

July 10, 1956

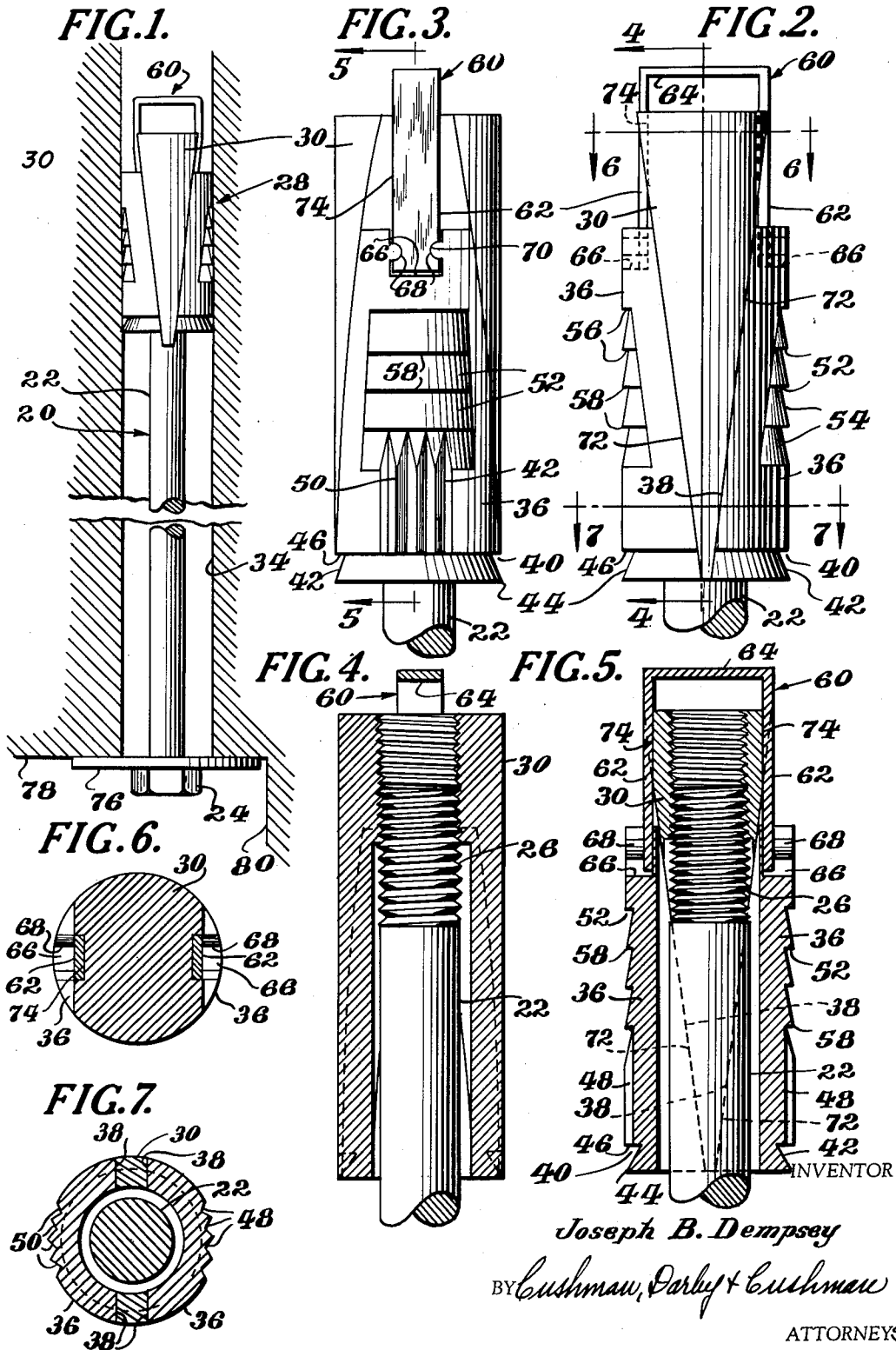
J. B. DEMPSEY

2,753,750

EXPANDIBLE MINE ROOF BOLT HAVING CONTINUOUS WEDGING ENGAGEMENT

Original Filed Dec. 9, 1952

2 Sheets-Sheet 1



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FIG. 8.

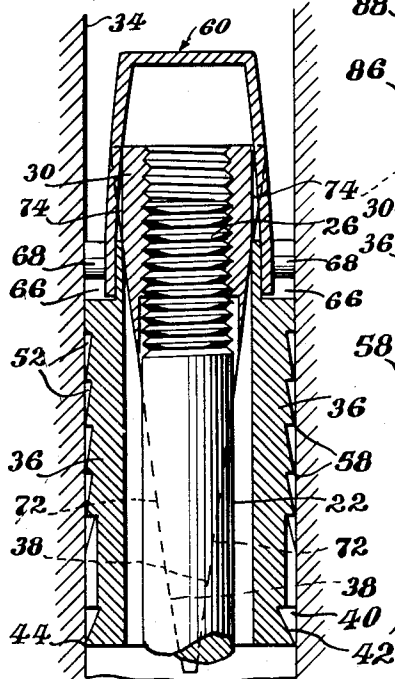


FIG. 9.

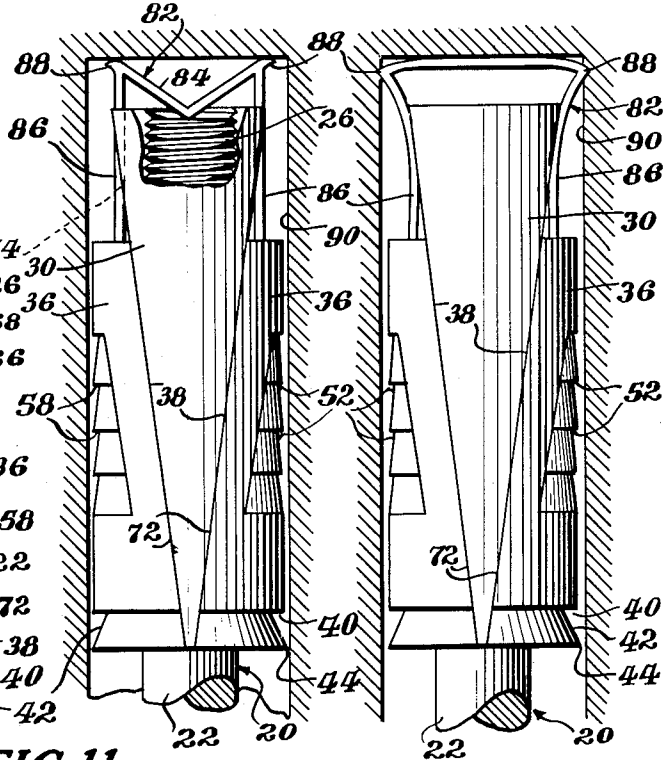


FIG. 10.

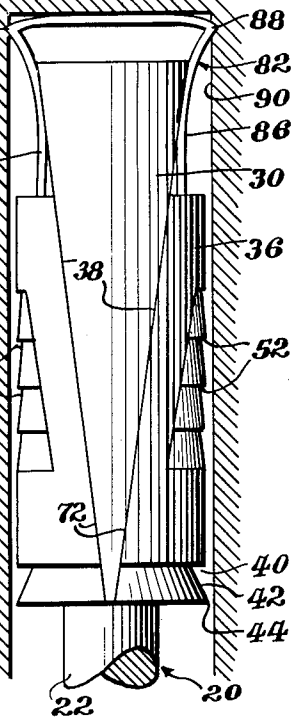


FIG. 11.

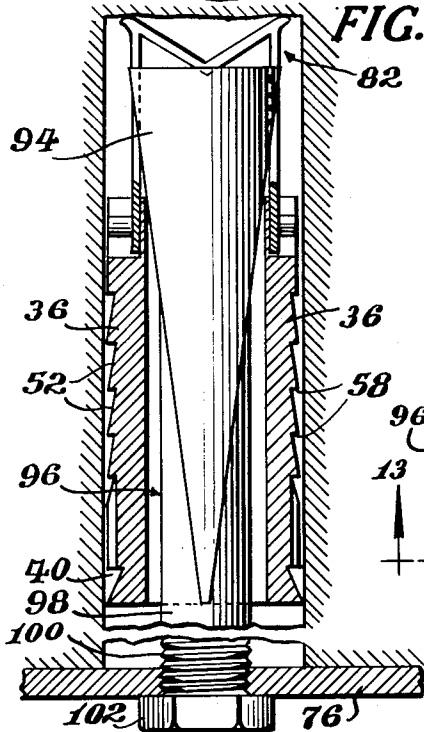


FIG. 12.

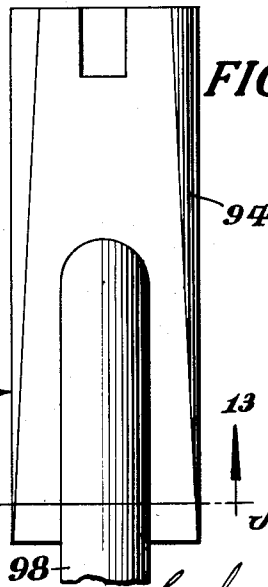
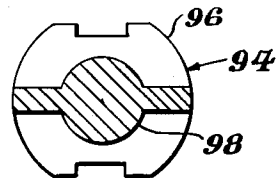


FIG. 13.



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EXPANDIBLE MINE ROOF BOLT HAVING CONTINUOUS WEDGING ENGAGEMENT

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Continuation of application Serial No. 324,910, December 9, 1952. This application May 4, 1955, Serial No. 506,020

3 Claims. (Cl. 85—2.4)

This invention relates to a mine roof bolt, and more particularly, to an improved mine roof bolt provided with means for temporarily retaining the same within a drilled hole in a mine roof until the permanent anchoring means is actuated to lock the bolt in place. This application is a continuation of my co-pending application, Serial No. 324,910, filed December 9, 1952, now abandoned, which was a continuation in part of my application Serial No. 285,461, filed May 1, 1952, and now abandoned.

Mine roof bolts are known and usually consist of a long bolt provided with multi-part permanent anchoring means on one end thereof for retaining engagement with the side walls of the upper portion of a hole drilled in a mine roof. The anchoring means of mine roof bolts presently in use are expandible and require the use of a percussive tool to effect their expansion. Accordingly, compressed air usually is piped into the far reaches of a mine to operate an appropriate percussive tool, as well as to power a compressed air drill for drilling the necessary roof holes into which mine roof bolts are inserted. Inasmuch as the working face of a mine may be as far as five miles, or more, away from the mine entrance, the piping of compressed air from the surface becomes relatively expensive. Absent such piping, it becomes necessary to haul a portable air compressor to the working face. As is well known, air compressors of adequate power are not only bulky, but also relatively expensive.

Another problem involved in the installation of mine roof bolts resides in the fact that such bolts are inserted in a substantially vertical hole in the ceiling of a mine passageway. Bolts now in use are not provided with means for temporarily retaining the bolt in place, after it has been inserted to its full extent in the hole, and consequently must be held therein until the expandible anchoring means is expanded for permanent retention of the bolt. It is rather difficult and requires a great deal of care on the part of a laborer to manually hold the bolt in place until an appropriate tool is used to expand the expandible anchoring means. Further, because of their rather long length, mine roof bolts are quite heavy, and a falling bolt not only is dangerous to human safety, but also can damage mining equipment.

Another problem in multi-part anchoring means for mine roof bolts is that the parts may become disassembled before installation. Such disassembly involves the possible loss of a part, and recovery thereof obviously is difficult in the usual darkness of a mine.

Still another problem with mine roof bolts resides in the fact that the expandible anchoring means is usually operated by an internal wedge which exerts a tremendous expansion force. Should any portion of the anchoring means in contact with the side walls of the hole overhang either or both ends of the internal wedge, the tremendous outward force exerted by the latter will tend to fracture

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that part of the anchoring means in engagement with the side walls of the hole.

It is, therefore, an object of this invention to provide an improved mine roof bolt with means for temporarily retaining the bolt within a drilled hole in a mine roof until the permanent expandible anchoring means is expanded to lock the bolt in place.

It is another object of this invention to provide expandible anchoring means for a mine roof bolt which enables the use of a plain headed bolt having a smooth shank and a threaded end.

It is another object of this invention to provide an expandible shell for a mine roof bolt having means for preventing rotation of the shell while a bolt is threaded into a wedge nut.

It is another object of the invention to provide a multi-part expandible anchoring means for a mine roof bolt which is not readily disassembled and thereby inhibits loss of a part prior to installation.

It is another object of the invention to provide expandible anchoring means for a mine roof bolt operable by an internal wedge, no part of which means will be fractured upon expansion thereof by such wedge.

It is a further object of this invention to provide an improved mine roof bolt which not only has greater holding engagement with the side walls of a drilled hole in a mine roof but also does not require the use of a power tool for its installation in such hole.

Other objects and advantages of the invention will be apparent from the following description and accompanying drawings, in which:

Figure 1 is a fragmentary, vertical, sectional view through a drilled hole in a mine roof illustrating the installation therein of a mine roof bolt embodying this invention.

Figure 2 is an enlarged, fragmentary view of the bolt anchoring means illustrated in Figure 1 but showing the position of the parts prior to expansion of the anchoring means into engagement with the side walls of a hole.

Figure 3 is an enlarged, fragmentary, side view of the bolt anchoring means illustrated in Figure 2.

Figure 4 is a sectional view taken on line 4—4 of Figure 2.

Figure 5 is a sectional view taken on line 5—5 of Figure 3.

Figure 6 is a transverse, sectional view taken on line 6—6 of Figure 2.

Figure 7 is a transverse, sectional view taken on line 7—7 of Figure 2.

Figure 8 is an enlarged, fragmentary, vertical, sectional view of the bolt anchoring means shown in Figure 1.

Figure 9 is a view corresponding to Figure 2 but illustrating a modified form of the invention in position in a drilled hole in a mine roof before expansion of the anchoring means.

Figure 10 is a view corresponding to Figure 9 and illustrating the position of the parts after the preliminary temporary anchoring operation.

Figure 11 is a view corresponding to Figure 9 but illustrating still another modified form of the invention. Certain of the parts are shown in vertical section to illustrate details more clearly.

Figure 12 is a fragmentary, side view of the internal wedge means shown in Figure 11, and

Figure 13 is a transverse, sectional view taken on line 13—13 of Figure 12.

Referring now to the drawings, there is shown in Figures 1 to 7 a mine roof bolt embodying this invention. The bolt proper 20 has a plain smooth shank 22 having a head 24 (Figure 1) on the outer end thereof and a threaded inner end 26 for engagement with an expandible

anchoring means 28. The anchoring means 28 consists of a wedge 30 and a two-part expansible shell 32 normally circular in transverse section and of a diameter only slightly less than that of a drilled hole 34 into which the mine roof bolt is to be inserted. The expansible shell 32 has two diametrically opposed parts 36 adapted to fit on opposite sides of the bolt shank 22. Each part 36 is formed as a longitudinally-tapering segment of a cylinder with its opposite longitudinal edges 38 disposed in a common plane, thus providing a substantially V-shaped slot between the opposed edges 38 of the two parts. Preferably, these two parts 36 of the shell 32 are formed by forgings or malleable iron castings.

The shell 32 thus formed by the two parts 36 is provided, adjacent the larger ends of the parts, with a circumferential groove 40, somewhat V-shaped in radial sections, having an inwardly inclined side wall 42 which merges, at its outer edge, with the end edge 44 of the shell, so that this end edge is substantially sharp, for a reason which later will become apparent. A wall 46 disposed substantially transversely of the shell 32 forms the other side of the groove 40. Adjacent this groove 40, and intermediate the side edges 38, each shell part 36 is provided with a plurality of longitudinal serrations comprising alternate concave grooves 48 and sharp ribs 50, best shown in Figure 7. The thus serrated portion of each part 36 is spaced from its longitudinal edges 38, as best shown in Figure 2, so that the part will not be weakened adjacent such edges. Above the longitudinal serrations each part 36 is provided with a plurality of adjacent circumferential grooves 52, each terminating short of the side edges 38 to avoid weakening the same. These grooves 52 have inclined walls 54 and opposite walls 56 disposed normal to the axis of the shell 32 and facing toward the larger ends of the parts 36, thus providing a saw-toothed configuration having sharp ridges 58 in longitudinal section, as best shown in Figure 5.

The smaller ends of the two parts 36 forming the shell are connected together by a spring steel band-like connecting member 60 that is substantially U-shaped. The connecting member 60 has normally parallel legs 62 extending generally longitudinally of the shell 32 and a base 64 extending transversely of the shell. The two legs 62 of the member may be secured to the parts 36 by disposition in complementary recesses 66 in the outer surfaces of the latter having opposed ribs 68 fitting in complementary notches 70 in the opposite edges of the legs, as best shown in Figure 3. The legs 62 may be permanently secured to the parts 36, however, as by welding or other appropriate means. It will be noted that the legs 62 are spaced inwardly from the outer arcuate surfaces of the shell parts 36.

Disposed between the two parts 36 of the shell is the wedge 30 in the form of a nut having opposite wedging surfaces 72 longer than and complementary to the longitudinal side edges 38 of the shell parts. The major transverse dimension of the nut 30 in an axial plane perpendicular to its wedging surfaces 72 is greater than the maximum distance between the opposed edges 38 of the shell parts 36 in their unexpanded position, so that the nut, at its larger end, projects from between the parts. At its larger end the nut 30 is provided with diametric, longitudinal channels 74 to accommodate the legs 62 of the connecting member 60, and the top of the nut is spaced only a short distance from the base 64 of the member. The smaller end of the nut 30 may also project from between the shell parts 36 or, as shown in the drawings, terminate adjacent the end faces of the latter. The exterior surfaces of the nut 30 between its wedging surfaces 72 are arcuate in transverse section, as best shown in Figures 6 and 7, to correspond to the circular peripheral outline of the shell 32.

Since the wedging surfaces 72 of the nut 30 are longer than the longitudinal edges 38 of each of the two shell parts 36 and in the normal contracted position of these

parts the larger end of the nut projects outwardly from between the parts, when the nut is drawn downwardly between the two shell parts to expand the shell into retaining engagement with the side walls of the hole, as later explained, the side edges 38 of the shell parts are engaged throughout their entire length, and throughout the entire expansion of the shell, by the wedging surfaces 72 of the nut. Because of this construction, the shell is expanded uniformly throughout its entire length and no portions of the opposed edges 38 of the two shell parts are internally unsupported, i. e., no portions of the edges 38 overhang the ends of an internal wedge, to thereby have a tremendous bending force exerted on the parts 36 which might cause fracture thereof.

For installation of a mine roof expansion bolt embodying this invention, a washer plate 76 (Figure 1) is slipped onto the plain bolt 20 and the latter threaded for a few turns into the wedge nut 30, as shown in Figures 4 and 5. The shell parts 36 then are sprung apart at their larger ends to slightly deform the connecting member 60, and thereafter the bolt 20, together with the anchoring means 28, is inserted into the drilled hole 34 in a mine roof, as shown in Figure 1. It will be seen that the connecting member 60 prevents the shell 32 from slipping down on the bolt during this inserting operation and, in fact, carries the two parts 36 upwardly with the bolt 20 by engagement with the top of the wedge nut 30. Because of the spring effect of the member 60, the sharp end edges 44 of the shell will drag against the side walls of the hole during insertion of the mine roof bolt and thereby prevent the entire assembly, including the bolt and its anchoring means, from falling out of the hole after the shell has been inserted a sufficient distance for the aforementioned sharp edges 44 to engage against the side walls of the hole. After the mine roof bolt has been inserted to its full extent, so that the plate 76 bears against the ceiling 78 of a mine passageway 80, the head 24 of the bolt 20 is pulled downwardly somewhat to engage the wedging surfaces 72 on the nut 30 with the opposed edges 38 of the shell parts and thereby slightly expand the shell. This expansion of the shell engages the sharp vertical ribs 50 with the side walls of the hole 34 so that the shell 32, together with the nut 30, is held against rotation, while an appropriate tool (not shown) is engaged with the bolt head 24 to rotate the bolt, to complete the wedging action by pulling down on the nut, and fully expand the shell into a permanent embedding engagement with the side walls of the hole, as shown in Figure 8. The flexible characteristics of the member 60 permit deformation thereof without fracture during the expanding operation. It also will be noted that the sharp ridges 58 dig into the formation and that the walls 56 of the grooves 52 directly engage the side wall formation in a direction which directly opposes outward movement of the bolt, nut, and shell.

It will be noted that the engagement of the legs 62 of the connecting member 60 within the opposite channels 74 in the larger end of the wedge nut 30 prevents other than deliberate disassembling of the shell from the nut. In fact, the shell can be disassembled from the nut only by springing the shell parts 36 sufficiently far apart to almost permanently deform the connecting member 60. Hence, by reason of this construction, loss of a wedge nut 30 or the shell 32 prior to installation is completely minimized, if not entirely avoided.

In the event that the sharp end edges 44 and the spring action of the connecting member 60, illustrated in Figures 1 to 8, are insufficient to retain the mine roof bolt temporarily in the hole 34 until the plain bolt 20 is rotated to actuate the anchoring means, the modification illustrated in Figures 9 and 10 may be used to augment such temporary retaining effect. In this construction, the two parts 36 of the shell and the wedge nut 30 are substantially the same as those shown in Figures 1 to 8.

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The base of the connecting member 82, however, is bent inwardly at its midpoint toward the wedge nut 30 to provide two straight base portions 84 disposed at an obtuse angle to each other, as best shown in Figure 9. At the elbows thus formed at the junction of the base portions 84 with each leg 86, there is provided an outwardly-extending pointed projection 88.

In use of this modification, the bolt 20 is threaded completely into the nut 30 so that the latter is flush with the threaded end of the former, and the entire assembly inserted into a hole 90 which has a depth such that when the mine roof bolt is inserted just short of its full extent therein, the elbows on the connecting member 82 contact the bottom 92 of the hole. Thereupon, the head (not shown) of the plain bolt 20 may be abruptly pushed inwardly or tapped with a hammer (not shown) to bump the inner end of the bolt against the base of the connecting member 82 and thereby straighten such base. The straightening of the base will force the elbows to the connecting member 82 diametrically outwardly into temporary retaining engagement with the side walls of the hole 90, as shown in Figure 10. The pointed projections 88 on the elbows augment this temporary retaining engagement by digging into the formation into which the hole has been drilled. The bolt 20 is then pulled down and its head rotated, as before, to expand the shell fully for permanent retention of the mine roof bolt in place in the mine roof.

In the modification of this invention, illustrated in Figures 11 to 13, the wedge nut 30 is replaced by a correspondingly shaped wedge formed as an integral head 94 on the inner end of a bolt 96 having a smooth shank 98 and a threaded outer end 100 for the reception of a tension nut 102 thereon. The installation procedure for this mine roof bolt is substantially the same as the procedure for installing the bolt shown in Figures 9 and 10, save that after the parts have been positioned to correspond to the showing of Figure 10 the tension nut 102 is rotated to effect full expansion of the shell without rotation of the plain bolt 96 itself. Obviously, a bolt 96 and nut 102 may also replace the bolt 20 and wedge nut 30 in the embodiment illustrated in Figures 1 to 8.

Since a percussive tool is not necessary for the installation of mine roof bolts embodying this invention, and compressed air is therefore unnecessary, all of the afore-described compressed air piping, or an air compressor, may be eliminated. For the installation of mine roof bolts embodying this invention, it only is necessary to drill holes for the same in a mine roof. These holes may be drilled easily by a portable hydraulic drill, deriving its power from appropriate electrical conductors run from the mine mouth, thus effecting a considerable saving in equipment.

It thus will be seen that the objects of this invention have been fully and effectively accomplished. It will be realized, however, that various changes may be made in the specific embodiments disclosed to illustrate the principles of this invention without departing from such principles. Therefore, this invention includes all modifications which are encompassed by the spirit and scope of the following claims.

I claim:

1. A mine roof bolt assembly comprising: an expandable anchoring shell having two separate diametrically-disposed parts, each shaped as a longitudinally-tapering segment of a hollow cylinder and having longitudinal side edges each disposed in a single plane, each extending the entire length of the corresponding part, and each opposed to the corresponding side edge of the other part, each corresponding pair of said opposed edges being divergent toward one end of said shell to form a V-shaped slot between said parts; wedge means disposed between said opposed part edges and having planar surfaces complementary thereto and in mutual wedging engagement therewith

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for effecting expansion of said shell upon relative longitudinal movement between the latter and said wedge means in one direction, said surfaces of said wedge means being of greater length than said shell part side edges and in wedging engagement with the entire length of the latter throughout said relative movement from substantially fully contracted to substantially maximum expanded condition of said shell, and the maximum transverse dimension of said wedge means being at least as small as that of said shell when the latter is in said fully contracted condition; and a U-shaped resilient member having the legs thereof secured to said shell parts and the base thereof extending diametrically of said shell at said one end thereof over one end of said wedge means.

2. A mine roof bolt anchoring assembly for insertion into a drilled hole in a mine roof, comprising: an expandable anchoring shell having two separate diametrically-disposed parts, each shaped as a longitudinally-tapering segment of a hollow cylinder and each having planar longitudinal side edges opposed to the corresponding side edges of the other part and exterior circumferentially-extending serrations providing relatively sharp edges facing generally angularly toward the larger end of the part, and each corresponding pair of said opposed edges being divergent towards one end of said shell to form a V-shaped slot between said parts; wedge means disposed between said opposed parts and having opposite exterior planar surfaces complementary to said part side edges and in mutual wedging engagement therewith for effecting expansion of said shell into retaining engagement with the side walls of the hole on relative longitudinal movement between said shell and said wedge means in one direction, the maximum transverse dimensions of said wedge means being at least as small as that of said shell when the latter is in its fully contracted condition and that end of said wedge means corresponding to said one end of said shell being substantially flat and disposed normal to the longitudinal axis of said shell; and a separate, generally U-shaped, spring steel member, substantially rectangular in cross section, connecting said parts, said member having substantially straight, generally parallel legs and a connecting base disposed generally at right angles to said legs and forming substantially right angle corners therewith, said legs being disposed generally longitudinally of said shell and rigidly secured at their free ends to said shell parts by interfitting portions on said parts and legs providing a mechanical interlock therebetween, and said base being disposed diametrically of said shell, at said one end thereof, over said flat end of said wedge means for engagement of the base portions of said corners thereby, the transverse dimension of said flat end between said corners being substantially equal to the distance therebetween, whereby said shell parts can be sprung apart at the other end of said shell, prior to insertion of the assembly into a hole, so that the resiliency of said member will urge certain of said sharp edges into engagement with the side walls of the hole for temporary retention of the assembly therein prior to expansion of said shell therein by operation of said wedge means.

3. An article of manufacture for use with and expansion by interior wedge means, having a generally flat end disposed normal to the longitudinal axis thereof, to form a mine roof bolt anchoring assembly for insertion into a drilled hole in a mine roof, comprising: an expandable anchoring shell having two separate diametrically disposed parts, each shaped as a longitudinally-tapering segment of a hollow cylinder and each having planar longitudinal side edges constituting wedging surfaces complementary to corresponding surfaces on the wedge means and opposed to the corresponding side edges of the other part, each said part having exterior circumferentially-extending serrations providing relatively sharp edges facing generally angularly toward the larger end of the part, and each corresponding pair of said opposed edges being divergent toward one end of said shell to form a V-shaped slot be-

tween said parts for reception of the wedge means which cooperates with said part side edges to expand said shell; and a separate, generally U-shaped, spring steel member, substantially rectangular in cross section, connecting said parts, said member having substantially straight, generally parallel legs extending longitudinally of said shell and a connecting base disposed generally at right angles to said legs and forming substantially right angle corners therewith, the free ends of said legs being rigidly secured to said parts by interfitting portions on said parts and legs providing a mechanical interlock therebetween, and said connecting base being disposed diametrically across said one shell end for disposition over and engagement of the base portions of said corners by, the flat end of the interior wedge means when said anchoring shell is assembled therewith, whereby said shell parts can be sprung apart at the other end of said shell, prior to insertion of the assembly into a hole, so that the resiliency of said member

will urge certain of said sharp edges into engagement with the side walls of the hole for temporary retention of the assembly therein prior to expansion of the shell by the wedge means.

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