MINE ROOF BOLTS HAVING SEGMENTED SHELL BIASED OUTWARDLY BY RESILIENT WASHER

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This invention relates to stay bolts, and particularly to stay bolts of the type known as mine roof bolts. There is disclosed in the copending application of Charles P. McCabe, Serial No. 358,414, filed May 29, 1953, entitled "Mine Roof Bolts With Multiple Piece Shell," now U.S. Patent No. 2,787,931, issued April 9, 1957, a bolt having a wedge-shaped head adapted for insertion head-end first into a hole in the roof of a mine. The wedge head of each such bolt serves as a support for an anchor shell structure which moves with the bolt into the hole. After the bolt and shell have been inserted to the desired depth, e.g. substantially to the end of the hole, the bolt is then pulled downward a short distance. The anchor shell, which frictionally grips the sides of the hole, does not follow this downward movement, but remains fixed in the hole. Wedging surfaces on the wedge head and the shell cooperate during that downward movement to anchor the shell and bolt firmly in the hole.

Said copending application discloses an anchor shell structure composed of two or more longitudinally separate sections, each attached at one end, as by riveting or welding, to a strap or tang which extends along the wedge head and is bent over to engage the end of the wedge head. Each strap or tang is made of resilient, yieldable spring steel stock and has an unstressed position in which its associated shell segment is spaced outwardly from the bolt head. When the bolt is inserted in the hole, the sections are deflected inwardly from their unstressed positions, so that they press against the walls of the hole with an outwardly directed force, creating frictional contact between the shell sections and the sides of 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 shell hole so that the shell sections stand still while the bolt is drawn down to bring the wedge head into engagement with the wedging surfaces of the shell, thereby driving the toothed surfaces into firm biting engagement with the walls of the hole.

The unstressed position of each tang or strap and its associated shell section or segment is selected, in the mine roof bolt structures described in said copending application, by a compromise between two different objectives. One objective is to have the shell segments spread widely enough, when the straps or tangs are unstressed, so that the toothed outer surfaces of the segments will engage with substantial force the walls of the largest diameter hole in which the bolt is likely to be used. The other objective is to have the shell segments located close to the wedge head, so that during shipment and handling prior to insertion of the bolt in the hole, the assembled bolt and shell will form a neat, easily handled unit, without having the shell segments spread widely so that they are likely to snag adjacent objects.

In the use of this device, however, it has been found that a strap or tang constructed from spring steel often formed a weak and insecure weld with forged steel shell segments. This was particularly true wherever the initial welding operation was imperfect. Anchor shell structures formed with such insecure welds had to be discarded during the manufacturing process, with consequent loss of material, labor and time. To remedy this welding problem, it was proposed to construct the strap or tang from mild steel rather than spring steel. Such a steel readily forms a strong, secure weld with forged steel. Furthermore, such a strap may be riveted instead of welded, since a hole adapted to receive a rivet is more easily provided in straps constructed of mild steel than in spring steel straps. Mild steel, however, possesses a considerably lower spring rate than spring steel and straps constructed therefrom do not possess sufficient resiliency to exert, when in a stressed position, the outwardly directed force necessary to permit secure engagement of the shell segments and the walls of a hole in which the bolt structure is likely to be used. This characteristic of mild steel creates a particular difficulty where the device is desired to be used in "oversized" holes. There the additional spread of the shell segments necessary to firmly contact the walls of the hole has the effect, because of the lower resiliency of the mild steel straps, of further reducing the force with which the shell segments engage such walls.

An object of the invention is to provide improved means for anchoring a mine roof bolt.

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

A further object of the present invention is to provide means for maintaining an anchor shell and bolt structure as one unit during packaging, handling and shipment.

It is a further object of my present invention to provide improved means for retaining an anchor shell upon a bolt structure, which retaining means is inexpensive and easily attached and removed.

The foregoing and other objects of the invention are attained by providing a compressively resilient washer encircling the wedge head near its thick end, and between the wedge head and the shell segments. The shell segments are forced resiliently outwardly by the washer, and are spread thereby to positions where they engage the walls of a hole into which the bolt is inserted.

There is further provided a hollow retainer, of cardboard or the like, which is adapted to encircle the shell and hold the shell segments closely adjacent the bolt shank, against the force of the resilient washer. This retainer is used during shipment and handling, and is removed prior to insertion of the bolt in a hole.

The invention together with its objects and advantages will be best understood from a study of the following description and claims taken in connection with the accompanying drawings, in which:

Fig. 1 is a view, partially sectional and partially elevational, of a bolt and anchor shell assembly embodying the invention;

Fig. 2 is a plan view of a retainer which forms part of the assembly of Fig. 1;

Fig. 3 is an elevational view of the retainer of Fig. 2;

Fig. 4 is a plan view of a washer which forms part of the assembly of Fig. 1;

Fig. 5 is an elevational view of the washer of Fig. 4;

Fig. 6 is a view, partially sectional and partially elev-
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vational, of a wedge head forming part of the assembly of Fig. 1; and Fig. 7 is a plan view of the wedge head of Fig. 6.

Referring now to the drawings, there are shown a bolt 1 and an anchor shell generally indicated by the reference numeral 2. The bolt 1 is threaded at its upper end and carries an internally threaded wedge head 3 having plane wedging surfaces 3a. The lower end of the bolt is provided with an integral head 10 by which the bolt may be rotated. Alternatively, the wedge head 3 might be made integral with the upper end of the bolt and cooperating threads provided on the head 10 and the lower end of the bolt.

The wedge head 3 is assembled on the bolt 1 with the end of the bolt somewhat below the end of the head, as shown at 16. The upper end of the threaded hole in the head then provides a recess 3b in the center of the end of the bolt head.

The shell 2 is made up of two diametrically opposed longitudinal shell sections 2a. Each shell section 2a has an outer toothed surface 2b and an inner flat wedging surface 2c; and in the preferred form of the invention constructed of forged steel. The shell sections 2a also have recesses 2d of arcuate cross-section formed on their inner faces to receive the shank of the bolt when the shell sections are squeezed together.

The respective shell sections 2a are connected at their upper ends, as by riveting or welding, to the opposite ends of a strap 4. The strap 4 has a wide U-shaped portion 4a at the center thereof which extends into the wedge head recess 3b. The strap 4 may be formed of any rigid material capable of forming a strong weld or being securely riveted to forged steel shell segments 2c. In the preferred embodiment of the invention, however, the strap is constructed from mild steel, a material having low elasticity and resiliency as compared to other steels. The strap is shaped and dimensioned so that when the U-shaped portion 4a is received in the recess 3b, the wedging surfaces 2c of the shell sections 2a are spaced from the wedging surfaces 3c of the wedge head 3, as shown in the drawing.

A ring or washer 8, illustrated in detail in Figs. 4 and 5, encircles the head 3 near its upper end. The washer is of material which is compressively resilient and preferably is also stretchable so that it frictionally grips the nut and holds itself in place. When in place, it assumes a conical contour, shown in Fig. 1, conforming to the periphery of the head 3. Alternatively, the washer 8 may have a conical shape when unstressed. This washer head 3 may be constructed of any substantially elastic material, as for example rubber or plastic compositions possessing a low spring rate. Its thickness and contour may be varied from that shown, depending upon the distance the shell sections are desired to be spaced away from the bolt and the shape of the wedge nut or head which it will engage.

The washer 8 produces a wider spread of the shell segments than is obtained when no washer is used, and a resiliency sufficient to allow straps constructed of mild steel to exert upon the walls of a hole into which it may be inserted an outwardly directed force sufficient to permit secure engagement of shell segments and hole walls. It is extremely useful for mine roof bolts employed in oversize holes, whether or not the retainer described below is also used.

During packing, shipping and handling, the anchor shell 2 is provided with a retainer 9 illustrated in detail in Figs. 2 and 3 of the accompanying drawings. This retainer is preferably positioned about the lower portion of the shell structure and is of a diameter substantially less than the outside diameter of said anchor shell when the retainer is removed. Retainer 9 may be made of inexpensive material, as for example cardboard, strong paper, cloth, etc.

When assembling the unit illustrated, the wedge head
with spring steel straps wherever an unusual degree of resiliency is required.

Other modifications of my invention will readily occur to those skilled in the art and it is therefore intended that the invention be limited only by the appended claims.

The invention claimed is:

1. A stay bolt comprising a shank having at one end a wedge head and adapted for insertion head end first into a hole, said wedge head increasing in thickness toward said one end of the shank, said wedge head having a recess in its end; an anchor shell structure comprising a wedge portion and a strap attached to one end of said wedge portion, said strap being insertable into said recess and effective to hold the shell structure in a normal position in which said wedge portion extends along the bolt from said one end facing but spaced outwardly from the wedge head; and washer means of radially yieldable resilient material engaging the outer surface of the wedge head and positioned between the wedge head and the anchor shell means and resiliently biasing the end of said wedge portion opposite said end to a position where its outer surfaces are outwardly spaced from said shank a distance greater than the distance from which said one end of said wedge portion is spaced from said wedge head.

2. A stay bolt comprising a shank with a wedge head at one end thereof and adapted for insertion head end first into a hole, said wedge head increasing in thickness toward said one end of the shank and having a central recess in its end; an anchor shell structure comprising two shell sections, each comprising a wedge adapted to cooperate with said wedge head, and a strap of mild steel integrally attached to the ends of the shell sections nearest said one end of the shank, said strap spanning the end of the wedge head and having a central U-shaped bend extending toward the wedge head and receivable in said central recess to center the shell structure on the shank and effective to hold said shell structure in a normal position in which said wedges extend along the bolt from said one end and facing but spaced outwardly from the wedge head; and a rubber washer yieldably and frictionally engaging said wedge head and interposed between the wedge head and the shell sections, said washer resiliently biasing the opposite ends of said shell sections outwardly to positions where their outer surfaces are spaced from the shank a distance greater than the distance from which said one ends are spaced from said wedge head.

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