A mine roof and rib support may include a support member having a roof support arm provided at an angle to a rib support arm, the roof support arm defining an aperture for receiving a mine roof bolt, and wherein the support member defines a channel having an opened side surface and two legs extending from the opened side surface to contact the mine roof and the mine rib. A method of supporting a rock formation may include positioning a support member having a roof support arm provided at an angle to a rib support arm, wherein the roof support arm defines an aperture for receiving a mine roof bolt and a channel having an opened side surface and two legs extending from the opened side surface to contact the mine roof surface and the mine rib surface extending a mine roof bolt through the roof support arm aperture.
ROOF AND RIB SUPPORT HAVING REVERSE C-CHANNEL

CROSS-REFERENCE TO RELATED APPLICATIONS


BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention
[0003] The support member relates generally to mine surface control and, more particularly, to a mine roof and rib support with a roof support arm and a rib support arm which simultaneously support the mine roof and mine rib.

[0004] 2. Description of Related Art
[0005] Mine roof and rib supports are commonly used in underground mining, excavating, and tunneling operations to support and control the overhead and lateral rock strata. In one conventional mine surface control system, a series of bore holes can be drilled into the mine roof or rib; a mine roof bolt can be installed in the bore hole; a channel, bearing plate, or mat can be positioned between the end of the mine roof bolt; and the mine roof or rib, and the mine roof bolt can be anchored in the bore hole and tensioned, such that the mine roof bolt and channel, bearing plate, or mat exert a compressive force upon the mine roof and rib to prevent deterioration of the overhead and lateral rock strata. One example of a roof and rib support system is disclosed in U.S. Patent Application Publication No. 2010/0054870, incorporated herein by reference in its entirety.

SUMMARY OF THE INVENTION

[0006] One embodiment of the invention is directed to a mine roof and rib support including a support member having a roof support arm and a rib support arm, wherein the roof support arm is provided at an angle to the rib support arm, and the roof support arm defines an aperture for receiving a mine roof bolt. The support member defines a channel having an opened side and front side surface opposite the opened side, the opened side having an opened side surface and two legs extending from the opened side surface to contact the mine roof surface and the mine rib surface. A curved junction portion may be included between the roof support arm and the rib support arm. In one embodiment, a bearing plate defining a through-hole could be positioned on the front side surface of the roof support arm, wherein the bearing plate through-hole is operatively aligned with the roof support arm aperture, and the mine roof bolt extends through the through-hole and the roof support arm aperture to compress the bearing plate against the support member. The bearing plate could be a C-channel bearing plate, wherein the roof support arm is nested within the C-channel bearing plate, or the bearing plate could be a flat bearing plate. The roof support arm could define a second aperture for receiving a second mine roof bolt. In this configuration, the mine roof and rib support could include two bearing plates, each defining a through-hole and positioned on the front side surface of the roof support arm, wherein the bearing plate through-holes are operatively aligned with the roof support arm apertures, and the mine roof bolts extend through the through-holes and the roof support arm apertures to compress the bearing plates against the support member. At least one of the bearing plates could be a C-channel bearing plate, wherein the roof support arm is nested within the C-channel bearing plate. Also, at least one of the bearing plates could be a flat bearing plate.

[0007] Another embodiment of the present invention is directed to a method of manufacturing a mine roof and rib support. This method could include bending an elongated member defining a channel having an opened side and front surface opposite the opened side, the opened side having an opened side surface and two legs extending from the opened side surface, such that the elongated member comprises a support member having a mine roof support arm and mine rib support arm provided in an angular orientation, with the opened side being on an outside of the mine roof and rib support arms and the front surface being on an inside of the mine roof and rib support arms and providing an aperture on the roof support arm. Bending may include providing a curved junction portion between mine roof and rib support arms.

[0008] Yet another embodiment of the present invention is directed to a method of supporting a rock formation. This method includes positioning a support member comprising a roof support arm, a rib support arm, the roof support arm provided at an angle to the rib support arm, wherein the roof support arm defines an aperture for receiving a mine roof bolt, the support member defining a channel having an opened side and front side surface opposite the opened side, the opened side having an opened side surface and two legs extending from the opened side surface, such that the support member legs contact a mine roof surface and a mine rib surface and extending a mine roof bolt through the roof support arm aperture into engagement with the rock formation. Prior to positioning the support member, the method could include bending the support member to provide the rib support arm at an angle to the roof support arm and bending could include providing a curved junction portion between mine roof and rib support arms. A bearing plate defining a through-hole through could also be positioned against the roof support arm, wherein the through-hole is aligned with the roof support arm aperture, and the mine roof bolt is extended through the through-hole and the roof support arm aperture. The bearing plate could be a C-channel plate nested with the roof support arm. The bearing plate could be compressed against the roof support arm, such as, for example, by torquing the mine roof bolt against the bearing plate. A second bearing plate defining a through-hole through could also be positioned against the roof support arm, wherein the second bearing plate through-hole is aligned with a second roof support arm aperture defined in the roof support arm, a second mine roof bolt is extending through the second roof support arm aperture into engagement with the rock formation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] A more complete understanding of the mine roof and rib support can be obtained by considering the following description in conjunction with the accompanying drawing figures in which:

[0010] FIG. 1 is a perspective view of an embodiment of a mine roof and rib support device;
[0011] FIG. 2 is a top view of a support member of the mine roof and rib support device of FIG. 1;
[0012] FIG. 3 is a side view of the support member of FIG. 2;
FIG. 4 is a schematic view of a method of constructing the support member of FIG. 2; FIG. 5 is a perspective view of an embodiment of a bearing plate of the mine roof and rib support device of FIG. 1; FIG. 6 is a perspective view of a second embodiment of a mine roof and rib support device; FIG. 7 is a side view of the support member; and FIG. 8 is a plan schematic view illustrating embodiments of mine roof and rib support devices installed at the intersection of the mine roof and opposite sides/ribs of a mine work area.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A more complete understanding of the mine roof and rib support can be obtained by considering the following description in conjunction with the accompanying drawings. As used herein, the term “upwardly” shall refer to a direction with respect to a mine passageway which is oriented generally along the direction extending from the mine floor to the mine roof. The term “downwardly” shall refer to a direction with respect to a mine passageway which is oriented generally along the direction extending from the mine roof to the mine floor. The term “outwardly” shall refer to an orientation generally in transverse direction extending from the walls of the passageway to the mine passageway central longitudinal axis. The term “inwardly” shall refer to an orientation generally in transverse direction extending from the central longitudinal axis of the mine passageway to the walls of the mine passageway.

Referring now to the figures in which like reference numbers refer to like elements, a perspective view of an embodiment of a mine roof and rib support device 10 is shown in FIGS. 1-3, which can generally include a support member 15 having a roof support arm 20 and a rib support arm 25, wherein rib support arm 25 is provided at an angle to the roof support arm 20, with a curved junction portion 40 therebetween. An aperture 30 may be provided through the support member 15 for receiving a mine roof bolt 35 located on the roof support arm 20. Also, the mine roof support arm 20 may optionally comprise a second aperture 32 for receiving a second mine roof bolt, as explained hereinbelow.

As shown in FIGS. 1-4, the support member 15 may include an opened side 22 having an opened side surface 24 and a front side surface 23, wherein opened side 22 includes two legs 60 extending from opened side surface 24, thereby defining a channel 65 extending therethrough. As shown, the support member may be a bent C-channel having curved portion 40 between mine roof support arm 20 and mine rib support arm 25 including legs 60 along the open portion of the C-channel. In use, the legs 60 can be positioned against the rock formation, i.e., against mine roof 50 on roof support arm 20 and against mine rib 55 on rib support arm 25 to contact mine roof 50 and rib 55, with flat front surface 65 facing away from the mine roof 50 and rib 55, thereby providing a reverse C-channel configuration. In an alternative embodiment, the support member 15 may be a bent T-channel, manufactured by Jennmar Corporation, such as disclosed in U.S. Pat. No. 5,292,209, which is hereby incorporated by reference, with flange portions functioning as legs 60, as shown in FIGS. 1-4. In this embodiment, the flange portions include longitudinal edges, at least a portion of which are positioned against the surface of mine roof 50 and/or rib 55.

Referring specifically to FIG. 4, the support member 15 may be constructed or manufactured from an elongated, flat C-channel member, such as described above, which is bent to form roof support arm 20 and rib support arm 25 with curved junction portion 40 therebetween, which is shown schematically. The legs 60 of the C-channel, as shown, will be on the outside of curved junction portion 40 of support member 15, with flat front surface 65 being on the inside. Because the support member 15 is bent, such that the legs 60 of the C-channel will be positioned on the outside of the support member 15; the support member 15 acts as a leaf spring when loaded with a deflection force.

As shown in FIGS. 1, 5 and 6, the mine roof and rib support device 10 may include a bearing plate 75, which may, for example, be a C-chinned bearing plate 75 into which the C-channel support member 15 may be nested. The bearing plate 75 defines a through-hole 80. In use, the bearing plate 75 is positioned on the front side surface of the roof support arm, wherein the through-hole 80 is operatively aligned with aperture 30 of mine roof support arm 20, such that bolt 35 can be inserted into through-hole 80 and aperture 30 through both bearing plate 75 and roof support arm 20. The bolt 35 can then be torqued against the bearing plate 75 to compress the bearing plate against the roof support arm 20 of support member 15, represented by force vector 120 in FIG. 8. Referring to FIG. 7, in an alternative embodiment, the bearing plate may, alternatively, be a flat bearing plate 75a. The flat bearing plate 75a may be used alone, or in conjunction with a nested C-channel bearing plate, such as bearing plate 77 illustrated in FIG. 7. In this embodiment, a second bearing plate 77 is positioned, such that a second through-hole 82 defined therethrough is operatively aligned with the second aperture 32 defined in roof support arm 20. In this manner, a second mine roof bolt 35a may be extended through the through-hole 82 and the roof support arm aperture 32 to compress the bearing plate 77 against the support member.

FIG. 8 schematically illustrates how the mine roof and rib support device 10 may be installed at each side of the mine tunnel. As shown, when the above-described mine roof and rib support device 10 is loaded with a deflection force in the horizontal direction, i.e., against the rib support arm 25, the support member 15 will provide a resistance against the deflection force. The deflection force is illustrated by force vector 125, which is opposite to the resistive force of support member 15. The amount of resistance the support member 15 will supply in the horizontal direction is dependent on the anchor point of the roof support arm 20 to the mine roof 50, for example, aperture 30, through which bolt 35 will be secured into mine roof 50. The support member 15 will provide greater resistance, the closer the anchor point is toward the inner radius of curved portion 40. As the anchor point is moved toward the radius of curved portion 40, a gustet-like effect occurs across curved portion 40 providing additional support to the support member 15 and, in particular, rib support arm 25. Because bearing plate 75 is compressed against roof support arm 20, the end 85 of bearing plate 75, nearest curved portion 40, acts as the effective anchor point of roof support arm 20 to mine roof 50, thereby, providing additional support to rib support arm 25, allowing rib support arm 25 to receive greater deflection forces from mine rib 55. Because anchor points closer to the inner radius of curved portion 40 provide greater horizontal resistance, longer bearing plates which extend from bolt 35 toward radius of curved portion 40 increase the resistive strength of
support member 15. Aperture 30, which may be preexisting on support member 15, may be used with bearing plates 75 of increasing length, which would avoid the necessity to drill additional aperture in roof support arm 20 to move the anchor point of the support member 15 closer to the inner radius of curved portion 40.

[0024] The above-described mine roof and rib support device 10 is particularly useful in mine entries in which the placement of horizontal bolts into rib support arm 25 is impossible due to space limitations. In certain situations, the mine roof and rib support device 10, including a C-channel support member 15, may be capable of bearing larger loads than that of similarly bent reinforced T-channel products. Also, a nesting C-channel bearing plate 75 provides two times the strength of using a flat bearing plate 75a alone, according to the present invention.

[0025] What has been described above includes exemplary embodiments of a mine roof and rib support having a roof support arm and a rib support arm that can support both the roof and rib of the mine at the same time. It is, of course, not possible to describe every conceivable combination of components or methodologies for purposes of this disclosure, but one of ordinary skill in the art may recognize that further combinations and permutations are possible in light of the overall teaching of the disclosure. Accordingly, the description provided herein is intended to be illustrative only and should be considered to embrace any and all alterations, modifications, and/or variations that fall within the spirit and scope of the appended claims.

The invention claimed is:

1. A mine roof and rib support comprising:
   a support member comprising a roof support arm, a rib support arm, the roof support arm provided at an angle to the rib support arm, wherein the roof support arm defines an aperture for receiving a mine roof bolt;
   wherein the support member defines a channel having an opened side and front side surface opposite the opened side, the opened side having an opened side surface and two legs extending from the opened side surface to contact the mine roof surface and the mine rib surface.

2. The mine roof and rib support of claim 1, further comprising a curved junction portion between the roof support arm and the rib support arm.

3. The mine roof and rib support of claim 1, further comprising a bearing plate defining a through-hole, the bearing plate being positioned on the front side surface of the roof support arm, wherein the bearing plate through-hole is operatively aligned with the roof support arm aperture, and the mine roof bolt extends through the through-hole and the roof support arm aperture to compress the bearing plate against the support member.

4. The mine roof and rib support of claim 3, wherein the bearing plate comprises a C-channel bearing plate, wherein the roof support arm is nested within the C-channel bearing plate.

5. The mine roof and rib support of claim 4, further comprising a curved junction portion between the roof support arm and the rib support arm.

6. The mine roof and rib support of claim 3, wherein the bearing plate comprises a flat bearing plate.

7. The mine roof and rib support of claim 1, wherein the roof support arm defines a second aperture for receiving a second mine roof bolt.

8. The mine roof and rib support of claim 7, further comprising two bearing plates, each defining a through-hole, the bearing plates being positioned on the front side surface of the roof support arm, wherein the bearing plate through-holes are operatively aligned with the roof support arm apertures, and each mine roof bolt extends through a through-hole and a roof support arm aperture to compress the bearing plates against the support member.

9. The mine roof and rib support of claim 8, wherein at least one of the bearing plates comprises a C-channel bearing plate, wherein the roof support arm is nested within the C-channel bearing plate.

10. The mine roof and rib support of claim 8, wherein at least one of the bearing plates comprises a flat bearing plate.

11. A method of manufacturing a mine roof and rib support comprising the steps of:
   bending an elongated member defining a channel having an opened side and front surface opposite the opened side, the opened side having an opened side surface and two legs extending from the opened side surface, such that the elongated member comprises a support member having a mine roof support arm and mine rib support arm provided in an angular orientation, with the open side being on an outside of the mine roof and rib support arms and the front side surface being on an inside of the mine roof and rib support arms; and
   providing an aperture on the roof support arm.

12. The method of claim 11, wherein the step of bending comprises providing a curved junction portion between mine roof and rib support arm.

13. A method of supporting a rock formation comprising the steps of:
   positioning a support member comprising a roof support arm, a rib support arm, the roof support arm provided at an angle to the rib support arm, wherein the roof support arm defines an aperture for receiving a mine roof bolt, the support member defining a channel having an opened side and front side surface opposite the opened side, the opened side having an opened side surface and two legs extending from the opened side surface to contact the mine roof surface and the mine rib surface; and
   extending a mine roof bolt through the roof support arm aperture into engagement with the rock formation.

14. The method of claim 13, further comprising, prior to the step of positioning the support member, the step of bending the support member to provide the rib support arm at an angle to the roof support arm.

15. The method of claim 14, wherein the step of bending comprises providing a curved junction portion between mine roof and rib support arm.

16. The method of claim 13, further comprising the steps of:
   positioning a bearing plate defining a through-hole there-through against the roof support arm; and
   aligning the through-hole with the roof support arm aperture, wherein the step of extending the mine roof bolt through the roof support arm comprises extending the mine roof bolt through the through-hole and the roof support arm aperture.

17. The method of claim 16, wherein the step of positioning the bearing plate comprises nesting the roof support arm within a C-channel plate.
18. The method of claim 16, further comprising the step of compressing the bearing plate against the roof support arm.

19. The method of claim 18, wherein the step of compressing the bearing plate comprises torquing the mine roof bolt against the bearing plate.

20. The method of claim 16, further comprising the step of positioning a second bearing plate defining a through-hole therethrough against the roof support arm; aligning the second bearing plate through-hole with a second roof support arm aperture defined in the roof support arm; and extending a second mine roof bolt through the second roof support arm aperture into engagement with the rock formation.

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