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**A rock bolt**

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(71) Applicant(s)  
**Steeledale Group Limited**

(72) Inventor(s)  
**Arturo Benedetto Giorgio Pastorino**

(74) Agent/Attorney  
**PATENT ATTORNEY SERVICES,26 Ellingworth Parade,BOX HILL VIC 3128**

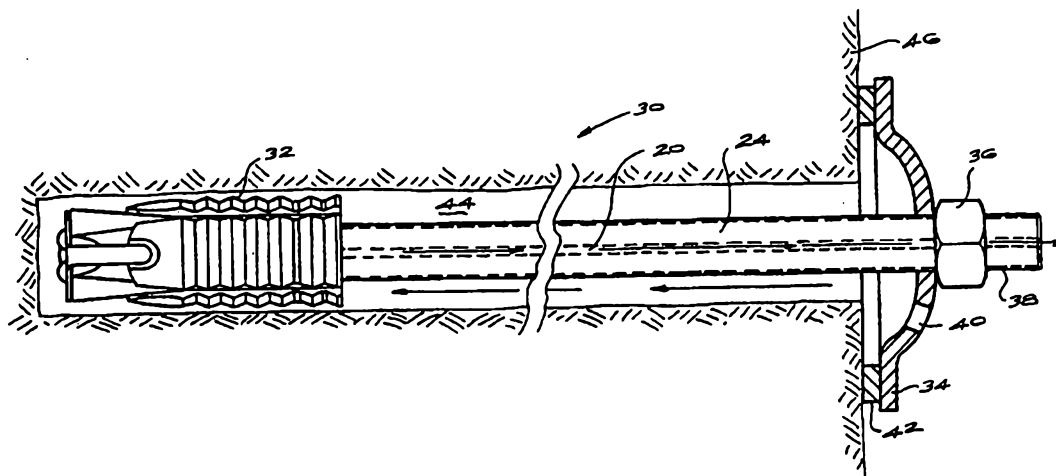
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(54) Title: A ROCK BOLT



(57) Abstract

A rock bolt (30) which includes a shank (24), at least one longitudinally extending slot (18) in the shank, an expanding anchor mechanism (32) at one end of the shank, a washer (34) at an opposed end of the shank, and a nut (36) which is engaged with thread (38) formed at least at the said opposed end of the shank.

## A ROCK BOLT.

This invention relates to a rock bolt.

Mechanical rock bolts e.g. of the expanding head type are sometimes categorised as  
5 temporary supports. After these bolts have been installed to provide immediate support in  
an underground excavation it is quite commonplace to provide what is referred to as  
permanent support by fixing shepherd crooks or similar devices in place using grouting  
techniques or appropriate resins.

The use of the aforementioned two types of supports does provide adequate rock  
10 reinforcement but at significant additional expense attributable to the drilling of two sets of  
holes in the rock body and the placing of two sets of rock anchors.

SUMMARY OF THE INVENTION

In accordance with the first aspect of the present invention, there is provided a rock  
bolt shank which includes an elongate member which is formed from a bar and which has at  
15 least one longitudinally extending slot in the elongate member, and which is characterised in  
that the slot is substantially closed on itself to enclose a closed passage inside the elongate  
member.

The slot may spiral along the length of the elongate member or may extend in any  
other appropriate way. Preferably however the slot is straight and extends substantially  
20 parallel to a longitudinal axis of the elongate member.

The slot may have any suitable profile in cross section. The slot may for example be  
U-



shaped.

Alternatively the slot is substantially closed on itself with a relatively narrow slit at a surface of the elongate member and forms a substantially closed passage inside the elongate member. The slot, in this example of the invention, may have a substantially tear-drop shape in cross-section.

The elongate member may be threaded around at least part of the slot.

10 The slot may have a tube in it.

Alternatively the slot may be at least partially covered or closed in any suitable way for example by making use of tape or any closing mechanism or substance in order to form a substantially closed passage inside the elongate member.

15

The shank may include a washer which is engaged with the elongate member and sealing means on an inner face of the washer to enable the washer to be brought into substantial sealing contact with a rock face during use of the rock bolt shank.

The washer may include a hole or an inlet device through which a settable substance such as a grout or resin may be injected.



In accordance with a second aspect of the present invention there is provided a rock bolt which includes a shank, an expanding anchor mechanism at one end of the shank, a washer at an opposite end of the shank, a nut which is engaged with thread formed at least at 5 the said opposite end of the shank, and at least one longitudinally extending slot which is formed in the shank, and which is characterised in that the slot is at least partially sealed to form a closed passage inside the elongate member.

The shank is preferably of the aforementioned kind.

10 In accordance with a third aspect of the present invention, there is provided a method of forming a rock bolt shank which includes the step of rolling at least one longitudinally extending slot in an elongate bar and then forming thread over at least a part of the length of the bar, and which is characterised in that it includes the step of at least partially sealing the slot to form a closed passage inside the bar.

The method may include the step of locating a tube in the slot.

15 The method may include the step of subjecting the elongate member to a rolling process in order to cause the slot to close substantially onto itself. In this way the slot may be shaped to form a substantially enclosed passage inside the shank.

The method may include the steps of engaging an expanding anchor mechanism with the shank at one end of the shank and a washer and a nut with a threaded opposing end of 20 the shank.

#### BRIEF DESCRIPTION OF THE DRAWINGS

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

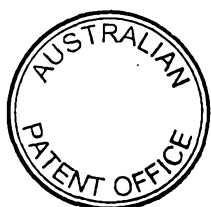
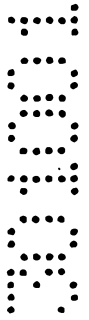
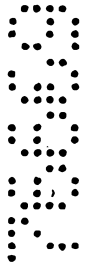


Figure 1 schematically illustrates successive stages in the formation of a profiled

shank



for use in a rock bolt according to the invention;

Figure 2 is a side view of a rock bolt shank according to one form of the invention;

Figure 3 is a cross-sectional view of the shank of Figure 2;

Figure 4 is a side view of a rock bolt shank according to a different form of the  
5 invention;

Figure 5 is a cross-sectional view of the shank shown in Figure 4; and

Figure 6 is a side view of an assembled rock bolt according to the invention illustrating  
its manner of use.

## 10 DESCRIPTION OF PREFERRED EMBODIMENT

Figure 1 of the accompanying drawings schematically illustrates five sets of rollers 10A, 10B, 10C, 10D and 10E, respectively and a rotatable sheave 12 which is driven through a gear mechanism by means of an electric motor, not shown.

15

An elongate member 14 of appropriate composition and cross-section, e.g. round bar 14 of an appropriate diameter, is fed from a coil, not shown, through the rollers and around the sheave. The round bar 14 is formed from steel which can be processed, as described hereinafter, and which possesses the necessary qualities for use as a rock bolt

20 shank.

Each pair of the rollers 10A to 10E is designed to shape the round bar into a predetermined cross-sectional profile.

The respective profiles produced by the pairs of rollers, are shown alongside the rollers, designated 14A to 14E respectively. The rollers 10A produce a shallow longitudinally extending slot 16 in the round bar and this slot is deepened by the rollers 10B. Successive rollers gradually close the slot onto itself. The profile 14D has a slot 18  
5 which is substantially U-shaped. In a final step carried out by the rollers 10E the U-shaped slot is closed substantially onto itself and has a tear-drop shape 20 in cross section. A relatively narrow slit 22 extends on the outer surface of the round bar along the length of the round bar at the junction of the side walls of the slot.

10 Apart from forming the slot to the desired shape the rollers ensure that the round bar is deformed appropriately so that it has a substantially circular cross section.

The rotating sheave 12 draws the bar through the rollers in a manner which is known in the art and which consequently is not further described herein.

15

The round bar is formed continuously with the slot and thereafter is straightened and cut into straight sections each of a predetermined length. A thread can be rolled over all or part of each section using standard thread rolling equipment, according to requirement, to form a shank of a rock bolt.

20

Figure 2 illustrates a portion of a shank 24 of a rock bolt according to one form of the invention while Figure 3 illustrates the shank in cross section. In this case use is made of a profile which is substantially similar to the profile 14E. It is apparent that through the rolling process a substantially closed and continuous passage 20 is formed along the



length of the shank.

Figures 4 and 5 are views similar to Figures 2 and 3 respectively and illustrate a shank 26. In this case, though use is made of a profile which is similar to the profile 14D. A thin walled plastic tube 28 is located in the slot along the length of the shank 26.

Thus in the Figure 4 embodiment a closed passage is provided along the length of the shank by means of the tube 24 which is located in the slot 16.

10 A substantially closed passage can be provided in any other way. For example once a slot has been formed along the length of the shank the mouth of the slot can be closed by means of tape which is wrapped around the shank. Any other closing mechanism can be employed. Another possibility is to provide a tubular sheath over the shank which encases the shank and effectively provides a closed passage inside the shank. The shank  
15 could also be closed using an adhesive or other suitable settable composition, or by means of welding. The invention is not restricted in this way.

Once the slot has been formed and processed according to requirement thread is rolled at least over a portion of the length of the shank. This is done using conventional thread  
20 rolling machinery.

Figure 6 illustrates from the side a rock bolt 30 constructed using a shank 24 of the kind shown in Figure 2. The rock bolt has an expanding anchor mechanism 32 engaged with one end of the shank. A washer 34 is engaged with an opposed end of the shank and a

nut 36 is threadedly engaged with thread 38 on this end of the shank.

The washer 34 is domed and includes an inlet aperture 40 which may, in practice, accommodate a filler valve of any appropriate kind e.g. a one-way valve. An inner  
5 surface of the washer has a flexible sealing disc 42, made for example of foam rubber, or rubber, secured to it.

In use the rock bolt is inserted into a hole 44 formed in a rock face 46. The nut 36 is tightened and the mechanism 32 is expanded into frictional contact with a wall of the  
10 hole. This is substantially in accordance with conventional techniques and provides the so-called "temporary" support. Thereafter a grout or any other suitable settable medium is injected through the aperture 40 in the washer. The medium flows into the hole 44 filling the entire volume thereof, and comes into close contact with the shank 24 and the opposing surface of the wall of hole 44. Air in the hole 44 is expelled through the  
15 passage 20 in the shank of the rock bolt. The sealing ring 42 prevents the settable medium from escaping from the hole. The medium, when it sets, bonds the shank to the wall of hole 44 and provides what is referred to as "permanent" support.

The rock bolt of the invention thus makes it possible to provide a temporary support of  
20 the kind referred to in the preamble of this specification and to make use of the same installation assembly and to inject grout or resin or any other settable substance into the hole, occupied by the rock bolt, to provide what is referred to in the art as a permanent support. It is therefore not necessary to make use of two sets of anchors to provide temporary and permanent supports. A substantial saving in cost in the drilling of holes

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and the use of steel is therefore achieved.

Another benefit results from the work hardening of the round bar 14 as it progresses through the rollers. This increases the tensile strength of the shank of the rock bolt.

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The claims defining the invention are as follows:

1. A rock bolt shank which includes an elongate member which is formed from a bar and which has at least one longitudinally extending slot in the elongate member, and which  
5 is characterised in that the slot is substantially closed on itself to enclose a closed passage inside the elongate member.
2. A shank according to claim 1 characterised in that the passage is adjacent a surface of the elongate member.
3. A shank according to claim 1 or 2 characterised in that the slot is substantially sealed.
- 10 4. A shank according to any one of claims 1 to 3 characterised in that the slot extends substantially parallel to a longitudinal axis of the elongate member.
5. A shank according to any one of claims 1 to 4 characterised in that, in cross section, the slot is substantially tear drop shaped.
6. A shank according to any one of claims 1 to 5 characterised in that the elongate  
15 member is threaded over at least a portion of the length.
7. A shank according to any one of claims 1 to 6 which is characterised in that it includes a tube located in the slot.
8. A shank according to any one of claims 1 to 7 which is characterised in that it includes a washer which is engaged with the elongate member and sealing means on an  
20 inner face of the washer to enable the washer to be brought into substantial sealing contact with a rock face during use of the rock bolt shank.



9. A rock bolt which includes a shank, an expanding anchor mechanism at one end of the shank, a washer at an opposite end of the shank, a nut which is engaged with thread formed at least at the said opposite end of the shank, and at least one longitudinally  
 5 extending slot which is formed in the shank, and which is characterised in that the slot is substantially closed on itself to enclose a closed passage inside the elongate member.

10. A rock bolt according to claim 9 characterised in that the shank is according to any one of claims 1 to 8.

11. A method of forming a rock bolt shank which includes the step of rolling at least one  
 10 longitudinally extending slot in an elongate bar and then forming thread over at least a part of the length of the bar, and which is characterised in that it includes the step of substantially closing the slot on itself to enclose a closed passage inside the bar.

12. A method according to claim 11 which is characterised in that it includes the step of  
 15 subjecting the elongate bar to a rolling process in order to cause the slot to close substantially onto itself.

13. A rock bolt shank substantially as hereinbefore described with reference to either one of the accompanying drawings, Figures 2 and 3.

14. A rock bolt substantially as hereinbefore described with reference to any one of the accompanying drawings, Figures 2, 3 and 6.



15. A method of forming a rock bolt as hereinbefore described with reference to any one of Figures 1, 2, 3 and 6.

Dated this 18th day of February 2002

5 PATENT ATTORNEY SERVICES

Attorneys for

STEELEDALE GROUP LIMITED

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