April 9, 1957 C. P. McCABE 2,787,931

MINE ROOF BOLTS WITH MULTIPLE PIECE SHELL HAVING U-SHAPED SPRING HOLDING MEANS

Filed May 29, 1953 2 Sheets-Sheet 1

Fig. 2.

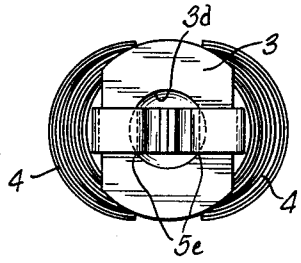


Fig. 4.

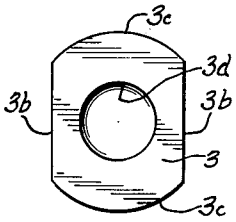


Fig. 5.

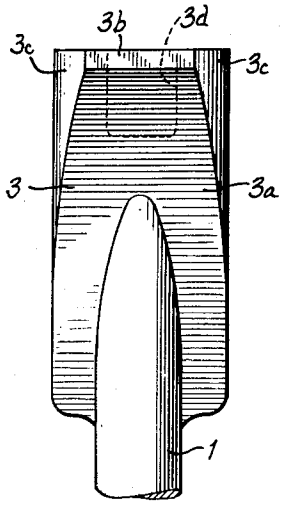


Fig. 1.

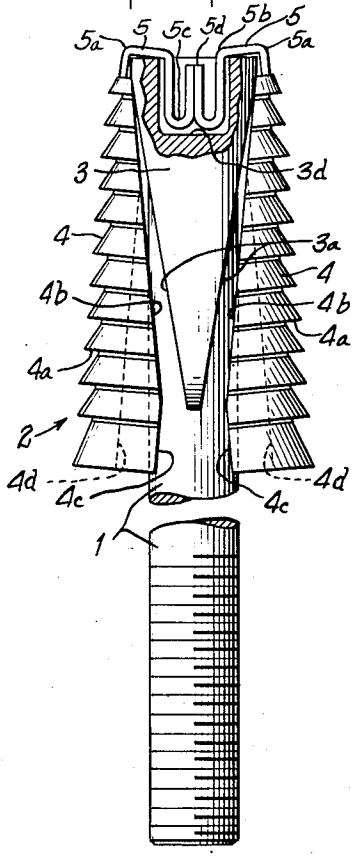


Fig. 3.

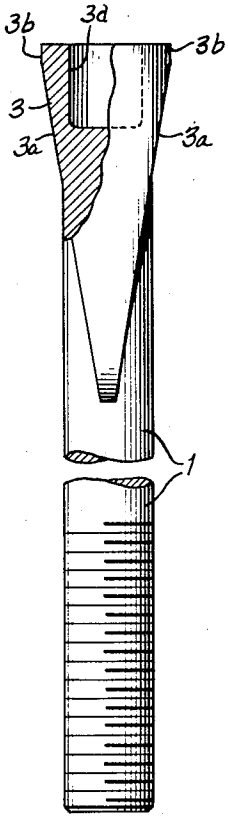
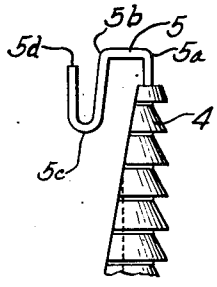


Fig. 6.



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Filed May 29, 1953 2 Sheets-Sheet 2

Fig. 8.

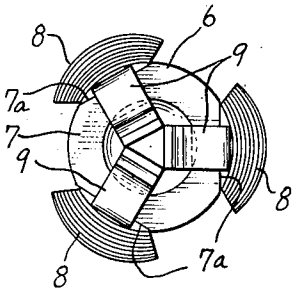


Fig. 10.

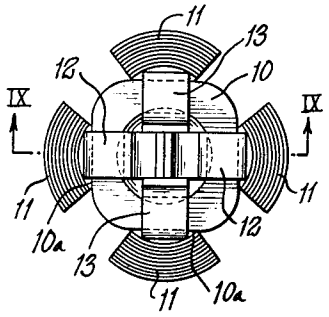


Fig. 12.

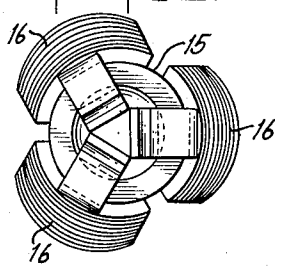


Fig. 11.

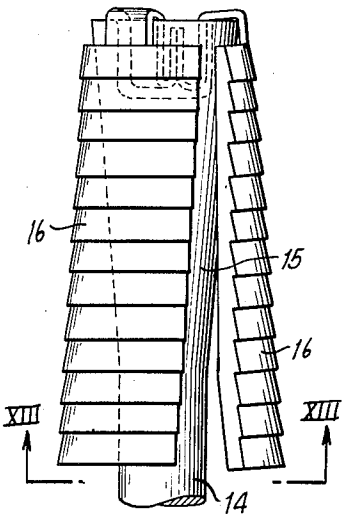


Fig. 7.

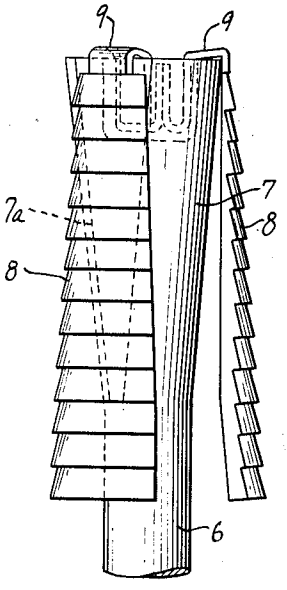


Fig. 9.

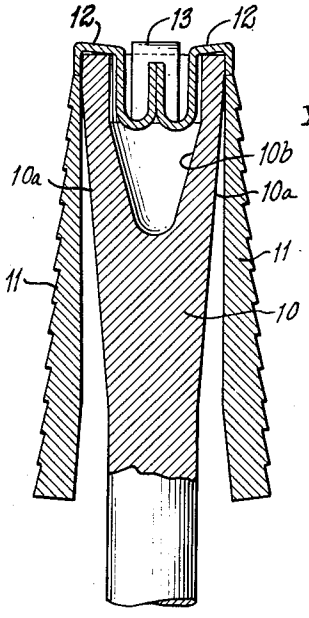
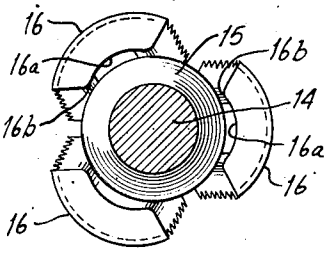


Fig. 13.



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2,787,931

MINE ROOF BOLTS WITH MULTIPLE PIECE SHELL HAVING U-SHAPED SPRING HOLDING MEANS

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Application May 29, 1953, Serial No. 358,414

7 Claims. (Cl. 85—2.4)

The present invention relates to stay bolts, especially those intended for insertion in mine roofs and similar structures. Many of the novel features of the present invention are applicable to stay bolts generally, regardless of the particular structures in which they may be used. Other features of the invention are of particular utility in connection with mine roof bolts.

In mining operations, it is common practice to provide a roof structure or support which underlies the rock roof of the mine, i. e. in underground passages or chambers, and aids in maintaining the integrity of the roof, for instance to protect the mine workers against the dislodgment and fall of roof fragments. In times past, the supporting arrangements generally comprised posts or props, surmounted with a framework of cap pieces, cross bars or the like, which was constructed usually of heavy planks or timbers and sometimes of steel plates or beams. These posts or props form obstructions in the mine passages, which are in many cases very narrow. For this and other reasons, it is now the practice in most modern mines to hold the framework against the rock ceiling or roof by means of very heavy stay bolts, known as mine roof bolts, which extend into drilled or bored holes in the mine roof and are anchored therein. The framework structures now commonly used are made of steel plates or beams of conventional cross-section.

These roof supporting structures are particularly necessary where the stratum overlying the one which is being worked consists of weak, friable material, for example, certain types of shale. For reasons of safety, it is desired at least to anchor the bolts deeply in this overlying stratum, and if possible to have the bolts extend completely through the weak stratum into a stratum of stronger material above. For that reason, the drilled holes for receiving the mine roof bolts are quite deep, usually extending three to six feet into the rock or roof strata, or even farther in some cases, and the shanks of the bolts are correspondingly long.

A common type of mine roof bolt heretofore used has included anchor means or structure threaded on the end of the long bolt, so as to be disposed at the upper part or end of the hole when the bolt is inserted. The bolt is then screwed further into the anchor structure, which is constructed with wedging mechanism or surfaces that thereby expand in a lateral direction. As the anchor thus enlarges, it seizes the sides of the hole and holds the bolt fast. Devices of this sort, however, have not been wholly satisfactory, the anchor, for instance, may tend to turn with the bolt in the hole rather than be expanded, or may be impeded from the slight downward movement necessary for tight expansion when the bolt is turned with the head on its outer or lower end snug against the roof structure. Some efforts have been made to provide for insertion of the anchor separately from the bolt, but a special setting tool is required to get the anchor in place, and other difficulties may yet remain.

It has also been proposed to have bolts with conical

wedge heads and also flat surfaced wedge heads to be inserted in the hole and that has the anchor fitted around it, so that upon pulling downwardly or outwardly on the bolt, as by suitable engagement with its lower end, the head is forced down into the anchor to expand it.

Bolts of this type have advantages of rapid insertion, ease of manipulation and sureness of grip. The present invention relates to this type of bolt and is designed to provide improved devices that realize these and other advantages. In a more specific sense, the mine roof bolts of the invention are designed to meet satisfactorily the various requirements which have now been found to characterize structure of this type, as indicated above. One of those requirements, for example, is that means must be provided to prevent the anchor from dropping or sliding back on the bolt as it is being inserted in the hole. It is also necessary to provide some means on the anchor to engage the sides of the hole and hold the anchor up while the bolt is pulled down to actuate its wedge structure and lock the anchor in place. Another requirement is that relative rotation of the bolt and anchor be effectively prevented in order that the bolt may be drawn down (i. e. outwardly) by turning a nut, for instance, which is threaded on the lower or outer end of the bolt and which seats against the under face of the plate or other structure of the mine roof for the desired supporting function.

An object of the present invention is to provide a mine roof bolt having an improved gripping and anchoring action.

A further object is to provide a mine roof bolt which is easier to manufacture than the structures of the prior art. Another object is to provide an improved shell structure for a mine roof bolt which is easier to manufacture than the shell structures of the prior art.

Another object is to provide an improved mine roof bolt and anchor structure which may be readily shipped, assembled for use, and adjusted to accommodate varying conditions of installation.

The foregoing and other objects of the invention are attained by making the shell structure in two or more longitudinally separate sections. The end of the bolt is formed with a wedge head having a recess in its end surface, and the corresponding end of each shell section is formed with a tang which extends upwardly and is bent over the peripheral portion of the wedge head and downwardly into the recess. The end of the tang is provided with a further U-shaped bend so that the free arm of the bend extends outwardly of the recess. The free arms of the U-shaped bends of the several tangs in each recess abut compressively and yieldably against one another and hold each other frictionally within the recess. This frictional engagement is sufficient to hold the shell structure together on the bolt during its insertion into the hole.

Each shell section is provided on its outer surface with teeth adapted to engage the sides of the hole, and on its inner face with a wedging surface adapted to engage the wedge head on the end of the bolt. When the bolt starts to move outwardly of the hole, each shell section is held against movement by frictional engagement of its outer toothed surface with the wall of the hole, so that the several shell sections stand still while the bolt is drawn down to bring the wedge head on the bolt into engagement with the wedging surfaces on the shell, thereby driving the toothed surfaces into firm biting engagement with the walls of the hole.

Other objects and advantages of the invention will become apparent from a consideration of the specification and claims taken together with the accompanying drawings.

In the drawings:

Fig. 1 is an elevational view, partly broken away and

partly in section, of one form of wedge head and anchor shell assembly embodying the invention;

Fig. 2 is a plan view of the assembly of Fig. 1;

Fig. 3 is an elevational view of the bolt of Fig. 1 with the anchor shell removed;

Fig. 4 is a plan view of the bolt of Fig. 3;

Fig. 5 is a side elevational view of the head of the bolt of Fig. 3;

Fig. 6 is a fragmentary elevational view of one of the shell sections of Fig. 1, showing the tang in its unstressed position;

Fig. 7 is an elevational assembly view of a modified embodiment of my invention;

Fig. 8 is a plan view of the assembly of Fig. 7;

Fig. 9 is a vertical sectional view of a further embodiment of my invention taken on the line IX—IX of Fig. 10;

Fig. 10 is a plan view of the assembly shown in Fig. 9;

Fig. 11 is an elevational assembly view of still another embodiment of the invention;

Fig. 12 is a plan view of the assembly of Fig. 11; and

Fig. 13 is a sectional view taken on the line XIII—XIII of Fig. 11, looking in the direction of the arrows.

Figures 1 to 6

These figures illustrate a bolt generally indicated by the reference numeral **1** and an anchor shell for that bolt generally indicated by the reference numeral **2**. The bolt **1** is provided with a wedge head **3**, best seen in Figs. 3 and 5, and having two diametrically opposed plane wedging surfaces **3***a*, which are upwardly divergent. The wedging surfaces **3***a* terminate at their upper ends at surfaces which are parallel to the axis of the bolt **1**. These surfaces include two flat surfaces **3***b* at the sides of the wedge head which are aligned with the wedging surfaces and two generally cylindrical surfaces **3***c* which extend between the ends of the surfaces **3***d*.

On its upper end, the wedge head **3** has a flat surface with a central recess **3***d*. The recess **3***d* is formed in the wedge head as a preliminary to or as a part of the forging of the wedge head, and aids in spreading the material of the bolt blank, thereby promoting the forging operation. The recess **3***d* also cooperates in retaining the several sections of the shell **2** in place, as described below.

The shell **2** is made up of two diametrically opposed shell sections **4**. Each shell section **4** has an elongated wedge portion including an outer toothed surface **4***a* and an inner flat wedging surface **4***b*. The wedging surfaces **4***b* are tapered to match the taper of the wedging surfaces **3***a* on the wedge head, and terminate at their lower ends in straight untapered surfaces **4***c* which are adapted to abut against each other when the two shell sections **4** are squeezed together from the position shown in Fig. 1. The shell sections **4** also have recesses **4***d* of arcuate cross-section formed on their inner faces, to receive the shank of the bolt when the shell sections are squeezed together.

Each shell section **4** is provided at its upper end with a projecting tang **5**. A short distance above the upper end of the shell section **4**, the tang **5** has a substantially right angle bend **5***a* in a direction away from the toothed surface **4***a*. Spaced along the tang **5** from the bend **5***a* is another substantially right angle bend **5***b*. These two bends cooperate to define a wide U-shaped hook portion which extends over the peripheral portion of the wedge head **3**. Near its end, the tang **5** is provided with a reverse 180° bend **5***c*, which provides an outwardly extending tip **5***d*. The tang **5** is shown with its bends in their unstressed positions in Fig. 6. The angles of the bends **5***b* and **5***c* are there shown to be slightly larger than when the shell sections are assembled on a bolt as seen in Fig. 1. The tangs **5** are formed of resilient material and their free dimensions are such that when they are pushed into the recess **3***d* as shown in Fig. 1, the tips **5***d* abut against each other compressively and resiliently and hold the corners **5***e* (see Fig. 2) of the tangs frictionally against the sides of the recess **3***d*, thereby holding the shell sections **4** in a normal position, shown in Fig. 1, in which the toothed surfaces **4***a* extend outwardly so as to engage resiliently the walls of the hole during an inserting movement of the bolt. In this nromal position, the wedging surfaces **4***b* of the shell sections **4** are spaced from the wedging surfaces **3***a* of the wedge head **3**.

When the bolt has been inserted as far as desired, the operator simply pulls downward on it in order to lock it in place. Upon initiation of such a downward pull, the toothed surfaces **4***a* engage the walls of the hole yieldably and frictionally and prevent downward movement of the shell sections. The downward pull on the bolt allows the tangs to slide frictionally out of the recess **3***d*, and the bolt moves downward a short distance until the wedging surfaces **3***a* engage the wedging surfaces **4***b* on the shell sections, whereupon the teeth **4***a* of the shell sections are driven into a firm biting engagement with the walls of the hole by the wedging action and the bolt **1** is locked against further downward movement.

The bolts **1** and the shell sections **4** are conveniently manufactured and shipped separately, and are assembled by an operator just before he inserts them as a unit into a hole drilled in a mine roof.

The holes into which these bolts are inserted may vary considerably in diameter, for example, from 1½" when drilled with a new bit, to 1⅜" when drilled with an old, worn bit. The operator may deform the tangs **5** as required in each case to establish the shell sections **4** in a spread position where they will engage the walls of the hole with the proper force to hold them in place during the wedging of the anchor.

Figures 7 and 8

These figures illustrate another embodiment of the invention including a bolt **6** having a wedge head **7** and adapted to receive three shell sections **8**. The structure is generally similar to that described in connection with Figs. 1 to 6, except that three wedging surfaces **7***a* are provided at equally spaced locations on the wedge head. The shell sections **8** have tangs **9** of similar construction to the tangs **5** of Figs. 1 to 6. Their free ends abut against each other in a trianguiar configuration, as shown in Fig. 8, forming an edgewise abutment rather than a flatwise abutment.

Figures 9 and 10

These figures illustrate a further modification of the invention including a bolt **10** adapted to receive four shell sections **11**. The bolt **10** is of similar construction to the bolts of the preceding embodiments of the invention, except that four equally spaced wedging surfaces **10***a* are provided on the wedge head. Two of the diametrically opposed shell sections **11** are provided with tangs **12** which abut in the same manner as the tangs **5** of Figs. 1 to 6. The other two shell sections **11** are provided with tangs **13** which are dimensionally slightly different from the tangs **12**, and whose ends abut against the sides of the abutting ends of the tangs **12**.

The bolt **10** has a central recess **10***b* of somewhat deeper contour than the corresponding recesses of the preceding embodiments of the invention. These recess contours may be used alternatively, as required for convenience in forming the wedge head on the bolt.

Figures 11 and 12

These figures illustrate still another modified form of the invention including a bolt **14** having a generally conical wedge head **15**, on which are mounted three shell sections **16**. Each shell section **16** is provided on its inner surface with a generally concave conical wedging surface **16***a*, provided with convex edges, as shown at **16***b* (Fig. 13). This contour of the wedging surfaces on the shell sections **16** provides a tight wedging engagement of the conical surfaces.

In this embodiment of the invention, the shell sections 16 have the same peripheral width throughout their length. This provides a larger gripping area than is the case in the other embodiments, where the shell sections must be made narrower at the top to accommodate the flat wedging surfaces. The provision of this larger gripping area counteracts to some extent the disadvantage of having curved wedging surfaces in the embodiment of Figs. 11–13.

It should be particularly noted that all the embodiments of my invention described herein may be built with an all steel shell structure, thereby eliminating the breaking or cracking which sometimes occurs when cast iron or malleable iron shells are used.

Other modifications of my invention will readily occur to those skilled in the art and I therefore intend the invention to be limited only by the appended claims.

I claim:

1. An anchor shell segment for use with a stay bolt to be fastened in a mine roof or the like, comprising a wedge having a wedging surface on one face and a convex toothed surface upon its opposite face, and an elongated tang of resilient material having one end integral with and projecting from one end of the wedge, said tang comprising a first portion extending from said one end of the wedge and generally parallel to the wedge, and terminating at a first bend of substantially 90° in a direction away from said toothed surface, a second portion extending from said first bend to a second bend of substantially 90° in the same sense as said first bend, a third portion extending from said second bend to a third bend of substantially 180° in a reverse sense from said second bend, said third bend having a substantial inside diameter and a fourth portion extending tangentially from said third bend and terminating in a free end, said fourth portion having a position spaced from said third portion by a substantial distance when said third bend is unstressed, said first, second and third portions and said first and second bends defining a first U-shaped hook, said third and fourth portions and said third bend defining a second U-shaped hook, said fourth portion being effective upon deflection from its unstressed position toward said third portion to transmit at least a portion of said deflection through said third bend and thereby to deflect said third portion in the same direction.

2. An anchor shell including two segments, to be used with a stay bolt to be fastened in a mine roof or the like, each said segment comprising a wedge having a wedging surface on one face and a convex toothed surface upon its opposite face, and an elongated tang of resilient material having one end integral with and projecting from one end of the wedge, said tang comprising a first portion extending from said one end of the wedge and generally parallel to the wedge, and terminating at a first bend of substantially 90° in a direction away from said toothed surface, a second portion extending from said first bend to a second bend of substantially 90° in the same sense as said first bend, a third portion extending from said second bend to a third bend of substantially 180° in a reverse sense from said second bend, said third bend having a substantial inside diameter and a fourth portion extending tangentially from said third bend and terminating in a free end, said fourth portion having a position spaced from said third portion by a substantial distance when said third bend is unstressed, said first, second and third portions and said first and second bends defining a first U-shaped hook, said third and fourth portions and said third bend defining a second U-shaped hook, said fourth portions being effective to abut each other resiliently when said second U-shaped hooks are compressed by insertion together in a recess having a diameter less than the sum of the unstressed distances across said second U-shaped hooks and thereby to hold the opposite

sides of said second U-shaped hooks yieldably and frictionally against the sides of the recess.

3. A stay bolt comprising a shank and a head integral with one end of the shank, said head being wedge-shaped with the wedge increasing in thickness toward said one end of the shank, said head having a recess in its end coaxial with said shank and having walls substantially parallel to the axis of the shank, and anchor shell means including at least two segments, each comprising a wedge adapted to cooperate with said wedge-shaped head, and an elongated tang of resilient material having one end integral with and projecting from one end of the wedge, said tang comprising a first portion extending from said one end of the wedge and generally parallel to the wedge, and terminating at a first bend of substantially 90° in a direction away from said toothed surface, a second portion extending from said first bend to a second bend of substantially 90° in the same sense as said first bend, a third portion extending from said second bend to a third bend of substantially 180° in a reverse sense from said second bend, said third bend having a substantial inside diameter, and a fourth portion extending tangentially from said third bend and terminating in a free end, said fourth portion having a position spaced from said third portion by a substantial distance when said third bend is unstressed, said first, second and third portions and said first and second bends defining a first U-shaped hook, said third and fourth portions and said third bend defining a second U-shaped hook, said second U-shaped hooks of both tang means being received in said recess, said recess having a diameter less than the sum of the unstressed distances across both second U-shaped hooks, said second U-shaped hooks being compressed by insertion within said recess, whereby said fourth portions abut each other resiliently and hold said third portions yieldably and frictionally against the sides of the recess.

4. A stay bolt as defined in claim 3, in which said tangs are deformable to spread said segments to define a circle whose diameter is greater than that of the hole in which it is desired to insert the stay bolt, so that when said tangs are so deformed prior to insertion, the outwardly directed force of the tangs acting upon the segments provides frictional engagement of the outer surfaces of the segments with the walls of the hole.

5. A stay bolt as defined in claim 3, in which there are two of said shell segments, diametrically opposed on said bolt, and said fourth portions of their tangs have flat surfaces in flatwise abutting relation.

6. A stay bolt as defined in claim 3, in which there are three of said shell segments, spaced equally about said bolt, and said fourth portions of their tangs have flat surfaces in edgewise abutting relation.

7. A stay bolt as defined in claim 3, in which there are four of said shell segments, spaced equally about said bolt, the tangs on two diametrically opposed segments of said four segments having flat surfaces on the fourth portions thereof in flatwise abutting relation, the other two diametrically opposed segments of the four having the fourth portions with flat surfaces abutting the sides of the fourth portions of the first-mentioned two tangs.

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