frusto-conical section.

[0007] The shear device at the trailing end of the shank may be of any appropriate kind. The shear device should shear when it is used to impart torque at a predetermined level to the shank so that the shear device is then releasable from the shank. The ability to transmit torque to the shank is required to rotate the shank so that mixing of an anchoring composition can take place effectively. The device may include a nut which is threadedly engaged e.

g. with a left-hand thread with the shank and which is then fixed to the shank using a shear pin which traverses at least part of the shank and the nut.

[0008] Preferably the frusto-conical section is formed integrally with the shank, for example in a forging process.

[0009] The frusto-conical section may terminate in a substantially planar surface which is transverse to a longitudinal axis of the shank. The shredding and mixing structure may project from this surface in a direction which is more or less parallel to the longitudinal axis.

[0010] The shredding and mixing structure may include a blade which, preferably, is centrally positioned on the planar surface. The blade, in outline (from one side), may be square or rectangular. A desirable aspect here is that each corner of the blade, remote from the planar surface, should form a right angle and, inherently, the corner should be sharp. Thus the corners are suited for piercing a flexible container which contains ingredients for an anchoring composition.

[0011] The blade may be flanked by mixing formations so that the structure is of cruciform shape (cross-shaped), viewed end-on.

[0012] In one preferred form of the invention the shank is formed from round bar with a diameter of 16 mm. The round bar is made from steel with a minimum yield strength of 580 mpa. With a shank of this size the frusto-conical section may have a maximum diameter of the order of 22 mm. The length of the blade measured in an axial direction of the shank may be of the order of 30 mm.

[0013] The shank may be coated with a release medium, as is known in the art so that it can debond from an anchoring composition (once set) and can then yield under load. The frusto-conical section at the leading end of the shank then acts as an anchor for the shank.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The invention is further described by way of example with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a rock bolt according to the invention;

Figure 2 illustrates a part of the rock bolt of Figure 1, which is enclosed in a circle marked 2;

Figure 3 is a side view of the rock bolt of Figure 1;

Figure 4 shows a part of the rock bolt which is enclosed in a circle marked 4 in Figure 3; and

Figure 5 is an end view of the rock bolt taken in the direction of an arrow marked 5 in Figure 4.

DESCRIPTION OF PREFERRED EMBODIMENT

[0015] Figure 1 of the accompanying drawings is a perspective view of a rock bolt 10 according to the invention. Referring as well to Figure 3, which illustrates the rock bolt from one side, the rock bolt includes an elongate shank 12 which has a trailing end 14 and a leading end 16. The leading end is shown from one side in Figure 4 and an end view of the leading end is shown in Figure 5. Figure 2 shows the leading end in perspective.

[0016] In one preferred form of the invention the shank is made from round bar with a diameter of about 16 mm and has a predetermined length. The shank preferably has a minimum yield strength of 580 mpa.

[0017] The trailing end 14 has a left-hand thread and a nut 20 is threadedly engaged therewith. A shear pin 22 extends through a passage bored radially into the nut and enters an in-register passage, not shown, at the trailing end 14. In this way the nut and shear pin form a shear structure which, initially, is fixed immovably to the shank.

[0018] The leading end 16 has an integrally forged frusto-conical section 30. This section, which typically has an axial length 32 of the order of 30 mm, has a maximum diameter 34 at one end which is of the order of 22 mm. An end of the frusto-conical section presents a substantially planar surface 36 which is at a right angle to a longitudinal axis 38 of the shank. Shredding and mixing structure 40, forged integrally with the section 30, extends from the planar surface 36. This structure includes a shedding blade 42 and mixing members 44 which project outwardly from and transversely to a base 46 of the blade. The blade and mixing members, viewed end-on present a cruciform shape.

[0019] The blade has a length 48, taken from the planar surface 36, which is of the order of 30 mm. Outer corners 50 of the blade are sharp and each corner defines a right angle. This is a feature which allows the blade to pierce a flexible housing, which contains an anchoring composition, with ease.

[0020] The mixing members 44, viewed from one side (see Figure 4) have a relatively short length 52, of the order of 3 mm or 4 mm i.e. less than about 14% of the length of the blade. Sides 54 of the mixing members, and sides 56 of the base of the blade are chamfered (see Figure 5).

[0021] In use of the rock bolt an anchoring composition in a flexible container, not shown, is inserted into a borehole formed in a body of rock. The leading end 16 of the rock bolt is then inserted into the borehole and the rock bolt is pushed fully into the hole. The shear structure at the trailing end 14 is engaged with a device which rotates the shank. As the shank is pushed home and rotated the blade 42 easily penetrates the flexible container. Due to its size and the sharp corners 50 the blade, upon rotation of the rock bolt, rapidly shreds the container irrespective of the material from which it is made. The anchoring composition inside the container is released and is mixed by ongoing rotation of the blade. The mixing members 44

which are simultaneously rotated help substantially in this regard.

[0022] The mixing members are relatively small compared to the blade and the likelihood that these members, which has chamfered sides 54, will entrain parts of the flexible container is remote. The blade on the other hand shreds the container and, as noted, continues with the mixing process.

[0023] The anchoring composition sets fairly rapidly and starts bonding to the shank and the leading end. The rotational force required to rotate the shank increases and ultimately a point is reached at which the shear pin 22 shears. It is then no longer possible to impart torque to the shank. Typically the nut 20 is automatically unscrewed from the shank. Alternatively the nut is manually released from the shank. A load-spreading washer, if required, can then be engaged with the shank whereupon the nut is re-engaged with the shank.

[0024] The structure at the leading end 16 of the shank has been found, in practice, to be highly effective in shredding a flexible container and, then, in mixing an anchoring composition released from the container, while addressing the problems referred to in the preamble hereof.

[0025] If desired at least part of the shank can have a de-bonding agent applied to it. For example part of the shank can be coated with a thin plastic layer. The anchoring composition then does not bond directly to the shank but acts primarily against the frusto-conical section 30. This feature allows the rock bolt to yield under load.

Claims

1. A rock bolt which includes an elongate shank with a leading end and a trailing end, a shear device fixed to the trailing end, the shank including a frusto-conical section at the leading end and a shredding and mixing structure which extends from the frusto-conical section.
2. A rock bolt according to claim 1 wherein the frusto-conical section terminates in a substantially planar surface which is transverse to a longitudinal axis of the shank and the shredding and mixing structure projects from the substantially planar surface.
3. A rock bolt according to claim 1 or 2 wherein the shredding and mixing structure includes a blade which is centrally positioned on the planar surface.
4. A rock bolt according to claim 3 wherein the blade, in outline, is square or rectangular and each corner of the blade, remote from the planar surface, forms a right angle.
5. A rock bolt according to claim 3 or 4 wherein the shredding and mixing structure includes mixing

members which project outwardly from and transversely to a base of the blade.

6. A rock bolt according to claim 5 wherein the mixing members have a length in an axial direction of the shank taken from the substantially planar surface which is less than 14% of the length of the shank, taken in the axial direction, from the substantially planar surface.
7. A rock bolt according to any one of claims 1 to 6 wherein at least part of the shank is coated with a release medium.
8. A rock bolt according to any one of claims 1 to 7 wherein the shank is made from round bar and the frusto-conical section and the shredding and mixing structure are forged integrally with the shank.

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