

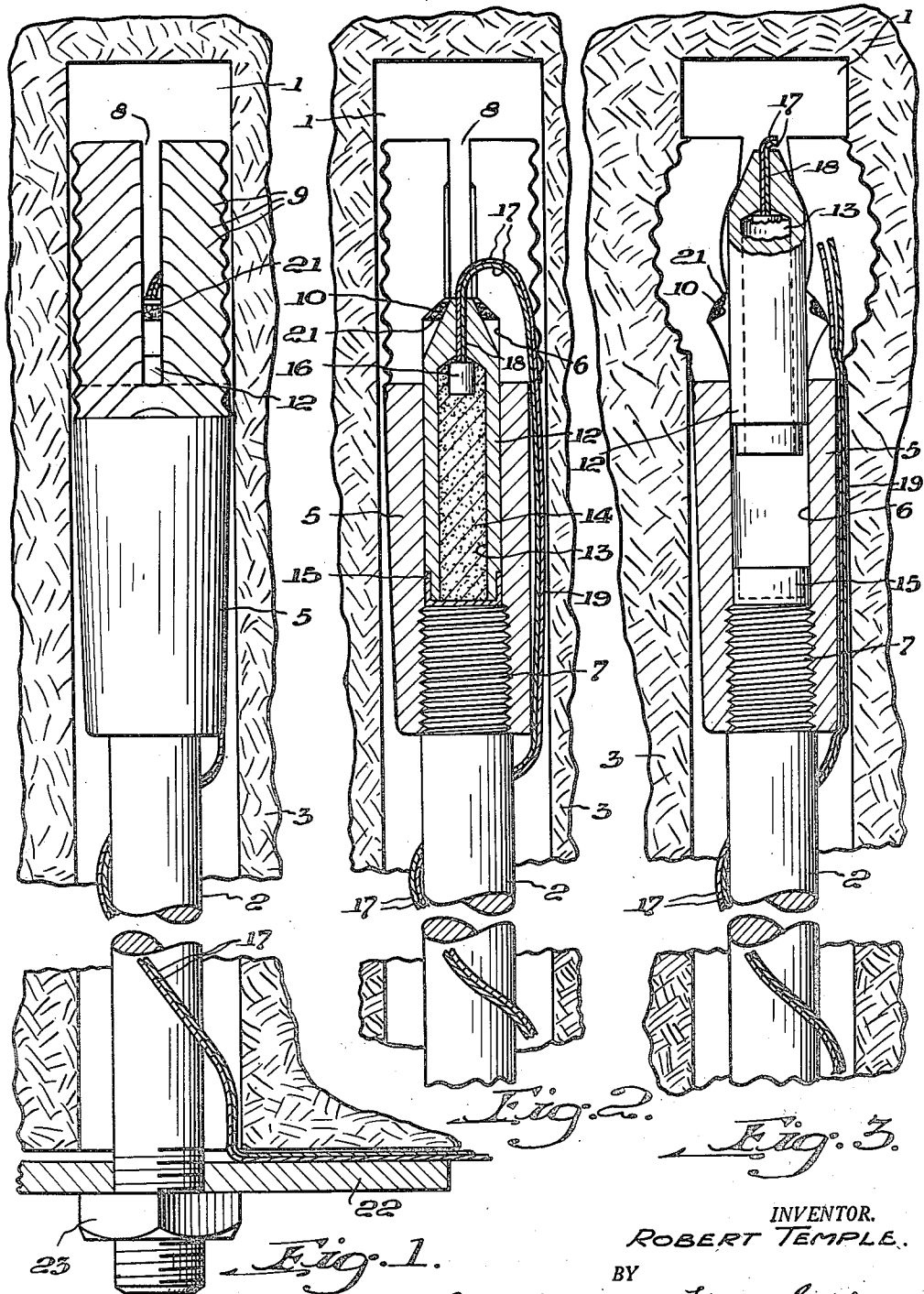
Nov. 18, 1952

R. TEMPLE

2,618,192

EXPLOSIVELY ACTUATED MINE ROOF BOLT ANCHOR

Filed Feb. 13, 1951



INVENTOR.

ROBERT TEMPLE.

BY

Brown, Critchlow, Flick & Beckham

his ATTORNEYS.

UNITED STATES PATENT OFFICE

2,618,192

EXPLOSIVELY ACTUATED MINE ROOF BOLT
ANCHORRobert Temple, Swissvale, Pa., assignor to Temple Velocity Equipment, Inc., Wilmington, Del.,
a corporation of Delaware

Application February 13, 1951, Serial No. 210,637

4 Claims. (Cl. 85-2.4)

1

This invention relates to the bolting of mine roofs to support them, and more particularly to means for anchoring the upper ends of the bolts in the bolt holes.

Up until recently, it was the universal practice to support mine roofs by means of timbers. This required horizontal beams and posts for supporting them. The installation of such timbering is expensive and the posts often take up much-needed space in the mine passages and rooms. In an effort to overcome the disadvantages of timbering, the practice is developing in many mines of supporting the roofs by means of bolts which extend up into holes drilled up into the roofs into the overlying rock. The upper ends of these bolts must be anchored in the rock so that the heads at their lower ends can tightly engage the roof around the lower ends of the holes to support it. The biggest problem in installing such bolts is to anchor their upper ends in the bolt holes quickly and effectively. Various ways of doing this have been tried, but heretofore none of them has been very satisfactory.

It is among the objects of this invention to provide a device for anchoring the upper end of a mine roof bolt in surrounding rock, which is easy to use, which anchors the bolt very quickly and securely, which is dependable in operation, and which does not depend on engagement with the upper end of the roof hole for the anchoring operation.

In accordance with this invention, a vertical barrel-like expansion member is provided with an axial passage having its lower portion adapted to receive and be fastened to the upper end of a bolt, which then is inserted in a hole drilled up into a mine roof. Disposed in the central portion of the axial passage is an upwardly directed projectile. The upper portion of the passage is of smaller diameter than the projectile. Means is provided for firing the projectile to drive it upward into the restricted upper portion of the passage in order to expand the surrounding portion of the expansion member so as to anchor it in the bolt hole. It is preferred that the body of the projectile be formed from a hollow stud filled with powder, and that the powder be detonated by an electric primer inside the stud. The primer can be connected by wires passing out of the stud and the expansion member and down along the bolt to a point outside of the bolt hole.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which Fig. 1 is a side view of a bolt and unex-

2

panded anchor inserted in a hole drilled upward from the roof of a mine passage; Fig. 2 is a vertical section of the anchor; and Fig. 3 is a similar vertical section, but showing the relative positions of the parts of the anchor after it has been expanded into the surrounding rock.

Referring to Figs. 1 and 2 of the drawings, a hole 1 is drilled up into the roof of a mine for several feet. The hole extends up through the shale which is to be supported and into solid rock, such as sandstone, when that is present. A headless bolt 2, threaded at both ends, then is inserted in the hole and its upper end is anchored therein so that the bolt can not be pulled down out of the hole. For anchoring the upper end of the bolt in the surrounding rock 3, an explosive-actuated anchoring device is fastened to its upper end.

In accordance with this invention, the anchor includes a vertical barrel-like expansion member 5 that has an axial passage 6 extending through it from end to end. The wall of the lower end portion of this passage is provided with a thread 7 to permit it to be screwed onto the upper end of the bolt. The upper part of the expansion member preferably is provided with a plurality of slots 8 extending radially through it and from its upper end downward more or less half-way to the upper end of the bolt. These slots separate the upper portion of the expansion member into segments, the outer surfaces of which may be provided with teeth 9 to help them grip the surrounding rock. The diameter of the upper portion of passage 6 is considerably smaller than the diameter of the rest of the passage. The large and smaller portions of the passage are connected by a shoulder 10. Preferably, the small upper portion of the passage does not extend as far down as the lower ends of slots 8. Consequently, the walls of the segments are thinner at their lower ends than are their upper portions, which makes bending of them easier.

For expanding the upper portion of the expansion member; that is, forcing its segments outward away from one another, a projectile is disposed in the central portion of passage 6 between the top of the bolt and shoulder 10. The body of the projectile is in sliding engagement with the wall of the passage and preferably is a stud 12 having a tapered upper end and having an axial bore 13 extending upward from its lower end. The wall of the bore is quite thin. Inside of the bore there is a charge of explosive powder 14 which is held in the stud by a friction sealing cap 15 fitted over the lower end of the stud in a

shallow annular recess. The cap keeps out moisture and therefore is important in coal mines. The powder is exploded preferably by means of an electric primer 16 embedded in it at the upper end of the bore 13. Connected to this primer are the upper ends of wires 17 which extend upward out of the stud through an axial opening 18 with which the point of the stud is provided. The wires then extend out into one of the slots 8 and down through a groove 19 in the side of the expansion member extending downward from the lower end of the slot. This groove keeps the wires from being scraped against the side of the bolt hole. The wires may be wrapped around the bolt to hold them in the groove, and their lower ends extend out of the bolt hole for connection to a suitable source of electricity (not shown), by which the primer head can be detonated.

In order to hold down the stud until considerable gas pressure has been built up by the exploding charge, and also to initially space the stud from the lower end of the reduced upper portion of passage 6 through the expansion member so that the stud can gain a little momentum before it strikes the overlying segments, a yieldable ring 21 is seated around the tip of the stud in engagement with shoulder 10. This ring may be made of soft metal, fiber or the like, which can momentarily retard the projectile but not prevent it from moving ahead.

In using this anchor, the projectile is inserted in the expansion member with ring 21 around the point of the stud and with the wires extending out between the segments. The upper end of the bolt then is screwed into the lower end of the expansion member, which holds the projectile in place with its upper end spaced from the expansion member by means of the ring. The wires then can be pulled down in the groove 19 in the side of the expansion member and be wrapped around the bolt to hold them in the groove. Before the anchor is pushed up into the hole by means of the bolt, a heavy plate 22 is slipped up onto the lower end of the bolt and held in place by a nut 23. This plate serves as an enlarged head for the bolt. The bolt, with the anchor at its upper end, then is inserted in the hole until the plate is close to, or practically engages, the roof of the mine. The primer wires extend out across the top of the plate. The bolt may be supported in this position directly by the operator or by a temporary extension (not shown) screwed on the bolt below the nut.

With the anchor and bolt held in position in the hole as just described, electric current is supplied to the lower ends of the wires to detonate the electric primer, whereby the charge of powder in the stud is exploded. The gas pressure resulting from the explosion builds up in the stud until it is great enough to force the stud upward through the yieldable ring 21. At the same time, the gas pressure inside of the stud separates it from the cap 15 on its lower end. The gas pressure in the bore of the stud and below it drives the stud up into the reduced upper portion of the passage through the expansion member and thereby forces the segments of that member out away from one another and thus expands the upper end of the expansion member into the surrounding rock, as shown in Fig. 3. The pressure builds up very rapidly in the small bore of the stud, but until the stud leaves its cap the pressure has only the small cross-sectional area of the bore to act against to produce the velocity of the stud. As soon as the stud leaves the cap, the

high pressure gases expand into passage 6 below the stud, where the diameter of the passage is as great as the external diameter of the stud. This gives the gases a greatly increased area to act against, thereby giving increased power velocity and work to the stud. The gas pressure inside the bore of the stud expands its thin wall tightly against the side of passage 6 so that the gas can not escape past the stud, which does not completely leave the large lower portion of the passage. Consequently, there is no escaping gas to cause noise. Recoil is absent, because the tendency of the explosion to drive the bolt downward is counteracted by the tendency of the stud to drive the expansion sleeve upward.

The expanded anchor serves as a strong support for the bolt that is suspended from it. Following the anchoring operation, which takes only a moment, the nut at the lower end of the bolt is screwed upward to force plate 22 up tightly against the mine roof to prevent the roof from falling. Later, if desired, the bolt and plate can be salvaged by unscrewing the bolt from the anchor.

It will be seen that the anchor described herein is of simple construction and is easy to operate. There is nothing about it to get out of order, and only a few seconds are required to install it after the mine roof has been drilled. It also is relatively inexpensive and requires no movement of the bolt to fire the projectile in the anchor.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. An explosive-actuated mine roof bolt anchor comprising a vertical barrel-like expansion member provided with an axial passage having its lower portion adapted to receive and be fastened to the upper end of a bolt to be inserted in a hole drilled up into a mine roof, an upwardly directed projectile slidably mounted in the central portion of said passage and having a tapered upper end, the upper portion of the passage being of smaller diameter than the projectile and joined to said central portion by a shoulder, a yieldable retarding ring encircling the tapered end of the projectile and engaging said shoulder to space said tapered end from said member, and means for firing the projectile to drive it upward into said upper portion of the passage to expand the surrounding portion of said member.

2. An explosive-actuated mine roof bolt anchor, comprising a vertical barrel-like expansion member provided with an axial passage having its lower portion adapted to receive and be fastened to the upper end of a bolt to be inserted in a hole drilled up into a mine roof, a stud slidably mounted in the central portion of said passage and having an axial bore extending upward therein from its lower end, a charge of powder in the bore, removable means closing the lower end of the bore, an axial opening connecting the upper end of said bore with the top of the stud, an electric primer disposed in the bore, electric wires attached to the primer and extending up through said opening, said wires extending out of said member and being adapted to be led down beside it for connection to a source of electricity

5

outside of said mine roof hole, whereby said charge can be detonated electrically to drive the stud upward, the upper portion of said passage being of smaller diameter than the stud so that when the stud is driven upward into it the upper portion of said member will be expanded.

3. An explosive-actuated mine roof bolt anchor, comprising a vertical barrel-like expansion member provided with an axial passage having its lower portion adapted to receive and be fastened to the upper end of a bolt to be inserted in a hole drilled up into a mine roof, a stud slidably mounted in the central portion of said passage and having an axial bore extending upward therein from its lower end, a charge of powder in the bore, removable means closing the lower end of the bore, an axial opening connecting the upper end of said bore with the top of the stud, an electric primer disposed in the bore, electric wires attached to the primer and extending up through said opening, the outside of said member being provided with a vertical groove, said wires extending out of said member and down through said groove, the lower ends of the wires being adapted to be connected to a source of electricity outside of said mine roof hole, whereby said charge can be detonated to drive the stud upward, the upper portion of said passage being of smaller diameter than the stud so that when the stud is driven upward into it the upper portion of said member will be expanded.

4. An explosive-actuated mine roof bolt an-

6

chor, comprising a vertical barrel-like expansion member provided with an axial passage having its lower portion adapted to receive and be fastened to the upper end of a bolt to be inserted in a hole drilled up into a mine roof, a stud slidably mounted in the central portion of said passage and having an axial bore extending upward therein from its lower end, a charge of powder in the bore, removable means closing the lower end of the bore, the upper end of the stud being tapered, the upper portion of said passage being of smaller diameter than the projectile, and joined to said central portion by a shoulder, a yieldable retarding ring encircling the tapered end of the stud and engaging said shoulder to space said tapered end from said member, and an electric primer in said bore for detonating said charge to drive the stud upward into said upper portion of the passage to expand the surrounding portion of said member.

ROBERT TEMPLE.

REFERENCES CITED

25 The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
750,623	Edmunds -----	Jan. 26, 1904
2,141,098	Wahlstrom -----	Dec. 20, 1938
2,362,738	Yarbrough -----	Nov. 14, 1944