A metal coupling used to join a strand cable with a threaded metal mine roof bolt includes a first portion having a first opening that is threaded to receive an engage with the bolt. The coupling includes a second portion having a second opening to receive and engage with the cable. A mine roof support includes a strand cable. The support includes a threaded metal mine roof bolt. The coupling which joins the strand cable with the threaded metal mine roof bolt that supports at least 1 ton of load from a mine roof when disposed in the mine roof. A method for forming a mine roof support includes the steps of screwing a threaded metal mine roof bolt into a first opening that is threaded of a metal coupling. There is the step of inserting a strand cable into a second opening of the metal coupling. There is the step of swagging the cable inside the coupling.
MINE ROOF CABLE BOLT, COUPLER AND METHOD

FIELD OF THE INVENTION

[0001] The present invention is related to a mine roof bolt. (As used herein, references to the “present invention” or “invention” relate to exemplary embodiments and not necessarily to every embodiment encompassed by the appended claims.) More specifically, the present invention is related to a mine roof bolt that features a coupling which joins a multi-strand cable to a rigid bolt and tensioning of the combined bolt is accomplished by the use of an expansion anchor attached to the top end of either the rigid bolt or cable. Resin can be used in both means to assist in anchoring to the rock in the borehole.

BACKGROUND OF THE INVENTION

[0002] This section is intended to introduce the reader to various aspects of the art that may be related to various aspects of the present invention. The following discussion is intended to provide information to facilitate a better understanding of the present invention. Accordingly, it should be understood that statements in the following discussion are to be read in this light, and not as admissions of prior art.

[0003] Mine roof supports are used to reinforce the roofs of mines. Commonly, these supports are made of a solid rigid metal bar. The use of such a bar can be relatively expensive and by definition inflexible. The use of cable is relatively cheaper and relatively flexible as compared to the bar. The problem is to somehow or other integrate the use of the cable to make an effective mine roof support with the advantages of a rigid metal bolt. The present invention solves this problem by using a special coupling to form a mine roof bolt that has both a strand cable and a rigid bolt coupled together with the coupling.

BRIEF SUMMARY OF THE INVENTION

[0004] The present invention pertains to a metal coupling used to join a strand cable with a threaded metal mine roof bolt. The coupling comprises a first portion having a first opening that is threaded to receive an engage with the bolt. The coupling comprises a second portion having a second opening to receive and engage with the cable.

[0005] The present invention pertains to a mine roof support. The support comprises a strand cable. The support comprises a metal coupling which joins the strand cable with the threaded metal mine roof bolt that supports at least 1 ton of load from a mine roof when disposed in the mine roof.

[0006] The present invention pertains to a method for forming a mine roof support. The method comprises the steps of screwing a threaded metal mine roof bolt into a first opening that is threaded of a metal coupling. There is the step of inserting a strand cable into a second opening of the metal coupling. There is the step of screwing the cable inside the coupling.

[0007] The present invention pertains to a method for reinforcing a mine roof. The method comprises the steps of placing a resin cartridge into a hole in the mine roof. There is the step of puncturing the cartridge with a strand cable attached to a metal coupling at the coupling’s first end, with a threaded metal bolt attached to a threaded second end of the coupling of a bolt. There is the step of rotating the bolt to mix the resin and to set an expansion anchor attached to the threaded bolt.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0008] In the accompanying drawings, the preferred embodiment of the invention and preferred methods of practicing the invention are illustrated in which:

[0009] FIG. 1 is a representation of a coupling of a mine roof bolt of the present invention.

[0010] FIG. 2 is a representation of a mine roof of the present invention.

[0011] FIG. 3 is a representation of an alternative embodiment of a mine roof bolt of the present invention.

[0012] FIG. 4 is a representation of the coupling in regard to dimensions.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Referring now to the drawings wherein like reference numerals refer to similar or identical parts throughout the several views, and more specifically to FIG. 1 thereof, there is shown a metal coupling 1 used to join a strand cable 2 with a threaded metal mine roof bolt 14. The coupling 1 comprises a first portion having a first opening that is threaded to receive an engage with the bolt 14. The coupling 1 comprises a second portion having a second opening to receive and engage with the cable 2.

[0014] The present invention pertains to a mine roof support 100, as shown in FIGS. 2 and 3. The support 100 comprises a strand cable 2. The support 100 comprises a threaded metal mine roof bolt 14. The support 100 comprises a metal coupling 1 which joins the strand cable 2 with the threaded metal mine roof bolt 14 that supports at least 1 ton of load from a mine roof when disposed in the mine roof.

[0015] Preferably, the strand cable 2 is swaged inside the coupling 1. The threaded metal mine roof bolt 14 is preferably threadingly engaged inside the coupling 1. Preferably, the bolt 14 is swaged inside the coupling 1. The strand cable 2 can be plain, galvanized, epoxy coated, or covered with grit to enhance its grip. The support 100 can include a mechanical expansion anchor 8 and a second metal coupling 1 to affix the mechanical expansion anchor 8 at the top of the cable 2. Preferably, the support 100 includes an expansion anchor 8 attached to the bolt 14. The support 100 preferably includes a bearing plate 11 attached to the bolt 14.

[0016] There can be a resin cartridge 9. The support 100 can include means 7 for mixing resin in the resin cartridge 9 placed on the strand cable 2. Preferably, the mixing means 7 is buttons swaged to the cable 2, or a spiral wire mixer affixed around the cable 2.

[0017] The present invention pertains to a method for reinforcing a mine roof. The method comprises the steps of placing a resin cartridge 9 into a hole in the mine roof. There is the step of puncturing the cartridge 9 with a strand cable 2 attached to a metal coupling 1 at the coupling’s first end, with a threaded metal bolt 14 attached to a threaded second end of the coupling 1 of a bolt 14. There is the step of rotating the bolt 14 to mix the resin and to set an expansion anchor 8 attached to the threaded bolt 14.

[0018] The present invention pertains to a method for forming a mine roof support 100. The method comprises the steps of screwing a threaded metal mine roof bolt 14 into a first opening that is threaded of a metal coupling 1. There is the
step of inserting a strand cable 2 into a second opening of the metal coupling 1. There is the step of swaging the cable 2 inside the coupling 1.

[0019] In the operation of the invention, a novel coupling 1 to join a rigid mechanical mine roof bolt 14 to a strand cable 2 making it one piece is shown in FIG. 1.

[0020] Referring to FIG. 1, the special coupling 1 has a certain length 5 of which is swagged to the strand cable 2. As also shown in FIG. 1, the threaded end 4 of a rigid bolt 14 is threaded engaged with threads 3 inside coupling 1.

[0021] A two-section bolt 14 shown in FIG. 2 features a strand cable 2 swagged inside the coupling 1 which in turn is threaded engaged to a mechanical bolt 14. The mechanical bolt 14 has an expansion anchor 8 on the threaded end 4 with emerging threads 316 at the top, which connect to the coupling 1.

[0022] FIG. 2 shows a strand cable 2 with any of several means 7 of mixing resin in a cartridge 9 form pushed by the leading-end 15 of the bolt 14 as they are being inserted into a drilled hole in the roof of a mine or tunnel.

[0023] The strand cable 2 (which can be plain, galvanized, epoxy coated, etc.) is connected to a rigid mechanical bolt 14 (FIG. 1) via a special coupling 1.

[0024] The strand cable 2 is swagged inside the coupling 1, and the mechanical bolt 14 is threaded engaged to it or by other techniques easily determined by those skilled in the art. (i.e. swaging also).

[0025] The mechanical bolt 14 has threads 3 (FIG. 2) long enough on top to not only accept the expansion anchor 8, but also enough to engage the special coupling 1.

[0026] The mechanical bolt 14 also has a bearing plate 11 and optional anti-friction washer 12 assembled at the head-end 13. (FIGS. 2 and 3.)

[0027] The method of installation is to have all components assembled prior to insertion. The resin cartridge 9 or cartridges 9 are placed in the hole. The bolt 14 lead-end is inserted in the hole. In low roof areas, the top cable-end can be bent to insert in the hole. This is advantageous over sectional rigid bolts, which must be connected after the lead portion of the bolt 14 is placed in the hole, then the head or bottom end, is placed in the pod or drive of the bolting machine. The bolting machine then raises the entire bolt 14 up through the resin. The drive of the bolting machine then turns the entire bolt 14 enabling the resin to be mixed and the expansion anchor 8 to set. The bolt 14 is tensioned initially from the expansion anchor 8 to the head end. After the expansion anchor 8 is set, the resin surrounding the cable 2 hardens and forms an additional anchored zone above.

[0028] An alternate method is to use the coupling 1 to join the two pieces of the bolt 14 (FIG. 3) TOP.—cable 2, plus bottom rigid bolt 14 with the coupling 1. Also, place a novel coupling 1 at the top of the cable 2 so as to join the cable 2 to an expansion anchor 8 with the system. The bolt 14 assembly is tensioned from the top to the bottom of the head-end. A resin cartridge 9 may or may not be used to grant the top area.

[0029] A description of the coupling 1 is now provided with references to FIG. 2.

[0030] The coupling 1 joins cable 2 with threaded bolt 14. The bolt 14 is a rigid mechanical bolt 14. It has a threaded end 4 at the top, which engages the tapped end of the special coupling 1. The opposite or bottom end is the drive end. The drive end may be an engaged head or fixed threadedly engaged nut. The cable 2 is swagged inside the special coupling 1.

[0031] The strand cable 2 is preferably an ASTM A416, Grade 270K, 0.600" Diameter, Typical Ultimate Strength at 59,000i.

[0032] The bolt 14 is preferably ASTM F432, 5/8" Diameter, Grade 75 Mechanical Bolt, Minimum Ultimate Load at 46,200i, Typical Range of Ultimate Strength at 55,000i to 59,000i.

[0033] The coupling 1 preferably has a tensile strength of 91,000 psi. This part is stronger than the combination of cable 2 and bolt 14 when Pulled Tested—The 5/8" Bolt would usually break first. The cable 2 typical range of Ultimate Strength—55,000i to 59,000i.

[0034] With reference to FIG. 4:

<table>
<thead>
<tr>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Length of thread inside coupling</td>
</tr>
<tr>
<td>b.</td>
<td>Length of swage onto cable</td>
</tr>
<tr>
<td>c.</td>
<td>Inside diameter of coupling</td>
</tr>
<tr>
<td>d.</td>
<td>Outside diameter of coupling</td>
</tr>
<tr>
<td>e.</td>
<td>Wall thickness of coupling where swage is to be swaged</td>
</tr>
<tr>
<td>f.</td>
<td>Interior threads of coupling which join to rigid roof bolt, Thread Design matched to bolt it joins</td>
</tr>
<tr>
<td>g.</td>
<td>Gap between cable and bolt inside coupling.</td>
</tr>
</tbody>
</table>

[0035] Preferred Example:

<table>
<thead>
<tr>
<th>Material</th>
<th>4130, 40,900 PSI Tensile</th>
</tr>
</thead>
</table>

[0036] Coupling Material—Steel or Casting (Metal)

[0038] How coupling 1 is manufactured:

[0039] Steel.—A round steel bar is cut to length. One end is drilled and tapped to accept the threaded end 4 of a rigid bolt. The other end is drilled to the proper diameter to accept the cable for swaging.

[0040] Steel Tubing.—Tubing with proper O.D. and I.D. is cut to length. One end is drilled and tapped to accept the rigid bolt. The other end already has proper I.D. to accept the cable.

[0041] Casting.—Melten metal is poured into a mold to form the coupling 1. Then the end is tapped to form threads.

[0042] The advantages of having the Rigid Bolt Section 14 with the Cable include:

[0043] 1. Helps to keep entire bolt (including cable portion) from twisting too much during tensioning; and,
[0044] 2. Improves torqueing of the bolt which can cause back spin and loss of load if only cable is used for entire length.

[0045] Although the invention has been described in detail in the foregoing embodiments for the purpose of illustration, it is to be understood that such detail is solely for that purpose and that variations can be made therein by those skilled in the art without departing from the spirit and scope of the invention except as it may be described by the following claims.
1. A mine roof support comprising:
a strand cable;
a threaded metal mine roof bolt; and
a metal coupling which joins the strand cable with the threaded metal mine roof bolt that supports at least 1 ton of load from a mine roof when disposed in the mine roof.

2. A support as described in claim 1 wherein the strand cable is swagged inside the coupling.

3. A support as described in claim 2 wherein the threaded metal mine roof bolt is swagging engaged inside the coupling.

4. A support as described in claim 3 wherein the bolt is swagged inside the coupling.

5. A support as described in claim 3 wherein the strand cable is plain, galvanized, epoxy coated, or covered with grit to enhance its grip.

6. A support as described in claim 1 including a mechanical expansion anchor and a second metal coupling to affix a mechanical expansion anchor at the top of the cable.

7. A support as described in claim 2 including an expansion anchor attached to the bolt.

8. A support as described in claim 7 including a bearing plate attached to the bolt.

9. A support as described in claim 8 including a resin cartridge.

10. A support as described in claim 9 including means for mixing resin in the resin cartridge placed on the strand cable.

11. A support as described in claim 10 wherein the mixing means is buttons swagged to the cable, or a spiral wire mixer affixed around the cable.

12. A metal coupling used to join a strand cable with a threaded metal mine roof bolt comprising:
a first portion having a first opening that is threaded to receive an engage with the bolt; and
a second portion having a second opening to receive and engage with the cable.

13. A method for forming a mine roof support comprising the steps of:
screwing a threaded metal mine roof bolt into a first opening that is threaded of a metal coupling;
inserting a strand cable into a second opening of the metal coupling; and
swagging the cable inside the coupling.

14. A method for reinforcing a mine roof comprising the steps of:
placing a resin cartridge into a hole in the mine roof;
puncturing the cartridge with a strand cable attached to a metal coupling at the coupling’s first end, with a threaded metal bolt attached to a threaded second end of the coupling of a bolt; and
rotating the bolt to mix the resin and to set an expansion anchor attached to the threaded bolt.

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