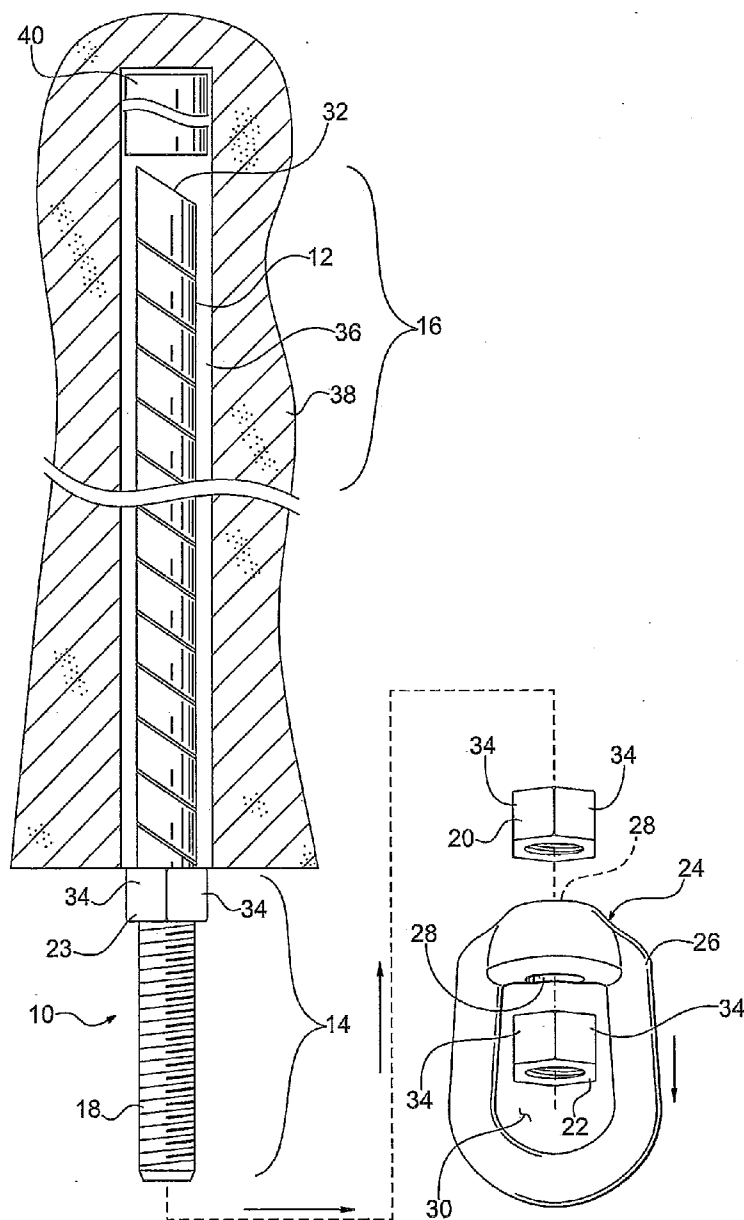




US 20120155970A1

(19) **United States**(12) **Patent Application Publication**
Wu et al.(10) **Pub. No.: US 2012/0155970 A1**(43) **Pub. Date: Jun. 21, 2012**(54) **MINE ROOF BOLT WITH END FITTING****Publication Classification**(75) Inventors: **Yaokun Wu**, Sudbury (CA);
Robert M. Gagnon, Val Caron
(CA); **Marc W. Lamothe**, Sudbury
(CA)(51) **Int. Cl.**
E21D 20/00 (2006.01)
E21D 21/00 (2006.01)(52) **U.S. Cl.** **405/259.6; 405/259.1**(57) **ABSTRACT**(73) Assignee: **FCI HOLDINGS DELAWARE, INC.**, Wilmington, DE (US)

A mine roof bolt includes an elongated body, first and second nuts, and an end fitting. The elongated body has a first end and a second end with the first end having a threaded portion. The first and second nuts are positioned on the threaded portion of the first end of the elongated body. The end fitting is positioned on the threaded portion of the first end of the elongated body between the first and second nuts.

(21) Appl. No.: **12/968,459**(22) Filed: **Dec. 15, 2010**

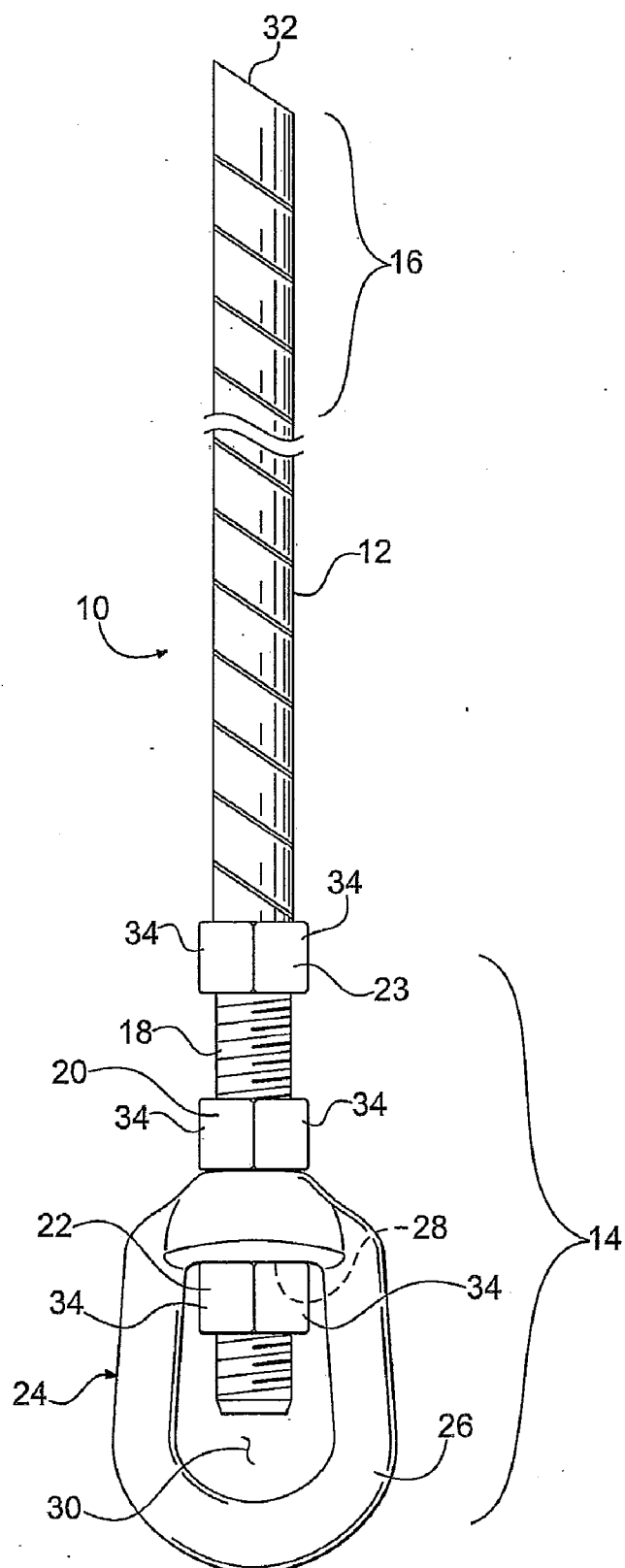


Fig. 1

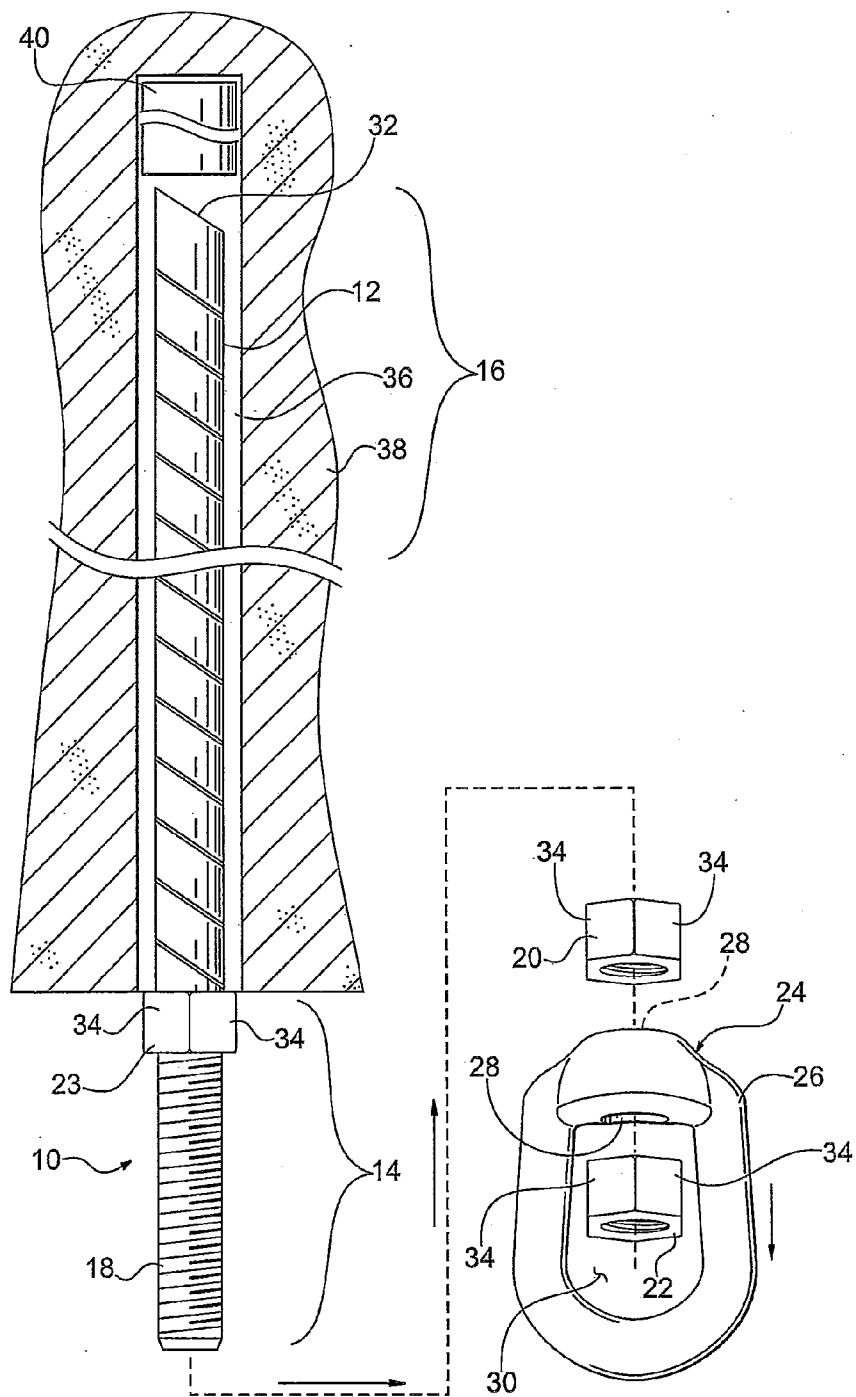


Fig. 2

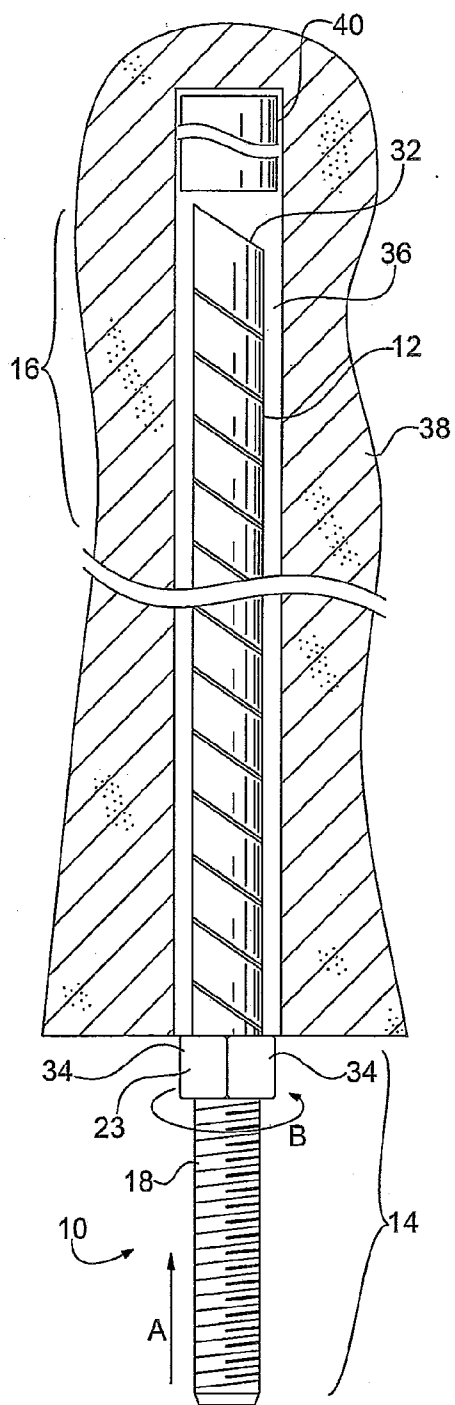


Fig. 3

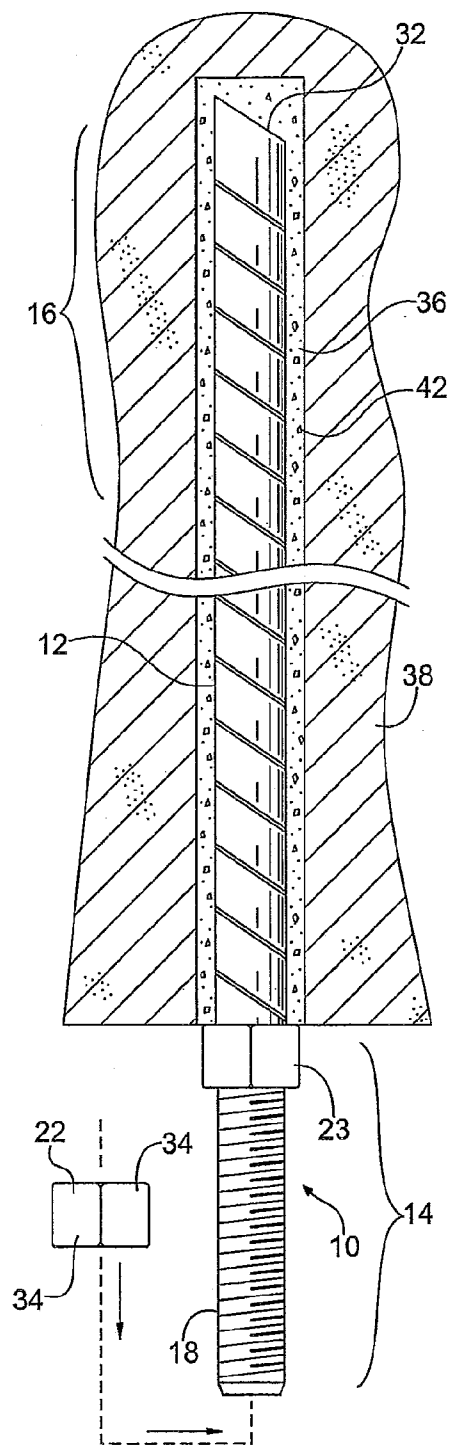


Fig. 4

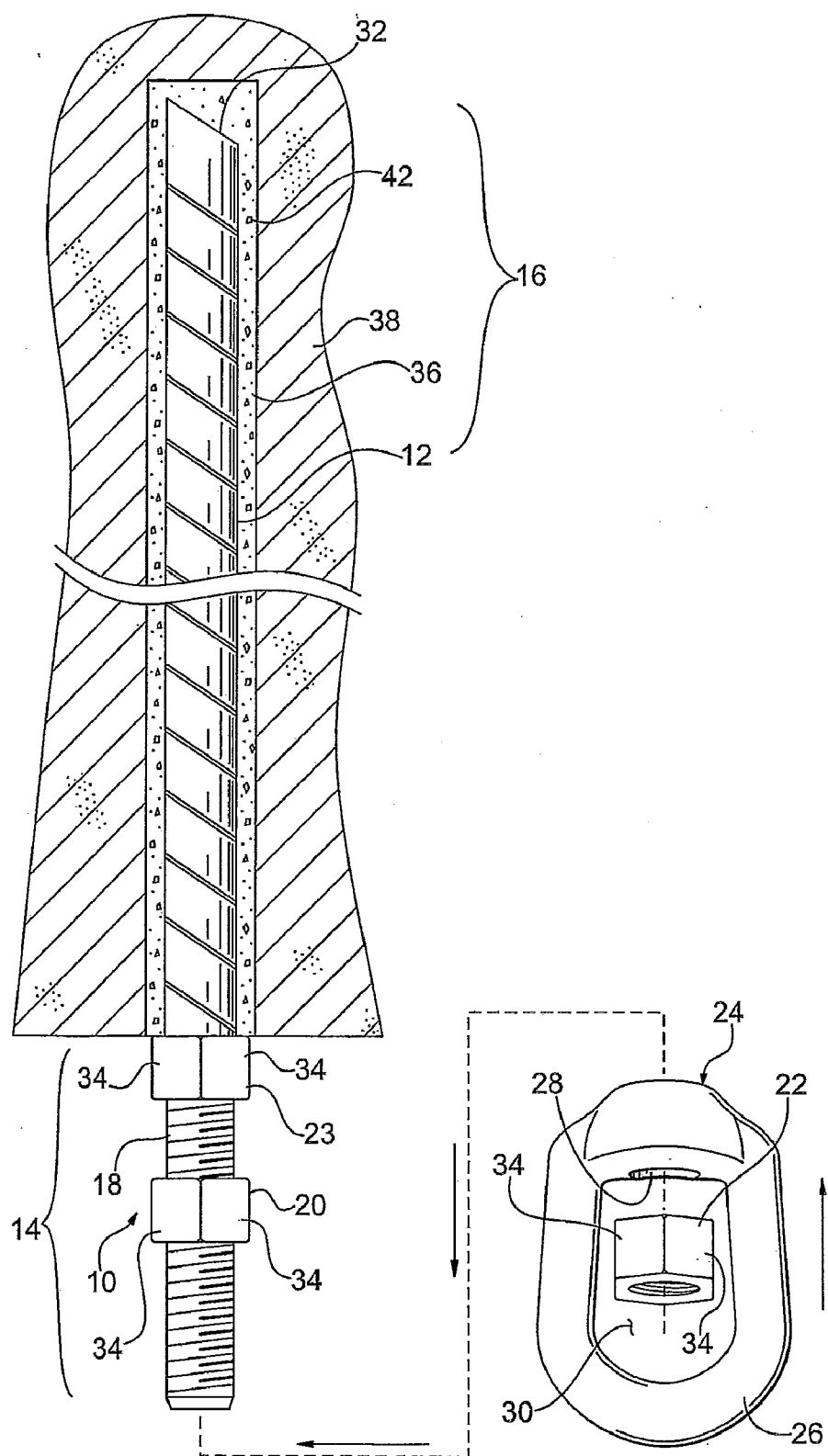


Fig. 5

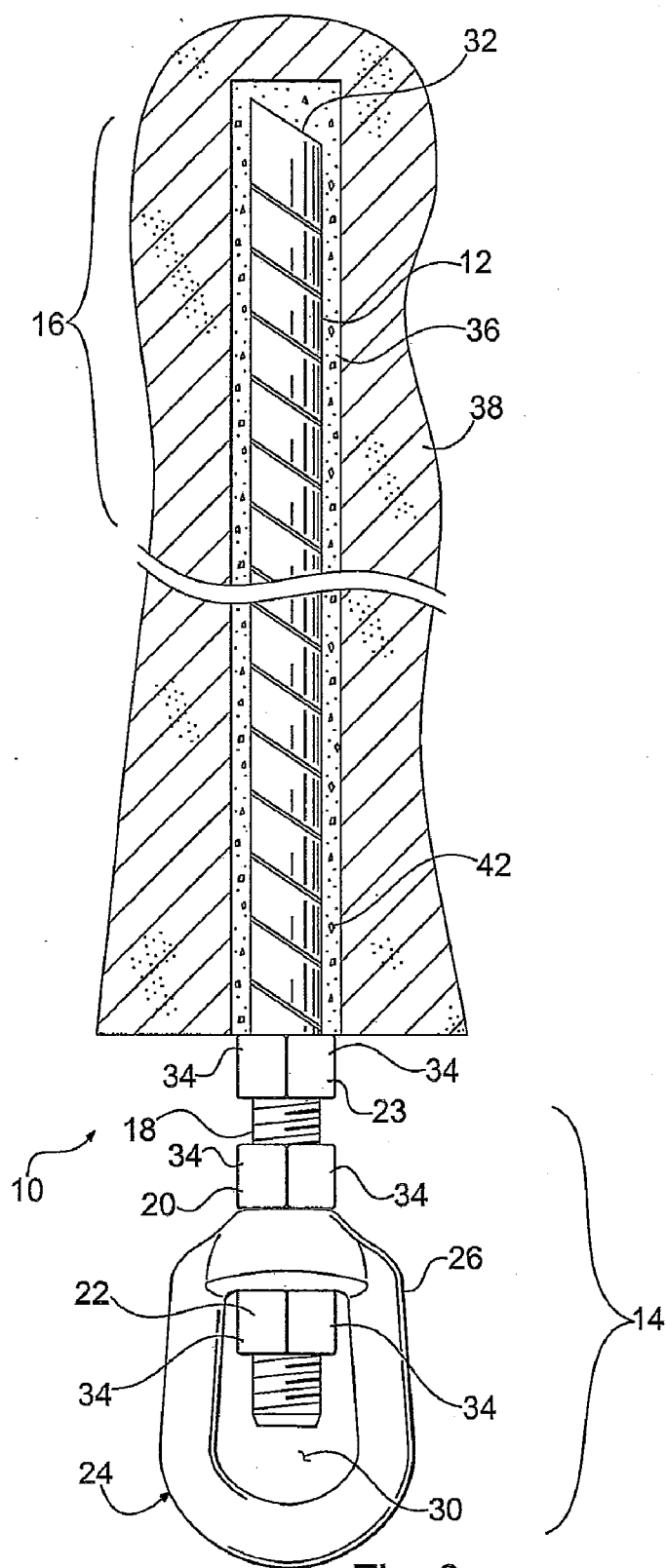


Fig. 6

MINE ROOF BOLT WITH END FITTING

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a mine roof bolt and, more particularly, to a mine roof bolt having an end fitting and a method of installing a mine roof bolt with an end fitting.

[0003] 2. Description of Related Art

[0004] The roof of a mine is conventionally supported by tensioning the roof with steel bolts inserted into bore holes drilled in the mine roof that reinforce the unsupported rock formation above the mine roof. The mine roof bolt may be anchored mechanically to the rock formation by engagement of an expansion assembly on the distal end of the mine roof bolt with the rock formation. Alternatively, the mine roof bolt may be adhesively bonded to the rock formation with a resin bonding material inserted into the bore hole. A combination of mechanical anchoring and resin bonding may also be employed by using both an expansion assembly and resin bonding material.

[0005] A mechanically anchored mine roof bolt typically includes an expansion assembly threaded onto one end of the bolt shaft and a drive head for rotating the bolt. A mine roof plate is positioned between the drive head and the mine roof surface. The expansion assembly generally includes a multi-prong shell supported by a threaded ring and a plug threaded onto the end of the bolt. When the prongs of the shell engage with rock surrounding a bore hole, and the bolt is rotated about its longitudinal axis, the plug threads downwardly on the shaft to expand the shell into tight engagement with the rock thereby placing the bolt in tension between the expansion assembly and the mine roof surface.

[0006] When resin bonding material is utilized, the bonding material penetrates the surrounding rock formation to adhesively join the rock strata and to firmly hold the roof bolt within the bore hole. Resin is typically inserted into the mine roof bore hole in the form of a two component plastic cartridge having one component containing a curable resin composition and another component containing a curing agent (catalyst). The two component resin cartridge is inserted into the blind end of the bore hole and the mine roof bolt is inserted into the bore hole such that the end of the mine roof bolt ruptures the two component resin cartridge. Upon rotation of the mine roof bolt about its longitudinal axis, the compartments within the resin cartridge are shredded and the components are mixed. The resin mixture fills the annular area between the bore hole wall and the shaft of the mine roof bolt. The mixed resin cures and binds the mine roof bolt to the surrounding rock. The mine roof bolt is typically rotated via a drive head. With bolts that are point anchored and tensioned, a breakaway nut may be used to rotate the bolt and subsequently tension the bolt upon curing of the resin bonding material. In certain mining environments, the mine roof bolt is provided with an end having an integral eye or a forged eye nut, which may be used as an anchoring point for a fall protection harness.

[0007] U.S. Pat. Nos. 4,958,796 and 5,474,274, both to Bernosky, disclose a coupling that attaches to a bolt head for providing a suspension system from mine roof bolts. U.S. Pat. No. 4,958,796, for example, shows a variety of mechanisms for attaching an eye nut to a coupler that is in turn attached to the mine roof bolt head (see FIGS. 2-6).

[0008] U.S. Patent Application Publication No. 2006/0285928 to Kanflod et al. discloses a swellable bolt that has an internally threaded end that can accept a hanger loop.

[0009] U.S. Pat. No. 6,868,647 to Poldmaa is directed to a mechanism for holding an eye bolt to the roof of a building that utilizes locking nuts.

SUMMARY OF THE INVENTION

[0010] In one embodiment, a mine roof bolt includes an elongated body, first and second nuts, and an end fitting. The elongated body has a first end and a second end with the first end having a threaded portion. The first and second nuts are positioned on the threaded portion of the first end of the elongated body. The end fitting is positioned on the threaded portion of the first end of the elongated body between the first and second nuts.

[0011] The end fitting may comprise an eye nut having a body that defines an opening configured to receive the threaded portion of the first end of the elongated body and an eyelet. The opening in the body of the eye nut may be threaded. The second end of the elongated body may include an angled surface. The first and second nuts may engage the end fitting and the elongated body may be formed from rebar. The first and second nut may define drive faces and the end fitting may extend away from the first end of the elongated body. The mine roof bolt may further include a third nut positioned on the threaded portion of the first end of the elongated body. The third nut may be spaced from the first nut toward the second end of the elongated body.

[0012] In a further embodiment, a method of installing a mine roof bolt includes positioning a cartridge having resin bonding material within a bore hole and inserting a mine roof bolt into the bore hole and rupturing the cartridge. The mine roof bolt has a threaded portion with a rotation nut positioned thereon. The method further includes rotating the mine roof bolt via the rotation nut thereby mixing the resin bonding material and positioning a first nut on the threaded portion of the mine roof bolt. The method also includes positioning an end fitting on the threaded portion of the mine roof bolt and positioning a second nut on the threaded portion of the mine roof bolt such that the end fitting is positioned between the first and second nuts.

[0013] The end fitting may be an eye nut having a body that defines an opening and an eyelet with the threaded portion of the mine roof bolt being positioned through the opening of the eye nut body. The opening in the body of the eye nut may be threaded and the eye nut may be threaded onto the threaded portion of the mine roof bolt. The second end of the elongated body may include an angled surface that engages the cartridge when the cartridge is ruptured. The method may further include the step of engaging the end fitting with the first and second nuts. The first nut may be positioned at about the midpoint of the threaded portion of the mine roof bolt. The method may further include removing the first and second nuts and end fitting from the threaded portion of the mine roof bolt prior to rotating the mine roof bolt.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is an elevational view of a mine roof bolt according to one embodiment of the present invention;

[0015] FIG. 2 is an elevational view of the mine roof bolt of FIG. 1, showing one step of installing the mine roof bolt in a bore hole;

[0016] FIG. 3 is an elevational view of the mine roof bolt of FIG. 1, showing a further step of installing the mine roof bolt in a bore hole;

[0017] FIG. 4 is an elevational view of the mine roof bolt of FIG. 1, showing another step of installing the mine roof bolt in a bore hole;

[0018] FIG. 5 is an elevational view of the mine roof bolt of FIG. 1, showing yet another step of installing the mine roof bolt in a bore hole; and

[0019] FIG. 6 is an elevational view of the mine roof bolt of FIG. 1, showing the mine roof bolt installed in a bore hole.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] The present invention will now be described with reference to the accompanying figures. For purposes of the description hereinafter, the terms “upper”, “lower”, “right”, “left”, “vertical”, “horizontal”, “top”, “bottom”, and derivatives thereof shall relate to the invention as it is oriented in the drawing figures. However, it is to be understood that the invention may assume various alternative variations and step sequences, except where expressly specified to the contrary. It is to be understood that the specific apparatus illustrated in the attached figures and described in the following specification is simply an exemplary embodiment of the present invention. Hence, specific dimensions and other physical characteristics related to the embodiments disclosed herein are not to be considered as limiting.

[0021] Referring to FIG. 1, one embodiment of a mine roof bolt 10 includes an elongated body 12 having a first end 14 and a second end 16. The first end 14 includes a threaded portion 18. First and second nuts 20, 22 are positioned on the threaded portion 18 of the first end 14 of the elongated body 12. The first nut 20 may be positioned at about a midpoint of the threaded portion 18. A third nut or rotation nut 23 is also positioned on the threaded portion 18 of the elongated body 12. The third nut 23 is spaced from the first nut 20 toward the second end 16 of the elongated body 12. As shown in FIG. 1, the third nut 23 is positioned at an end of the threaded portion 18 that is opposite the first end 14 of the elongated body, although the third nut 23 may have other locations along the threaded portion 18. Although not shown, the third nut 23 may be formed integrally with the elongated body 12.

[0022] An end fitting 24 is positioned on the threaded portion 18 of the first end 14 of the elongated body 12 between the first and second nuts 20, 22. The end fitting 24, as shown in FIG. 1, is an eye nut having a body 26 that defines an opening 28 and an eyelet 30, although other suitable end fittings may be utilized. The opening 28 of the body 26 of the end fitting 24 is configured to receive the threaded portion 18 of the first end 14 of the elongated body 12. In particular, the opening 28 in the body 26 of the end fitting 24 is threaded and cooperatively engages the threaded portion 18 of the first end 14 of the elongated body 12. In certain embodiments, the end fitting 24 is a forged steel eye nut having an ultimate load of 50,000 lbs. The second end 16 of the elongated body 12 includes an angled surface 32 that is configured to assist in rupturing a resin cartridge, which will be discussed in more detail below. This is not meant to be limiting. The second end 16 may alternatively include an expansion assembly mounted on the elongated body 12, as is known in the art.

[0023] The end fitting 24 is positioned between the first and second nuts 20, 22 on the threaded portion 18 of the first end 14 of the elongated body 12 such that the end fitting 24

engages the first and second nuts 20, 22. In other words, the first and second nuts 20, 22 engage the end fitting 24 to sandwich the end fitting 24 between the nuts 20, 22. The first, second, and third nuts 20, 22, 23 define drive faces 34 that are configured to be engaged by a drive tool (not shown). In one embodiment, the nuts 20, 22, 23 are hex jam nuts, although other suitable fasteners may be utilized. The elongated body 12, as shown in FIG. 1, is formed from rebar, although other suitable elongated bodies may be utilized. The end fitting 24 extends away from the first end 14 of the elongated body 12. In particular, the body 26 of the end fitting 24 and an eyelet 30 extend below the first end 14 of the elongated body 12 with the eyelet 30 being configured to serve as an anchoring point for a fall protection harness (not shown).

[0024] Referring to FIGS. 2-6, one embodiment of installing the mine roof bolt 10 in a bore hole 36 defined in rock strata 38 is disclosed. The mine roof bolt 10 is installed by positioning a frangible resin cartridge 40 into the bore hole 36 and inserting the mine roof bolt 10 into the bore hole 36. As shown in FIG. 2, the first and second nuts 20, 22 and end fitting 24 are removed from the mine roof bolt 10 and the second end 16 of the elongated body 12 of the mine roof bolt 10 is inserted into the bore hole 36. As shown in FIG. 3, the mine roof bolt 10 is moved axially within the bore hole 36 as indicated by arrow A and is also rotated about a longitudinal axis of the mine roof bolt 10 as indicated by arrow B. The mine roof bolt 10 is rotated about its longitudinal axis via the third nut or rotation nut 23. In particular, a driving tool (not shown) engages the drive faces 34 of the third nut 23 and rotates the third nut 23. As the bolt 10 is moved axially within the bore hole 36, the angled surface 32 on the second end 16 of the elongated body 12 contacts and ruptures the resin cartridge 40, thereby releasing a curable resin 42. The rotation of the mine roof bolt 10 facilitates the mixing of the contents of the resin cartridge 40. Although not shown, the bolt 10 may also be rotated by repositioning the first and second nuts 20, 22 on the threaded portion 18 and engaging the second nut 22 with the drive tool such that second nut 22 engages the first nut 20 to cause rotation of the entire mine roof bolt 10.

[0025] As shown in FIG. 4, upon curing of the resin 42, the mine roof bolt 10 is securely anchored within the bore hole 36. The first nut 20 is then positioned on the threaded portion 18 of the mine roof bolt 10. In particular, the first nut 20 is positioned at about the midpoint of the threaded portion 18, although other suitable locations may be utilized. Referring to FIG. 5, the end fitting 24 is positioned on the threaded portion 18 of the first end 14 of the elongated body 12. More specifically, the threaded portion 18 of the first end 14 of the elongated body 12 is positioned through the opening 28 of the end fitting body 26 such that the first end 14 of the elongated body 26 extends through the body 26 and into the eyelet 30. As noted above, the opening 28 of the end fitting body 26 may be threaded such that the end fitting 24 is threaded onto the first end 14 of the elongated body 12. The second nut 22 is then positioned on the threaded portion 18 of the first end 14 of the elongated body 12 such that the end fitting 24 is positioned between the first and second nuts 20, 22. The end fitting 24 engages the first nut 20 upon being positioned on the first end 14 of the elongated body 12 and the second nut 22 engages the end fitting 24 to sandwich the end fitting 24 between the first and second nuts 20, 22. The threaded portion 18 may extend at least ½ inch past the second nut 22. Referring to FIG. 6, the mine roof bolt 10 is shown installed in the bore hole 36 with the end fitting 24 positioned on the first end 14 of the elon-

gated body **12** between the first and second nuts **20, 22**. The sandwiching of the end fitting **24** between the first and second nuts **20, 22** provides increased strength over conventional mine roof bolt arrangements utilizing an end fitting.

[0026] While several embodiments of the mine roof bolt were described in the foregoing detailed description, those skilled in the art may make modifications and alterations to these embodiments without departing from the scope and spirit of the invention. Accordingly, the foregoing description is intended to be illustrative rather than restrictive.

The invention claimed is:

1. A mine roof bolt comprising:
an elongated body having a first end and a second end, the first end having a threaded portion;
first and second nuts positioned on the threaded portion of the first end of the elongated body; and
an end fitting positioned on the threaded portion of the first end of the elongated body between the first and second nuts.
2. The mine roof bolt of claim 1, wherein the end fitting comprises an eye nut having a body, the body defining an opening configured to receive the threaded portion of the first end of the elongated body and an eyelet.
3. The mine roof bolt of claim 2, wherein the opening in the body of the eye nut is threaded.
4. The mine roof bolt of claim 1, wherein the second end of the elongated body includes an angled surface.
5. The mine roof bolt of claim 1, wherein the first and second nuts engage the end fitting.
6. The mine roof bolt of claim 1, wherein the elongated body is formed from rebar.
7. The mine roof bolt of claim 1, wherein the first and second nuts define drive faces.
8. The mine roof bolt of claim 1, wherein the end fitting extends away from the first end of the elongated body.
9. The mine roof bolt of claim 1, further comprising a third nut positioned on the threaded portion of the first end of the elongated body.
10. The mine roof bolt of claim 9, wherein the third nut is spaced from the first nut toward the second end of the elongated body.

11. A method of installing a mine roof bolt comprising:
positioning a cartridge having resin bonding material within a bore hole;
inserting a mine roof bolt into the bore hole and rupturing the cartridge, the mine roof bolt having a threaded portion and a rotation nut;
rotating the mine roof bolt via the rotation nut thereby mixing the resin bonding material;
positioning a first nut on the threaded portion of the mine roof bolt;
positioning an end fitting on the threaded portion of the mine roof bolt; and
positioning a second nut on the threaded portion of the mine roof bolt such that the end fitting is positioned between the first and second nuts.
12. The method of claim 11, wherein the end fitting comprises an eye nut having a body, the body defining an opening and an eyelet, and wherein the threaded portion of the mine roof bolt is positioned through the opening of the eye nut body.
13. The method of claim 12, wherein the opening in the body of the eye nut is threaded, and wherein the eye nut is threaded onto the threaded portion of the mine roof bolt.
14. The method of claim 11, wherein an end of the mine roof bolt opposite the threaded end includes an angled surface that engages the cartridge when the cartridge is ruptured.
15. The method of claim 11, further comprising engaging the end fitting with the first and second nuts.
16. The method of claim 11, wherein the mine roof bolt is formed from rebar.
17. The method of claim 11, wherein the first nut is positioned at about a midpoint of the threaded portion of the mine roof bolt.
18. The method of claim 11, further comprising removing the first and second nut and the end fitting from the threaded portion of the mine roof bolt prior to rotating the mine roof bolt.

* * * * *