GROUT DELIVERY SYSTEM FOR A ROCK BOLT

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Abstract

A grout delivery device which includes a body which defines an internal volume (18), opposing first (34) and second (26) apertures in the body, in communication with the volume, through which a rock support tendon (50) extends, and a grout formation (44) on the body for connection to a grout source.
GROUT DELIVERY SYSTEM FOR A ROCK BOLT

BACKGROUND OF THE INVENTION

[0001] This invention relates, generally, to the delivery of grout to a rock support tendon and more particularly is concerned with a device to assist in delivering grout to a drill hole in which a rock support tendon is to be anchored.

[0002] As used herein “grout” includes a cementitious mixture and any other settable mixture which can be employed to anchor a rock support tendon in position, and “rock support tendon” includes, without being limited, a rock bolt, a cable anchor and similar support devices.

[0003] The grouting of rock support tendons is a widespread practice. The grout protects the support tendons from any ground water which may be present and which could cause the support tendons to corrode and, secondly, the support performance of the support tendons is enhanced for the grouting increases the capability of the support tendons to resist shear forces in the surrounding rock.

[0004] When a rock support tendon is grouted in a drill hole, provision must be made for air which is trapped in the drill hole to escape to atmosphere. One system in use employs a first tube for delivering the grout to the drill hole and a second tube to allow air to escape from the drill hole. Ends of the tubes protrude into a working place at which the rock support tendon is installed and are subject to blast damage—a factor which can make grouting difficult or impossible.

[0005] In a second approach, of which the applicant is aware, use is made of a hollow spherical device which is seated on an outer side of a bearing plate or washer which is engaged with a protruding end of the rock support tendon. Grout is delivered to the drill hole through the hollow interior of the device. The spherical device is, however, also exposed to the workplace and can therefore be damaged by blasting or by moving machinery.

[0006] An object of the present invention is to provide a device which facilitates delivery of a grout to a drill hole and which, to a substantial extent, is protected against damage of the aforementioned kind.

SUMMARY OF INVENTION

[0007] The invention provides a grout delivery device which includes a body which defines an internal volume, opposing first and second apertures in the body, in communication with the volume, through which a rock support tendon extends, and a grout formation on the body for connection to a grout source.

[0008] Preferably the body is at least partly flexible

[0009] The body may have a first body portion in which the first aperture is located and a second body portion in which the second aperture is located. The second body portion may be movable relative to the first body portion at least to a limited extent.

[0010] The internal volume may be in the nature of a passage or chamber or a similar space which is at least partly enclosed.

[0011] The flexibility of the body may be achieved in any appropriate way. For example different portions of the body may be made from different materials. Another possibility is for the body to be made with one or more lines of weakness which facilitate flexing of the body. A third possibility is for the body to be formed with formations in the nature of a bellows or the like. These types of construction are exemplary only and are non-limiting.

[0012] The formation, for connection to the grout source, is preferably located on the first body portion.

[0013] The first body portion is preferably bulbous.

[0014] An outer surface of the first body portion, surrounding the first aperture, is preferably convex or semi-spherical, conical or the like. Thus a cross-sectional dimension of the first body portion measured between opposing points on the outer surface in a direction which is transverse to an axis of the first aperture, may increase in a direction away from a mouth of the first aperture.

[0015] The second body portion may be substantially tubular. A section of the body between the first body portion and the second body portion may be slightly flared i.e. of decreasing cross-section from the bulbous first body portion to the tubular second body portion.

[0016] The formation for connection to the grout source may be in the nature of a spigot and may include a formation which facilitates engagement of the spigot with an opening, in a member such as a bearing plate, through which the spigot is passed.

[0017] The invention also extends to an assembly of a device of the aforementioned kind and a bearing plate which includes a central opening which is aligned with the first aperture of the device and a second opening through which the grout formation of the device passes and, preferably, with which the grout formation is engaged.

[0018] A rock support tendon may extend through the first and second apertures and through the central opening of the bearing plate. A seal may be provided at an interface of the device and the rock support tendon in the region of the first aperture. The seal may be of any appropriate kind and, by way of example only, may be constituted by a washer of a flexible material such as rubber which closely surrounds the rock support tendon and which engages with an annular gap between the first body portion and the tendon. Alternatively the body can be formed with a small collar, which protrudes into the volume, and which closely surrounds an adjacent surface of the tendon.

[0019] The bearing plate could have any suitable shape and, for example, is domed or flat or semi-conical.

[0020] The device may be used in different ways. In one form of the invention an elongate tube is engaged with the body in direct communication with the second aperture.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The invention is further described by way of examples with reference to the accompanying drawings in which:

[0022] FIG. 1 is a side view of a device according to the invention;

[0023] FIG. 2 shows the device in perspective;

[0024] FIG. 3 is a cross-sectional view, from one side, of the device shown in FIG. 1;

[0025] FIG. 4 shows, in cross-section, the device engaged with a rock support tendon, in one mode of use;

[0026] FIG. 5 shows the device used with a rock support tendon in a different mode of use;

[0027] FIG. 6 shows the device when used with a cable anchor; and
FIGS. 7 and 8 are perspective and cross-sectional views respectively of a device according to a different form of the invention.

DESCRIPTION OF PREFERRED EMBODIMENT

FIGS. 1, 2 and 3 of the accompanying drawings are side, perspective and cross-sectional views respectively of a device 10 used for delivering grout to a rock support tendon, according to the invention.

The device includes a body 12 formed by a first body portion 14 and a second body portion 16.

The body encloses an internal volume 18, in the nature of a chamber.

The first body portion 14 is bulbous and has a convex or semi-spherical outer surface 20. A first aperture 22 is centrally positioned in the convex surface.

The second body portion 16 is formed by a short tube 24 which terminates in a second aperture 26 which directly opposes the first aperture. An intermediate section 28 between the body portions is flared and reduces in cross-section from the bulbous first body portion to the tubular second body portion.

As is evident particularly from FIG. 3 the first body portion 14 has a region 30 which is formed with ribs which impart to the region a bellows-type appearance. As a consequence the region 30 is flexible, at least to a limited extent, and the first body portion can thus be moved relative to the second body portion to some extent.

It is desirable for the body to be flexible, at least to a limited extent, for reasons which are described hereinafter. This flexibility can be achieved using any suitable technique and the scope of the invention is not limited to the use of the bellows-like structure. For example the body could be made from one or more parts and the region 30 or the flared section 28 could be made from a softer and more flexible material than remaining portions of the body. Other approaches to achieve this desired property of flexibility are of course possible e.g. by forming appropriate sections of the body with lines of weakness which promote bending or flexing of the body.

In this example of the invention (refer to FIG. 3) an inwardly extending collar 34 is positioned at a rim of the first aperture and extends into the volume 18.

A small spigot 36 is positioned on the outer surface 20. The spigot is to one side of the first aperture and has a frusto-conical leading end 40 followed by a small shoulder 42. A passage 44 extends through the spigot.

FIG. 4 illustrates, in cross-section and from one side, one way of using the device 10. A rock support tendon 46 has an elongate rigid shank 50 which extends through the opposing first and second apertures 22 and 26. A bearing plate 52 is passed onto the shank over the convex outer surface 20 of the bulbous first portion. The bearing plate has a domed central area 54 which is sized to fit closely over the convex surface 20. The shank extends through a centrally positioned opening 56 in the bearing plate. A shaped washer 58, as is known in the art, is placed over the shank and this is followed by a nut 60 which is threadedly engaged with a protruding end 62 of the shank.

The bearing plate is formed with a small opening 64 and the spigot 36 of the device is passed through this opening. The shoulder 42 abuts and engages with a portion of the outer surface of the bearing plate which surrounds the opening.

The shank extends through the tubular second portion 24 into a drill hole 70 formed in a body of rock 74. An outer edge 76 of the bearing plate abuts a surface of a rock face 78 surrounding the drill hole 70.

The device 10 can be used in two ways, at least, depending on the nature of the rock support tendon with which the device is engaged. In one mode of use a tube 80 is engaged with a leading end of the tubular second portion so that the second aperture 26 is in direct communication with an interior of the tube. The tube can be clamped or otherwise fixed to the tubular second portion. The tube extends into the hole 70 to a required extent. Grout from a grout delivery system, not shown, can then be injected into the passage 44 in the interior of the spigot. The grout flows into the volume 18 and then passes into an elongate annular volume 82 which surrounds the shank and which is bounded by the inner surface of the tube. As the grout advances air is expelled from the drill hole, travelling on an outer side of the tube. The air eventually reaches atmosphere through paths which are formed on an outer side of the device 10.

In a second mode of use, illustrated in FIG. 5, the shank, designated 50A, is formed with an elongate, axially extending, air passage 84. In this mode of use the tube 80 is not used. When grout is injected into the volume 18 it emerges from the second aperture 26 and fills an annular gap 86 between an outer surface of the shank 50A and an opposing inner surface of the drill hole. Air trapped inside the drill hole can escape, as the grout advances, by entering a mouth of the passage 84 which is located at a far end of the shank. When grout starts leaving the passage 84 it is evident to an operator that the drill hole has been completely grouted.

In FIGS. 4 and 5 the rock face 78 is generally perpendicular to the longitudinal direction of the drill hole. This is not necessarily the case. In many applications, particularly in arduous underground conditions, the rock face is inclined to the axial direction of the hole. Clearly, the orientation of the rock support tendon is determined by the hole direction. Similarly, the orientation of the bearing plate is determined by the orientation of the rock face surrounding the mouth of the drill hole. It is for this reason that a degree of flexibility of the body of the device is required. The tubular second portion is inserted into the drill hole and is therefore not able to be moved to any meaningful extent. The bulbous first portion which is captured by the domed bearing plate must be movable, together with the bearing plate, relatively to the rock support tendon. The bellows-like region 30 allows this movement to take place.

FIG. 6 shows the use of the device with a tendon 46A which includes an elongate, slightly flexible, cable 50B, and not a rigid shank.

An end 90 of the cable projects from a mouth of a drill hole 70 formed in a rock body 74, and passes through a volume 18 inside a device 10A which is similar to the device 10, but which includes an additional tubular spigot 98. Other parts of the device 10A, which are the same as parts of the device 10, bear similar reference numbers. The device 10A is located inside a bearing plate 52 in that it has an opening 100 through which the spigot 98 extends.

A breather tube 102 extends through the spigot 98, and the volume 18, into the drill hole 70 and, alongside the cable 50B, to an inner end of the drill hole.

A barrel 106 is passed onto the end 90 and a wedge 108 is engaged with the end 90 and the barrel, which bears against an outer face of the bearing plate 52. These compo-
ments are used to tension the cable, as is known in the art. Grout is injected into the drill hole through the spigot 44 and fills the annular space between the cable and a wall of the drill hole. Air is expelled through the breather tube 102.

[0048] FIGS. 7 and 8 show another device 10B according to the invention in perspective and in cross-section respectively. The device has a body 12B with a first, frusto-conical, portion 14B and a second, tubular, portion 16B. The portion 14B has a plurality of apertures 112, and two formations 98B and 44B which correspond to, and which perform the same functions as, the spigots 98 and 44 respectively. The apertures 112 weaken the body and allow for a degree of relative movement between the body portions 14B and 16B. A passage 18B, through the body 12B, acts in the same way as the volume 18.

[0049] The device 10B is used in the same way as the device 10A, but preferably with a bearing plate of a corresponding shape i.e. not as domed as the bearing plate 52.

1. A grout delivery device for use with a bearing plate and a rock support tendon which extends through an opening in the bearing plate, the device including a body which defines an internal volume, a first aperture positioned in a surface of the body which opposes an inner surface of the bearing plate, a second aperture in the body which opposes the first aperture, the rock support tendon extending through the first and second apertures which are in communication with the volume, and a grout opening in the body which is displaced from the first and second apertures and through which grout is injectable into the volume.

2. A device according to claim 1 wherein the body includes a first body portion in which the first aperture and the grout opening are located and a second body portion in which the second aperture is located.

3. A device according to claim 2 wherein the second body portion is movable relative to the first body portion at least to a limited extent.

4. A device according to claim 3 wherein the body includes bellows-type formations which allow the second body portion to be movable relative to the first body portion.

5. A device according to claim 2, wherein an outer surface of the first body portion surrounds the first aperture and is convex, semi-spherical or conical in shape.

6. A device according to claim 2 wherein the second body portion is substantially tubular.

7. A device according to claim 1 wherein the grout opening is formed by a spigot which projects from the body and through which is formed a passage.

8. An assembly of a device according to claim 1 and a bearing plate which includes an opening which is aligned with the first aperture in the body and a second opening which is in register with the grout opening in the body.

9. An assembly according to claim 8 which includes a rock support tendon which extends through the first and second apertures and through the opening of the bearing plate.

10. An assembly according to claim 9 which includes a seal at an interface of the device and the rock support tendon in the region of the first aperture.

11. An assembly according to claim 8 which includes an elongate tube which is engaged with the body in direct communication with the second aperture.

12. An assembly according to claim 8 wherein the bearing plate has a domed area in which the opening is located.

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