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EXPANSION SHELL WITH CONVEYING PLANAR SURFACES
IN PLANES FORMING A DIHEDRAL
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3,221,590

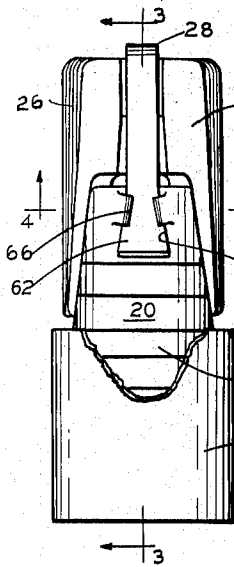


FIG. 1

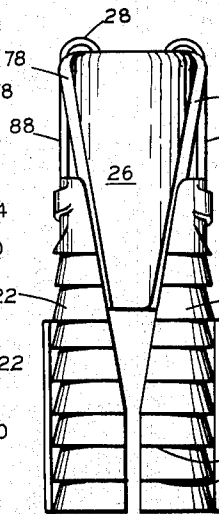


FIG. 2

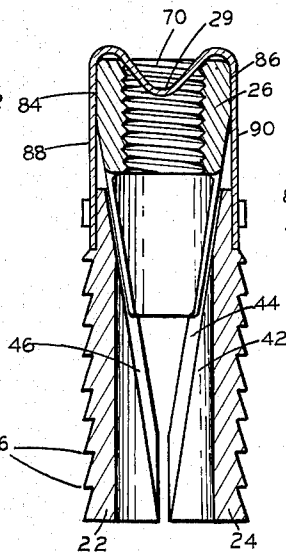


FIG. 3

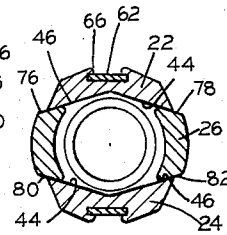


FIG. 4

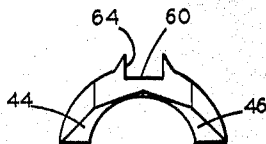


FIG. 6

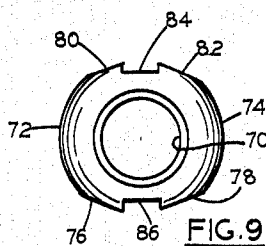


FIG. 9

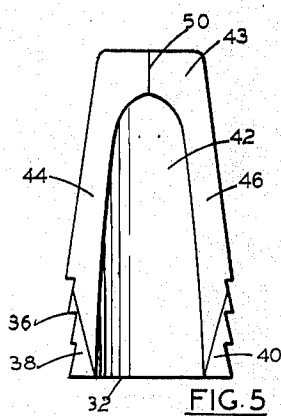


FIG. 5

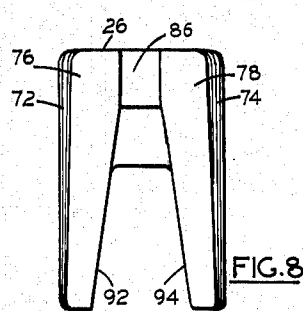


FIG. 8

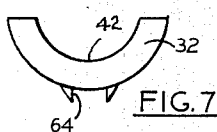


FIG. 7

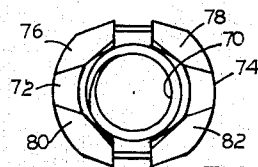


FIG. 10

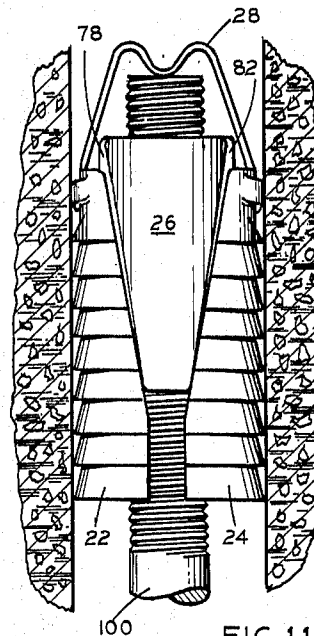


FIG. 11

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EXPANSION SHELL WITH CONVERGING PLANAR SURFACES IN PLANES FORMING A DIHEDRAL

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3 Claims. (Cl. 85-76)

This invention relates to expansion shells for use with mine roof bolts for the purpose of placing the mine roof rock strata under compression to provide a rock strata roof support bridge.

In using mine roof bolts for mine roof support and for similar purposes, the rock strata is bored to a suitable depth as determined by the rock formation, it being desirable to bore to a depth sufficient to include in the strata a relative thick layer of relatively hard rock. In boring, sections of the bore may deviate somewhat, and variations in diameter and other irregularities occur, and in inserting an expansion shell assembly into the bore, there may be a tendency for the shell to shift laterally or become somewhat disaligned from the general axis of the bore and the bolt. Such action may be due to deviations in the bore, or soft spots or irregularities in the bore at the particular location where expansion of a shell is contemplated. As the shell segments are expanded away from the bolt, the guiding effect of the bolt, to hold the segments in line with the bolt is gradually lost. Expansion shells of the type shown in Dempsey 2,753,750, wherein the wedge faces are formed on two diverging planes only, may allow the shell segments to shift laterally or become askew with reference to the wedge and the axis thereof as held by the bolt, with the result that the interengaging wedging surfaces between the wedge and shell segments may become seriously out of alignment, with resulting loss in holding power.

The present invention is directed to an expansion shell wherein the wedge and shell segment engaging faces have engaging surfaces that are angularly disposed, whereby the shell segments cannot slide or twist laterally with respect to the wedge. More particularly each of the shell segments have wedge engaging surfaces which are inclined about 7 degrees from the axis of the shell, and approximately 70 degrees from the plane of symmetry of the individual segments. The wedge engaging surfaces are portions of two planes forming a dihedral, the intersection line of which lies at approximately 7 degrees from the axis of the shell, and one plane of which is at an angle of 140 degrees from the other plane. The wedge is provided with four surfaces arranged on angles corresponding to the angles of the surfaces of the mating shell segments. By such an arrangement, the shell segments have an inwardly facing channel like contour, which embraces the wedge, and forces the parts to retain their alignment when the wedging action is applied. Furthermore the shell segments are precluded from becoming disassociated from the wedge, and becoming lost in the field, when held contracted around the wedge by a temporary band applied to the skirt portions of the shell segments.

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 purposes 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:

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FIGURE 1 is an elevational view of the expansion shell, with a removable band partly broken away;

FIGURE 2 is a side elevational view of the shell with the band shown in section;

FIGURE 3 is a sectional view taken on the line 3-3 of FIGURE 1;

FIGURE 4 is a transverse sectional view taken on the line 4-4 of FIGURE 1;

FIGURE 5 is an inside view of one shell segment;

FIGURE 6 is an upper end view of the segment;

FIGURE 7 is a lower end view of the segment;

FIGURE 8 is an elevational view of the wedge;

FIGURE 9 is an upper end view of the wedge;

FIGURE 10 is a lower end view of the wedge; and

FIGURE 11 is a view similar to FIGURE 2 with the shell expanded within a rock strata bore, and with an expanding bolt in place.

Referring to the drawings, there is shown an expansion shell having a two part shell, 20, the segments 22 and 24 of which are identical, an expanding wedge 26, and a strap 28 of semi-spring steel connecting the segments. In FIGURES 1 and 2, the expansion shell is shown in contracted form, with a plastic band 30 disposed about the lower end, to hold the shell segments in a confining relation with respect to the wedge 26 so that the parts cannot become disassociated from one another. It will be understood that when the expansion shell is prepared for use, the band is removed as by sliding the same axially from the end of the shell.

Each of the segments 22 and 24 are symmetrical about an axial lengthwise plane, and have a substantially planar semi-annular end wall at their lower ends as at 32. The outer wall is generally cylindrical, except that is provided with a plurality of arcuate rock gripping teeth 36 spaced uniformly along the length except at the upper end.

The lower end of each segment has inwardly facing surfaces 38 and 40 lying in a common plane, extending parallel, with but offset slightly from the plane of the axis of the sleeve. The inside wall of each segment is cylindrical as at 42, and extends from the lower end upwardly toward a region adjacent the upper end where the cylindrical surface yields to the upper end of the wedge engaging surfaces 44 and 46. Each of the surfaces 44 and 46 are planar, and are inclined outwardly away from the plane of the surfaces 38 and 40, and are disposed at an angle with respect to each other, so that the planes of the surfaces 44 and 46 are those of a dihedral, the line of intersection 50 of which extends at an angle approximately seven degrees from the axis of the assembled shell. The angle between the planes of the surfaces 44 and 46 of the dihedral is approximately 140 degrees, and are each about 70 degrees from the plane of symmetry of each segment. It will be seen that the internal cylindrical surface 42 referred to is bounded by the planar portions 44 and 46 of the dihedral referred to. The upper end of the cylindrical surface 42 terminates at the upper end, as at 43, where the 7 degree line of intersection of the planes forming the dihedral appears at 50.

It will be understood that the upper end of each segment thus thins out somewhat, and in order to avoid undue loss of strength, the arcuate external teeth are discontinued in this region. The exterior of the upper end of each segment, is provided with a dovetail recess 60 in its outer surface to receive the dovetail end 62 of the strap 28. The dovetail ends of the strap are seated in the two recesses of the segments, and the side wall portions 64 of the recesses are swaged over to rigidly hold the strap end in place as at 66.

The wedge member has a central threaded bore 70, to receive the threaded end of a bolt, and opposed cylindrical outer surfaces 72 and 74 between which are opposed camming surfaces 76 and 78, and 80 and 82. Each of the

surfaces 76 and 78 are planar, and lie in the planes of a dihedral whose intersection is inclined to the bore axis by about 7 degrees. Likewise surfaces 80 and 82 lie in the plane of a dihedral whose intersection is inclined to the bore axis at about 7 degrees. The wedge is symmetrical about planes at right angles to each other, and one of which is common to the axis of the wedge and the dihedral plane intersections, and the surfaces 76 and 78, and the surfaces 80 and 82 lie at angles approximately 70 degrees from such plane.

The wedge member at its upper end is provided with flat bottom grooves 84 and 86 to loosely embrace the legs 88 and 90 of the strap member. As can be seen from FIGURE 8, the threaded aperture portion of the wedge extends a little less than half way down from the upper end of the wedge, and the lower end of the wedge comprises spaced legs as at 92 and 94, and the internal surfaces 96 and 98 of such legs are approximately cylindrical, and of a radius to clear the shank of a bolt.

As may best appear in FIGURE 2, and also FIGURE 4, it will be seen that the inclined camming surfaces 46 and 44 of each of the shell segments 22 and 24 embrace the camming surfaces 76 and 78, and 80 and 82 of the wedge, and with the band 30 in place, which holds the segments in contracted position, the wedge cannot escape from the shell, nor can the shell become separated from the wedge. The assembly as shown in FIGURES 1 and 2 may be taken to the vicinity of use, with a bolt of suitable length threaded part way into the wedge but not so far as to contact the V 29 of the strap. Immediately prior to insertion of the expansion shell into a bore prepared in rock strata, the band is removed as by sliding downwardly from the shell, at which time the lower ends of the shell segments are sprung apart, bending the strap 28 as necessary, unless the strap has already been suitably sprung, sufficiently to yieldingly urge the lower ends of the segments apart. In such case, it will be understood that the band prior to removal, held the segments approximately in the position shown in FIGURE 2, against the yielding urge of the strap 28, which is of semi-spring stock.

As the shell with its bolt 100 is forced into the rock strata aperture, the upper ends of the segments 22 and 24 are held by the strap 28 at about the same spacing as shown in FIGURE 2, but the lower ends of the segments are splayed apart by the resiliency of the strap, so that as the assembly is shoved into the aperture, the lower ends of the segments are contracted by the rock strata aperture, against the urge of the strap 28. Thus the assembly is easily inserted into the rock strata bore, and readily forced upward into the bore to the depth desired. In addition the shell will not readily drop out of a vertical bore, because of the tendency of the lower ends of the segments to dig into the bore wall.

Due to the spreading effect of the strap upon the lower ends of the segments, sufficient friction between the segments and strata bore exists, such that when the shell is in expanding position, the threading of the bolt further into the bore of the wedge, so as to engage the strap at 29 is facilitated, since the shell frictionally resists rotation by its resilient engagement with the bore wall. As soon as the bolt end engages the strap, the wedge commences to be driven downwardly between the shell segments to expand the segments into bore wall engagement. Under the downward thrust upon the wedge, the central loop of the strap may be deformed somewhat upwardly. However the head end of the bolt, at the mouth of the strata bore is at this time brought to bear against the mine roof through a suitable large bearing plate or washer. Thereafter, further threading of the bolt into the wedge draws the wedge downwardly between the shell segments, and the bolt is subjected to tension between the mine roof bearing plate and the hold of the shell segments upon the bore wall. Further tightening of the bolt increases the grip of the shell, by further expansion of the shell segments, as indicated in FIGURE 11, and increases the tension on the bolt, thereby placing the rock strata between

the bolt head and shell in compression to the extent as desired.

During the procedure described, the wedge, because of the inter engagement of the inclined wedging surfaces with the mating surfaces of the segments, is confined against lateral movement with respect to the segments. As indicated in FIGURE 11, when the wedge is drawn to a position such as to create considerable expansion, the wedge surfaces thereof mate substantially completely with the segment surfaces 44 and 46, and the dihedral angles of the planes thereof maintains the wedge in respect to the segments in centered and aligned position. Thus the wedge cannot shift laterally with respect to the segments nor can the segments shift laterally with respect to the wedge, and uniform holding power will always be had.

It will thus appear that the inclined surfaces, with their angular relation of about 140 degrees, serves the dual function of maintaining the assembly parts from becoming separated, when the band 30 is in place, and when removed, and the assembly inserted into the strata bore, the same surfaces assure proper alignment between segments and wedge. When the segments are spread away from the bolt, there no longer exists an embracing relation between the semi-cylindrical wall 42 of the segments and the bolt, that would tend to preserve alignment. The inclined wedging surfaces serve to preserve such alignment, at all stages of expansion.

While one specific form of the invention has been illustrated and described and certain angles referred to, it is to be understood that the invention is not limited thereto. As various changes in the construction and arrangement 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 claims for a definition of the limits of the invention.

What is claimed is:

1. A mine roof bolt expansion shell assembly comprising a pair of opposed shell segments, a wedge member disposed therebetween and having a threaded aperture to receive a bolt, each of said segments being shaped as a longitudinally tapering segment of a hollow cylinder and being symmetrical about an axial plane passing through the axis of the assembly, and each having planar side edge surfaces extending substantially the entire length of the segments converging at the upper end and lying in the planes of a dihedral, the intersection line of which is inclined upwardly and away from the axis of the assembly at an angle in the order of seven degrees, and the planes of said surfaces lying at angles to the plane of symmetry in the order of seventy degrees, said wedge member having four planar surfaces adapted to mate with said edge surfaces of said segments, and being substantially symmetrical about said axial plane and a second axial plane at right angles thereto, said surfaces lying in planes converging downwardly toward said second axial plane at an angle in the order of seven degrees, and converging laterally from said first axial plane toward the second axial plane at an angle in the order of twenty degrees, and an inverted U shaped spring strap connecting the upper ends of said segments and tending to spread the lower ends of said segments, and said wedge member having opposed side notches disposed between the planar surfaces to receive the side arms of said strap.

2. A mine roof bolt expansion shell assembly comprising a pair of opposed shell segments, a wedge member disposed therebetween and having a threaded aperture to receive a bolt each of said segments being shaped as a longitudinally tapering segment of a hollow cylinder and being symmetrical about an axial plane passing through the axis of the assembly, and each having planar side edge surfaces extending substantially the entire length of the segments converging at the upper end and lying in the planes of a dihedral, the intersection line of which is inclined upwardly and away from the axis of

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the assembly at an angle in the order of seven degrees, and the planes of said surfaces lying at angles to the plane of symmetry in the order of seventy degrees, said wedge member having four planar surfaces adapted to mate with said edge surfaces of said segments, and being substantially symmetrical about said axial plane and a second axial plane at right angles thereto, said surfaces lying in planes converging downwardly toward said second axial plane at an angle in the order of seven degrees, and converging laterally from said first axial plane toward the second axial plane at an angle in the order of twenty degrees, and resilient means connecting the upper ends of said segments.

3. A mine roof bolt expansion shell assembly comprising a pair of opposed shell segments, a wedge member disposed therebetween and having a threaded aperture to receive a bolt each of said segments being shaped as a longitudinally tapering segment of a hollow cylinder and being symmetrical about an axial plane passing through the axis of the assembly, and each having planar side edge surfaces extending substantially the entire length of the segments converging at the upper end and lying in the planes of a dihedral, the intersection line of

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which is inclined upwardly and away from the axis of the assembly at an angle in the order of seven degrees, and the planes of said surfaces lying at angles to the plane of symmetry in the order of seventy degrees, said wedge member having four planar surfaces adapted to mate with said edge surfaces of said segments, and being substantially symmetrical about said axial plane and a second axial plane at right angles thereto, said surfaces lying in planes converging downwardly toward said second axial plane at an angle in the order of seven degrees, and converging laterally from said first axial plane toward the second axial plane at an angle in the order of twenty degrees.

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EDWARD C. ALLEN, *Primary Examiner.*