May 10, 1966 N. H. SIEGEL 3,250,170

EXPANSION SHELL

Filed March 9, 1964

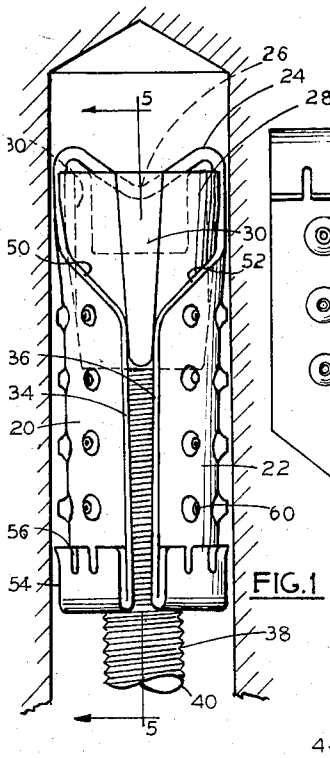

FIG. 1

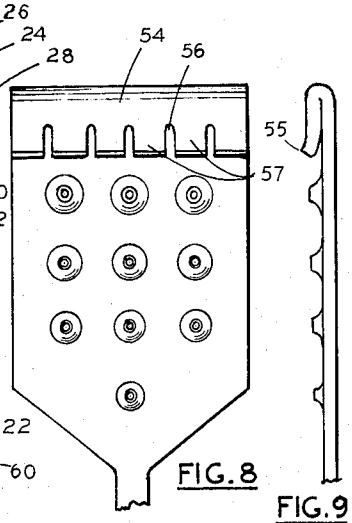

FIG. 8

FIG. 9

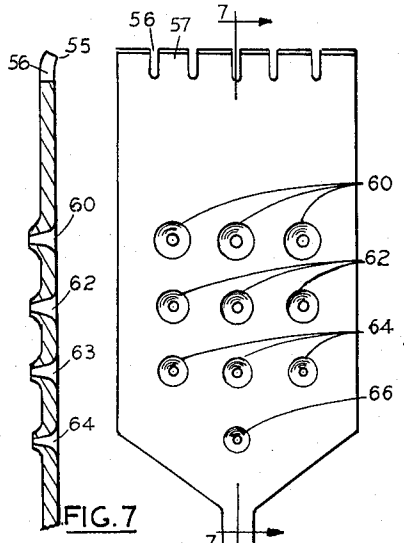

FIG. 7

FIG. 6

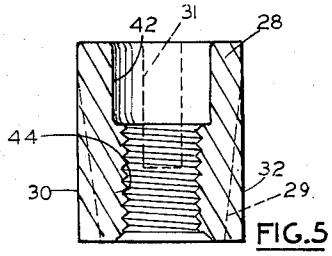

FIG. 5

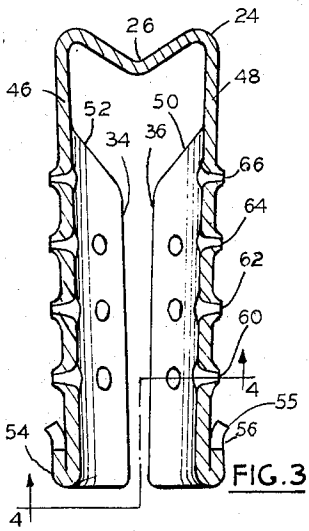

FIG. 3

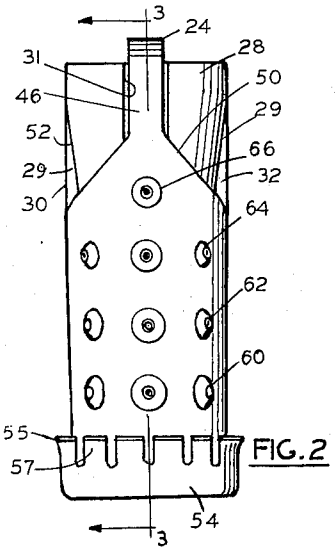

FIG. 2

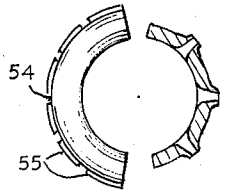

FIG. 4

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EXPANSION SHELL

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This invention relates to expansion shells adapted for mine roof support and the like, and more particularly to a shell formed from heavy sheet metal.

The use of expansion shells and bolts for insertion into mine roof bores to provide roof support from the rock strata lying there above is well known. In the support of a mine roof by roof bolts and expansion shells, the frequency of spacing between adjacent bolts to assure adequate support results in the use of substantially large quantities of such shells. Heretofore, the materials from which such shells have been formed, for the most part, has been malleable iron castings due to the non-uniform thickness and contour of the shell parts to provide a suitable wedging action. It will be appreciated that the holding power of such shells, when expanded and anchored in the rock stratta should equal or exceed the tensile strength of the bolts used, and that any attempt to provide a shell formed of sheet metal or substitute material should match or exceed the holding power of the malleable casting types, since the bolt employed should carry its full load and is a costly item, and the formation of bores in the rock to receive the expansion shells is also a costly operation.

The present invention is directed to the formation of an expansion shell from hot rolled heavy uniform gage steel coils, in a series of steps adapted for rapid punch press and forming operations, the form of the shell being peculiarly adapted to progressive forming operations. The invention is further directed to the form of the shell so produced, such that the shell in use will provide the same ease of use as that associated with the malleable casting type, and provide holding power, when expanded and anchored in position, equal to or above that of the malleable cast type. Further the invention is directed to the formation of a shell wherein a wedging effect is achieved, though the shell is made from sheet metal of uniform thickness. The invention is also directed to producing such shells at a cost well below the cost of the equivalent malleable cast shells so that economy in the use of substantial quantities of such shells will result.

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:

FIGURE 1 is a front elevational view of the shell and wedge assembly before expansion and shown in a mine roof bore;

FIGURE 2 is a side elevational view of the shell and wedge;

FIGURE 3 is a longitudinal section of the shell only taken substantially on the line 3—3 of FIGURE 2;

FIGURE 4 is an end view partly in section taken on the broken line 4—4;

FIGURE 5 is a sectional view through the wedge, and taken on the line 5—5 of FIGURE 1;

FIGURE 6 is a blank from which the shell is made with extrusions punched therein;

FIGURE 7 is a fragmentary sectional view taken on the line 7—7 of FIGURE 6;

FIGURE 8 is a fragmentary view of one end of the blank, with the end folded over to form a cuff; and

FIGURE 9 is a fragmentary edge view of FIGURE 8.

Referring to the drawings there is shown a one piece heavy gage sheet metal shell comprising arcuate and somewhat cylindrical segments **20** and **22** joined at one end by a U strap **24**, having a bolt end engaging V disposed centrally thereof as at **26**. Within the shell is a wedge **29** having a conical wedging surface **29** and preferably tapered wings **30** and **32** adapted to ride down between the edges **34** and **36** of the respective shell segments **20** and **22**. The wedge **28** is provided with a central aperture, the upper portion of which is enlarged as at **42** and the lower portion of which is threaded as at **44** to receive the threaded end **38** of a mine roof bolt **40**. The strap **24** has substantially parallel portions **46** and **48** of uniform cross section merging with the tapering upper edge portions **50** and **52** of the segment portions **20** and **22**, and the wedge is provided with grooves **31** adapted to loosely embrace the strap portions **46** and **48**.

Each of the segments is provided with an outer upwardly turned integral arcuate cuff **54**, the upper edge of which is sliced as at **56** to form segments **57**, thus providing a segmental castellated effect. The upper edges of such segments are bent outwardly to provide gripping edges or teeth **55**. Each of the segments is provided with a plurality of crater like extrusions punched outwardly from the metal, the extrusions being slightly graduated, so as to reduce in radial height from the cuff upwardly, the extrusions **60** being of greater height than the extrusions **62**, **64** and **66** which are of gradually lesser height. In practice, three lengthwise rows of extrusions may be employed, and the center row of each shell may have four such extrusions, while the side rows may have three such extrusions. The lower extrusions **60** of each row may be arranged on a circumferential arc and will be of like height, and the intermediate extrusions **62**, and **64** may also lie on circumferential arcs, and the extrusions lying on each arc will preferably be of uniform height.

The external diameter of the arcuate cuff portions will be substantially equivalent to the spacing between the outer surfaces of the parallel portions **46** and **48** of the strap **24**, so that the segments will incline somewhat inwardly toward the lower end, and the side edges **34** and **36** will provide a tapered slot into which the wedge wings **30** and **32** will ride, as the wedge is drawn downwardly into the shell. In this manner, and by reason of the gradual decrease in height of the extrusion **60**, **62**, **64** and **66**, the exterior of the shell and assembled wedge, prior to expansion will have a uniform overall diameter, and will readily slide up into a substantially cylindrical rock bore of slightly greater diameter.

In the formation of the shell, a blank of heavy gage sheet metal, as for example hot rolled pickled and oiled steel of 12 gage (0.1046 inch thick) may be formed to the shape shown in FIGURE 6. The crater like extrusions may be formed by tapering punches having an included angle of about 15 degrees. After cutting the blank and punching the crater like extrusions, the ends of the blank may be slotted as at **56** and the segments **57** thus formed may be bent slightly at the end as is indicated at **55**. The end is then turned over to form a cuff as at **54**, see FIGURES 8 and 9, following which, each end of the blank is formed over a slightly conical mandrel to provide the segments **20** and **22**. Thereafter the strap **24** is bent to the U shape shown, and the V **26** formed, so as to position the segment portions **20** and **22** opposite one another substantially as shown in FIGURE 1, it being understood that a wedge **28** is disposed

in the upper portion of the shell, with its grooves **31** embracing the portions **46** and **48** of the strap.

It will be understood that the hot rolled steel employed has a degree of resilience, as will be evidenced in the strap portion. However, in bending the strap to the shape indicated, the metal is upset, and in order to retain the shell on the wedge, the strap will be bent and the segments **20** and **22** positioned so as to embrace the wedge, substantially as shown in FIGURE 1. Thus when a bolt is threaded into the wedge, the shell will be retained in position about the wedge, and will thus be prevented from becoming lost, it being understood that it is common practice in the field to thread a bolt into an assembly, long before actual use in a mine roof bore.

The extrusions or craters, and the teeth **55** will engage the rock wall of the bore and provide initial friction to prevent rotation, when starting the wedge in its downward travel in the shell, prior to expansion of the shell into anchoring relation. The initial friction of the shell on the bore wall can be enhanced, by providing a slight bend in the bolt below the shell, or the shell segments may be sprung apart slightly, just before insertion into the bore, whereby the lower cuff and its teeth may frictionally and resiliently engage the bore wall, due to the resilience of the strap.

Once the shell assembly and bolt is positioned in the bore, the bolt is threaded further into the wedge until the bolt end engages the V bend **26** of the strap. Further threading of the bolt in the wedge provides initial downward thrust of the wedge in the shell. In this manner the shell is expanded to provide satisfactory initial grip with the bore wall. At this point the bolt head is brought to bear against a plate lying against the mine roof. Further tightening of the bolt draws the wedge further down into the shell expanding the same, and tensioning the bolt. During such operation, the V **26** of the strap may yield to permit the end of the bolt to over travel, if necessary. Further tightening of the bolt draws the wedge further into the shell increasing the anchorage and the tension upon the bolt. Such tension places the strata above the mine roof under compression.

It will be seen that by reason of the cuff **54**, the shell segments have in effect a tapering thickness, although formed of sheet metal of uniform thickness, and the thick cuff prevents any danger of the wedge being pulled out through the bottom of the shell by over tensioning of the bolt. In practice the shell with its crater like extrusions and cuff teeth has been found to provide an anchorage and holding power exceeding the tensile strength of the bolt used. The cuff provides the necessary shell thickness whereby the wedge cannot be drawn too far down into the shell, or to a position further down than is necessary to develop an anchorage commensurate with the tensile strength of the bolt.

It will be seen from the foregoing that the advantages inherent in expansion shells formed by casting to achieve the necessary contour and tapering thickness of the shell wall, are obtained by fabrication from sheet metal by ordinary sheet metal forming processes. While the arrangement of the extrusions have been described as located on lengthwise and circumferential lines, any pattern may be adopted as desired.

While a single form of the invention has been illustrated and described, it is to be understood that the invention is not limited thereto. As 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 claims for a definition of the limits of the invention.

What is claimed is:

1. An expansion shell assembly for mine roof bolts and the like comprising a shell formed from a single piece of heavy substantially uniformly thick sheet metal and in which the shell comprises a pair of like opposed arcuate shell elements defining a substantially cylindrical configuration connected by a generally U-shaped strap at one end, and in which each of the shell segments is provided at its free end with a portion being folded to adjacently superimpose a limited extent of the outer surface of the remaining portion of said segment, thereby defining an outer cuff at said free end, said cuff being longitudinally slotted at its free end to form a plurality of segment teeth with the ends of said teeth being outwardly bent to provide rock gripping tooth edges at its lower end and a plurality of substantially conically crater-like radially outwardly projecting rock engaging protrusions disposed circumferentially and lengthwise over the shell outer surface between the cuff and strap of each shell segment, said shell segments having side edges tapering away from one another from the cuff to the strap ends thereof to provide opposed tapering slots, and a conical wedge having a threaded aperture therein to receive a mine roof bolt, disposed between the connected ends of said shell segments and the U strap with the smaller end of said wedge being received by said segments, and opposed grooves on said wedge loosely embracing said U strap.

2. The expansion shell assembly set forth in claim **1** wherein the radial height of said extrusions gradually decreasing from the cuff end to the opposite end thereof.

3. The expansion shell assembly set forth in claim **1** wherein the said wedge includes opposed wings disposed in said slots, wherein the side surfaces of said wings are tapered to correspond to the tapered slots.

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