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MINE ROOF EXPANSION SHELL
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1 Claim. (Cl. 85—2.4)

This invention relates to mine roof expansion bolts and more particularly to an improvement providing for varying the degree of expansion of the expanding shell thereof to accommodate rock strata of varying hardness.

To provide support for mine roofs, it is common practice to drill a plurality of holes upwardly into the rock strata above the roof to a depth or height sufficient to reach and extend into a layer of hard rock strata, the depth being sufficient to receive an expansion sleeve within the hard layer. Thereafter an elongated bolt having an expansion sleeve on the end is inserted into the hole to a depth to locate the sleeve within the hard rock layer. Thereafter the sleeve is expanded and the head of the bolt acting through a plate, bears against the mine roof to draw the layers of the rock formation together and to provide support. The length of such bolts may vary considerably in order to reach the hard rock strata. In some cases there may be a strata of softer rock which is at a sufficient distance above the roof of the mine to provide adequate support without drilling further to locate a harder strata. Such softer strata may be adequate to provide the necessary support, providing the expansion sleeve is adapted to expand to a greater extent than the normal expansion sleeve which would be used in the hard rock strata. In some instances the height of the mine roof above the mine floor may be so low as to restrict the depth that can be drilled, and provide the use of mine bolts of a length to reach hard strata, and in such cases an expansion sleeve capable of holding in softer strata would be desired.

The present invention is directed to an expansion sleeve and an expanding or booster element which may be used in conjunction with such a sleeve so that the expansion sleeve may be expanded to a substantially greater degree than would normally be possible without the element. By using such sleeves with the expansion element, a standard expansion sleeve designed for hard rock, may be readily adapted to accommodate a strata of soft rock. Where the strata of softer rock is sufficiently distant above the roof of an expansion sleeve which will hold in such soft strata, may be used in combination with a bolt shorter than that required to reach hard strata, and still provide adequate mine roof support. Thus a considerable saving in bolt length may result. Also the cost of drilling the hole is reduced, because of the reduced depth. The element employed for providing increased expanding effect of the expansion sleeve is in the form of a booster plate formed of heavy sheet metal, such as 14-gauge steel, the booster plate being in the form of a V in order to provide divergent plates adapted for location between the opposite expanding wedge surfaces. Such a booster plate is adapted for use in expansion shells of the type disclosed in Patent 2,753,750 granted July 10, 1956, wherein a wedge with opposed inclined wedging surfaces co-acts with a shell composed of two opposed half sleeves having complementary wedge surfaces. The booster plate is provided with detents to assure a proper central location of the divergent plate portions between the wedge surfaces of the wedge member and shell half sleeves, and provision is further made to assure equal movement of the plate portions. The booster is so constructed as to be readily formed from sheet metal economically, and may be readily inserted into a standard expansion shell assembly at the time the need therefor arises.

The above and other novel features of the invention will appear more fully hereinafter from the following detailed description when taken in conjunction with the accompanying drawings. It is expressly understood that the drawings are employed for purpuses of illustration only and are not designed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawings wherein like reference characters indicate like parts:

FIGURE 1 is a front elevational view of one side of the expander shell assembly in unexpanded position.
FIGURE 2 is a side elevational view of the expander shell assembly of FIGURE 1.
FIGURE 3 is a side elevational view of the expander shell of FIGURE 2 shown in expanded position.
FIGURE 4 is a top plan view of the expander wedge.
FIGURE 5 is a front elevational view of the expander wedge.
FIGURE 6 is an inside elevational view of one of the shell half sleeves.
FIGURE 7 is a plan view of the booster element before forming to a V member; and
FIGURE 8 is a perspective view of the booster element ready for insertion in an expansion shell assembly.

Referring to FIGURES 1 and 2, there is shown an expansion shell 20 comprising half sleeve segments 22 and 24. Each of the segments have a plurality of exterior arcuate saw tooth grooves 26 for gripping rock strata, and one of which grooves may have a plurality of circumferentially spaced teeth 28 to resist initial rotation. The lower portion of each shell is provided with a plurality of length-wise extending grooves 30, to resist rotation, and the lower end of each shell segment is provided with an arcuate saw tooth skirt 32 having circumferential teeth 34 formed therein.

Each of the shell elements is provided with an inclined wedge surface 36, as more particularly shown in FIG. 6 and each segment is hollow as at 38 to provide clearance for a mine rock bolt 40.

In order to expand the shell elements there is provided a wedge member 42 which is generally cylindrical and the diameter of which corresponds to the overall diameter of the shell assembly prior to expansion. The wedge element has a threaded aperture in the upper end as at 44 to receive the upper threaded end 46 of the bolt 40. The wedge member has opposed planar wedge faces 48 and 50 which are inclined at the same angle as the wedge faces 36 of the shell elements.

The shell elements are secured together by a U-strap 51. The ends of the U-strap are perforated and secured to the respective shell members upon bosses 52 which are riveted over. The ends of the straps lie in grooves 54 in the upper end of the shell members and the walls of such grooves may be peened over the strap ends as is indicated at 55. The upper end of the strap may have a shallow V portion 56, the central portion 58 of which is designed to initially engage the end of the bolt 40 when expansion of the assembly is to be effected. The wedge member is provided with shallow grooves 60 on each side to provide clearance for the depending ends 62 of the strap 51.

It will be understood that the shell assembly parts thus far described are adapted to co-act with one another to provide substantial lateral expansion of the shell elements 22 and 24 when the wedge member is drawn downwardly between the shell elements by the threaded movement of the main bolt and the engagement of the end thereof with the strap 50.

To increase the lateral expansion substantially over and above that capable of being attained by the shell assembly parts thus far described, there is provided a booster element 70 which may be formed from sheet steel of such gauge as will provide the desired booster effect. The booster element may be stamped from strip stock of the
width indicated at either end 52 and 74 of the blank shown at FIGURE 7. Each end of the strip stock, which is of a suitable length as indicated, is rounded as at 76 and provided with a notch 76 to provide clearance for the strap 50. The central section of the blank is provided with an elongated aperture 89 providing side arms 82 and 84 which are spread apart centrally as at 86 to provide clearance for a bolt of the diameter such as the bolt 40. Inwardly of each end lips 88 and 90 are struck from the blank. The blank after thus being formed is bent into a V shape as indicated at FIGURE 8 with the lips 88 and 90 projecting outwardly, to provide inclined plate portions 92 and 94 which are adapted to be located between the wedge faces 48 of the wedge member and the wedge faces 36 of the shell elements.

As shown in FIGURE 2, the booster element is located in position between the wedge member and the shell elements, the wedge member and shell elements being in an expanded position. It will be seen that the lips 88 and 90 are disposed above the upper ends 96 and 98 of the shell elements, so that as the wedge member is drawn downwardly to expand the shell elements the lips 88 and 90 will first engage the upper ends 96 and 88 of the shell elements and thereafter retard or delay the downward movement of the booster element in respect to the shell elements 22 and 24. As the wedge member is drawn further downwardly within the booster member which member is temporarily arrested in its movement by the lips, the plate portions 92 and 94 of the booster element are expanded and the lower end of the wedge member moves downward into the loop portions 100 of the booster member. Each lower end of the wedge member is provided with sharp projections 102 and 104 which upon further relative movement between the element and booster member move into engagement with the respective loops 100 of the booster member. When such engagement occurs equal movement downward of the plates 92 and 94 of the booster member is assured since the projections 102 and 104 dig into the loops 100 to prevent unequalized movement of the plates 92 and 94. Further movement of the wedge member forces the booster member downward into the shell elements 22 and 24 and such movement results in the deformation of the lips 88 and 90, the lips 88 and 90 being bent back into the recesses 106 and 108 from which the lips were struck as is indicated in FIGURE 3. Thereafter further expansion of the shell members to the maximum desired width as indicated in FIGURE 3 is affected by the further threading of the bolt 40 into the wedge member, with the end of the bolt bearing against the strap member, as shown in FIGURE 3.

It will be appreciated that when an assembly as shown in FIGURE 1 is inserted up into a drilled hole and extended into rock strata where the assembly is to be expanded, the bolt is rotated to draw the wedge 42 into the shell elements and booster to create expansion, the end of the bolt abutting the strap 51. Initially the hole is of such diameter as to provide resistance to rotation of the shell by reason of the teeth 38 engaging the hole wall. Initial engagement may result by reason of the fact the hole is not bored straight, or by introducing a slight bend in the bolt, to cause the shell to bear against the side of the hole wall. Once the shell commences to expand, all of the teeth dig into the bore and thereafter positively prevent rotation of the shell. Thereafter the bolt 40 is rotated to the extent necessary to draw the wedge 42 well into the shell to expand the shell sufficiently into the strata to provide a firm hold. The bolt proceeds upwardly into the hole to draw a plate up against the mine roof, and once the plate is bearing against the mine roof further rotation of the bolt tends to further expand the shell and draw the rock formation under compression to provide maximum support.

The use of the booster results in an expansion which provides a grip within the bore which has been found to be much greater in load supporting ability. The booster quickly converts a standard expansion device from one which would only provide an effective hold in hard rock strata, to one which provides an effective hold in strata of much less density and hardness. By having boosters available formed of different thicknesses of sheet metal, any desired expansion may be had, to satisfy the requirement as indicated by the hardness of the rock during drilling.

It will be seen that a standard expansion sleeve assembly may be quickly fitted with a booster of metal of such thickness as may be indicated to be required by the feel of the rock strata during the drilling. Thus a standard shell assembly, with a supply of boosters, may be quickly adapted for use in rock of widely varying hardness. As previously set forth, the use of boosters to provide greater expansion, in many instances renders it unnecessary to drill holes to a depth sufficient to strike hard rock, since the holding power of the expander assembly may be increased sufficiently to provide adequate holding power in softer rock. Also it becomes possible to employ expanders in shallow mines, where the depth of the hole and the length of the bolts that can be used are limited by the shallow height of the mine roof. Thus great savings both in drilling time, and in the cost of bolts, which may be substantially shortened in many instances results, and the expander shell, whether equipped with the booster or otherwise, has the same overall diameter, prior to expansion, so that the holes drilled, may be of uniform diameter. It will be apparent that to obtain increased holding power without the booster, would require expander assemblies of greater initial diameter and hence the hole drilled would have to be larger. Since the nature of the strata is not necessarily known prior to drilling, it would be impractical to attempt to determine or predict before hand the hole diameter to accommodate expander assemblies of different diameters. The advantages of being able to use an expander of a standard diameter, readily adapted to accommodate a wide variety of rock strata, with requisite holding power, will thus be readily apparent.

While only one form of the invention has been illustrated and described, it is to be understood that the invention is not limited thereto. That various changes may be made without departing from the spirit of the invention, as will be apparent to those skilled in the art, reference will be had to the appended claim for a definition of the limits of the invention.

I claim:

A mine roof expansion bolt assembly comprising an expandable anchoring shell comprising a pair of shell elements each comprising a longitudinally tapering segment of a hollow cylinder, said elements having exterior rock engaging segments, and interior planar wedge expanding surfaces, an inverted U strap having depending ends secured exteriorly to the narrow end of each of said segments, a wedge member having an axially threaded aperture and wedge faces complementary to the shell element surfaces and having opposed notches embracing the ends of said U strap, and a V shaped member having two diverging plate portions interposed between each wedge face and its complementary element wedge expanding surfaces, said V member having a central elongated aperture extending into each of the plate portions to a point at least midway of the length of the plate portions, and in alignment with the threaded aperture of said wedge member, and of sufficient size to receive a bolt extending therethrough and threaded in said wedge member, said V member having notches in its divergent ends of said plate portions embracing the ends of said U straps, said V member having lips struck outwardly adjacent the divergent ends spaced from and adapted to engage the upper ends of said shell elements to retard movement of said
plate portions relative to said shell elements during initial expansion caused by said wedge member being drawn into said shell elements, said V member having its plane portions joined by spaced central loop portions, said wedge member having lower side edges spaced from said loop portions, relatively sharp projections extending downwardly from the lower side edges of said wedge member and lying in the median plane of said wedge faces and adapted to engage the central loop portions of said V member on opposite sides of the aperture therein to enforce equal movement of the plate portions with the wedge member within the faces of said shell elements.

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