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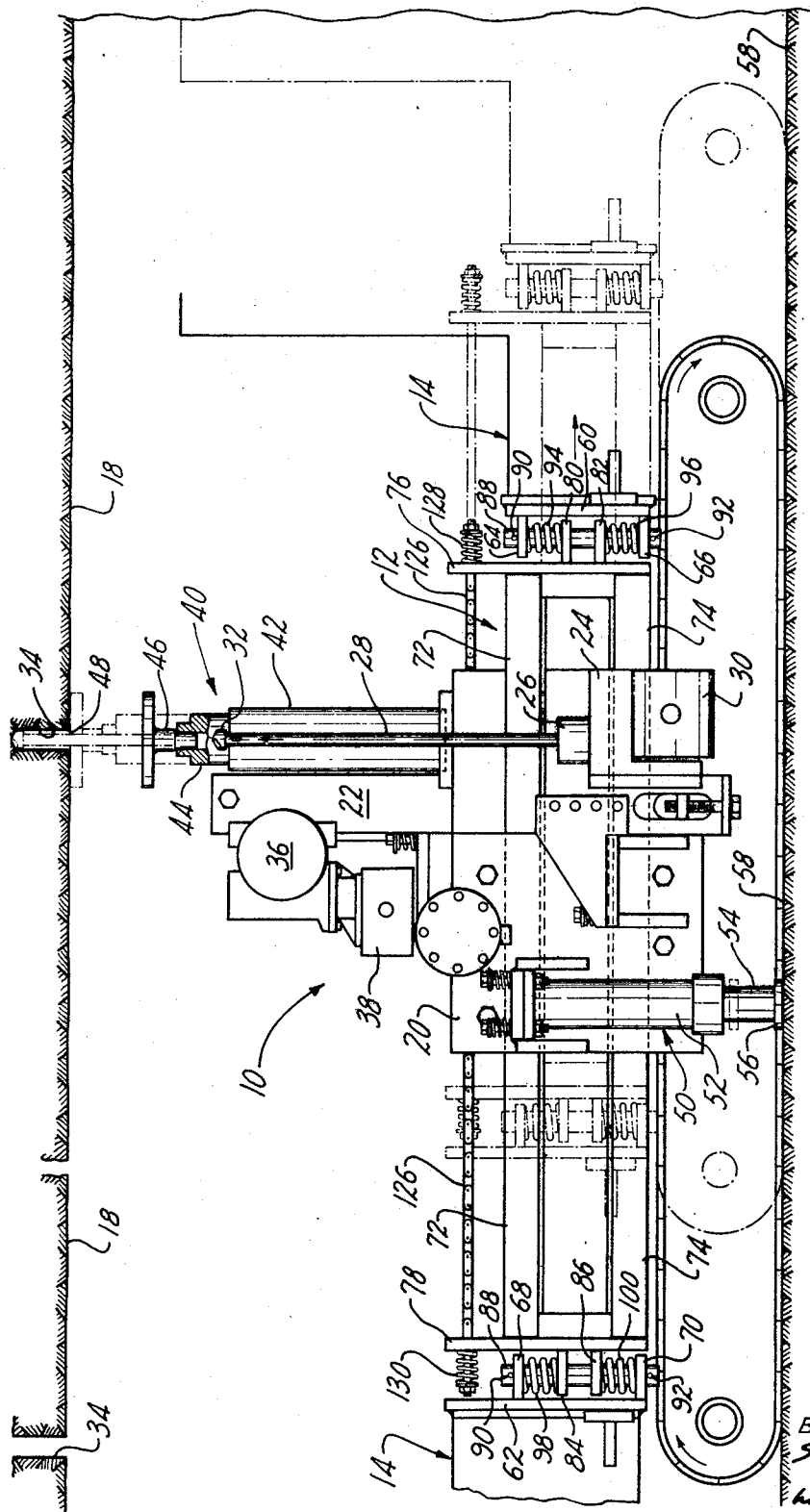
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3,493,058

ROOF DRILLING AND BOLTING METHOD AND APPARATUS

Filed April 30, 1968

2 Sheets-Sheet 1.



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2 Sheets-Sheet 2

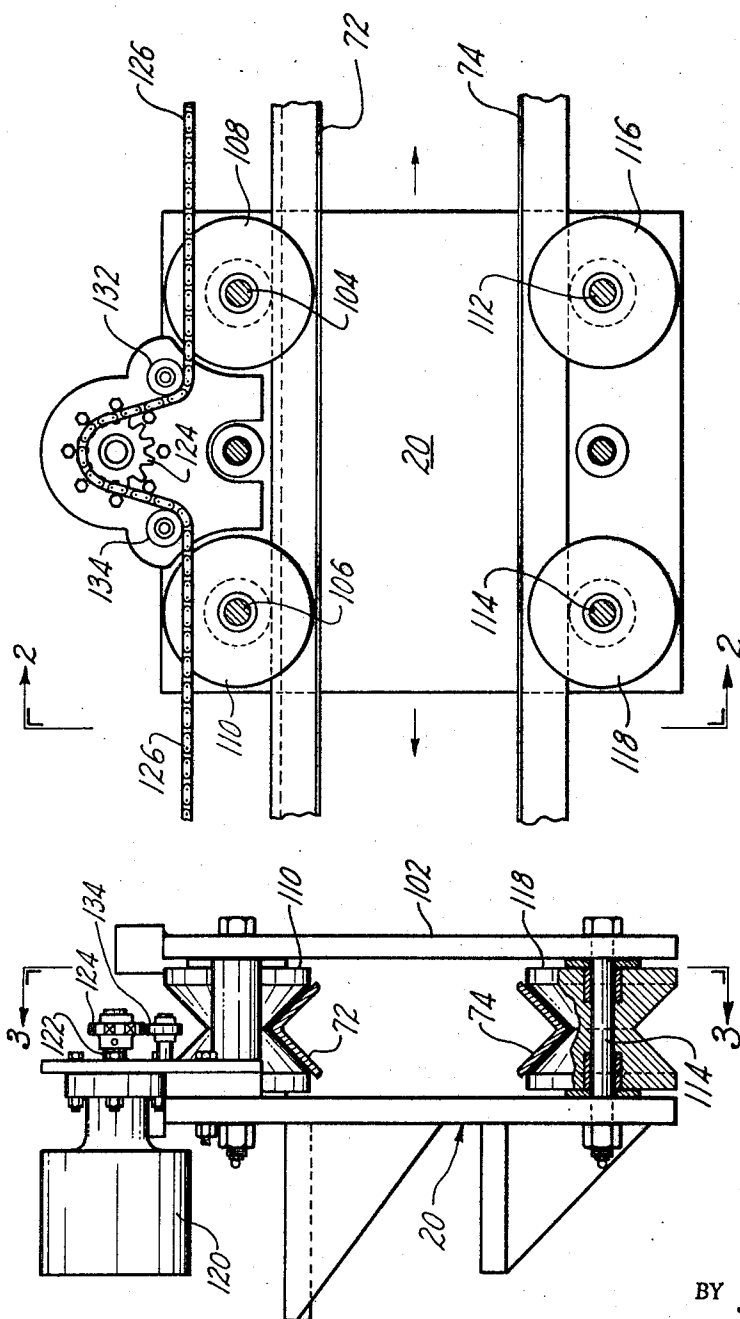
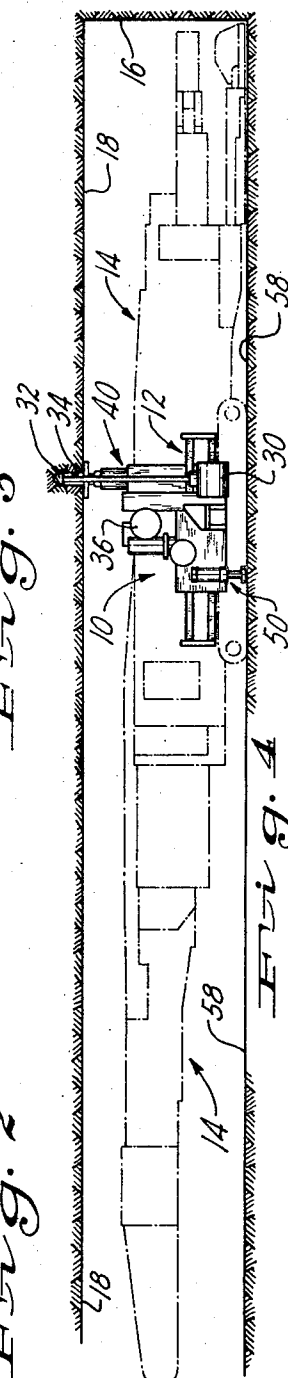


Fig. 2



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ROOF DRILLING AND BOLTING METHOD AND APPARATUS

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6 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure relates to a roof bolter mounted on the side of a continuous mining machine. The roof bolter assembly includes a carriage with a bolter mask, a roof jack and a floor jack mounted thereon. A bolter drill unit is arranged to move vertically on the bolter mast to drill vertical bolt holes in the mine roof and to tighten roof bolts positioned in the bolt holes. The roof jack and floor jack are arranged to be extended into abutting relation with the mine roof and mine floor to support the roof and lock the bolter carriage in a fixed position. A frame member is connected to the side of the mining machine and has a pair of rails extending longitudinally along the side of the mining machine. The carriage has upper and lower sets of wheels supported on the rails to permit relative longitudinal movement between the mining machine and the roof bolter assembly. A hydraulically driven sprocket is mounted on the carriage and meshes with a longitudinally extending chain that is secured to the frame member. The sprocket is arranged to move the bolter assembly longitudinally on the frame member.

The method of bolting while continuously mining and advancing the mining machine into the mine face includes advancing the roof bolter carriage along the rails to a location adjacent to the front end of a frame secured to the mining machine. Roof and floor jacks are thereafter extended to lock the roof bolter assembly between the mine roof and the mine floor and support the mine roof at that location. The mining machine continues to advance and move relative to the stationary roof bolter assembly while the roof bolter assembly drills a vertical bolt hole in the roof and thereafter sets a roof bolt in the bolt hole. After the roof bolt has been set, the roof jack and floor jack are retracted and the roof bolter assembly is moved along the frame toward the front end of the frame for setting a roof bolt at this forward location. During the repositioning of the roof bolter assembly on the frame, the mining machine continues to advance and dislodge coal from the face.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to a method and apparatus for installing roof bolts along the side of a vehicle while the vehicle is moving. More particularly, this invention relates to a method and apparatus for mounting a roof bolter assembly on a mining machine and fixedly positioning the roof bolter assembly to install roof bolts without interrupting the forward advance of the mining machine.

Description of the prior art

In continuous underground mining, the mining machine dislodges the material from the face and conveys the dislodged material rearwardly to a receiver. The mining machine is designed to continuously advance and dislodge the material being mined, thus forming an entry

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or tunnel in the seam. It has been found, however, where roof conditions require roof support near the mine face, that continuous operation and advance of the mining machine is not possible. At intervals, the mining operation must be stopped and withdrawn from the entry. A roof bolter similar to the roof bolters illustrated in United States Patents 2,718,118; 2,771,273; 2,815,191; 2,854,217 and 2,870,994 is then moved into position in the entry adjacent the mine face. The roof bolter drills vertical holes in the mine roof and wedge-type roof bolts are inserted in the holes. The bolter has a wrench-like attachment that tightens the bolts in the wedge-type shell to provide the needed support for the roof. After the bolts are set, the roof bolter is withdrawn from the entry and the continuous mining machine is again moved into the entry into a position adjacent the mine face. The mining machine then continuously dislodges material until it exposes a section of unsupported roof that would create a hazard if not supported by roof bolts. The mining operation is again interrupted while roof bolts are set in this section of unsupported roof. It is apparent that this mining procedure is intermittent and does not utilize the capabilities of the continuous mining machine.

United States Patent 3,268,258 entitled "Conveying and Roof Bolting Method and Apparatus" suggests a solution to the problem of interrupting the operation of the mining machine, in order to install and set roof bolts. A surge device that is positioned behind the continuous miner has roof bolters mounted on the side. The surge device is moved under the tail conveyor of the mining machine a sufficient distance so that the mining machine can continue to advance while the surge device remains stationary and the roof bolters set bolts in the roof. The surge device then advances to a second position under the tail conveyor of the mining machine. The solution suggested by United States Patent 3,268,258 has several material limitations. An expensive surge device that follows the continuous miner is essential. The surge device must be separately propelled and cannot be connected to the mining machine for movement therewith. It is necessary for the surge device to remain stationary while the roof bolters set the bolts and the roof is not supported at the locations where the bolts are being set. The solution suggested by United States Patent 3,268,258 would not be suitable where roof conditions limit the unsupported section of roof to a span that is less than the length of the continuous mining machine. In certain mines, safety regulations require the roof above the mining machine operator to be supported and the apparatus suggested in United States Patent 3,268,258 does not protect the mining machine operator because the mining machine operator is always exposed to unsupported roof.

SUMMARY OF THE INVENTION

The hereinafter described invention now permits the mining machine to continuously operate while the roof bolts are set closely adjacent the mine face. A roof bolter assembly is movably supported on rails that are secured to the side of the mining machine. Roof and floor jacks fixedly position the roof bolter assembly in the entry and the rail mounting permits the mining machine to advance in the entry relative to the fixed roof bolter assembly. While the mining machine is advancing and dislodging material, the stationary roof bolter is drilling vertical holes in the roof and setting roof bolts in the drilled holes. The roof bolter is connected to the mining machine adjacent the operator's compartment for the mining machine operator and the extended roof and floor jacks provide roof support while the roof bolts are being set.

Accordingly, the primary object of this invention is to provide a method and apparatus for setting roof bolts in

the mine roof closely adjacent the mine face while the continuous mining machine is advancing and dislodging material from the face.

Another object of this invention is to provide a roof bolter movably mounted on a mining machine and operable to set roof bolts while the mining machine is moving relative to the roof bolter.

A still further object of this invention is to provide a means for maintaining a roof bolter mounted on a continuous mining machine in fixed position while the continuous mining machine moves relative thereto.

These and other objects and advantages of this invention will be more completely disclosed and described in the following specification, the accompanying drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a view in side elevation of the roof bolter and the mounting frame. An advanced position of the mounting frame is illustrated in dash-dot lines.

FIGURE 2 is a fragmentary view in end elevation illustrating the manner in which the roof bolter is mounted on the frame member, and is taken along the line 2—2 of FIGURE 3.

FIGURE 3 is a view in side elevation illustrating the carriage motor mounting means and the apparatus for positioning the roof bolter longitudinally on the frame member taken along the line 3—3 in FIGURE 2.

FIGURE 4 is a diagrammatic representation of the roof bolter mounted on a continuous mining machine. The mining machine is illustrated in dash-dot-dash lines as being in a mine entry.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, and particularly to FIGURES 1 and 4, there is illustrated a roof bolter generally designated by the numeral 10 that is movably supported on a frame member 12. The frame member 12 is, in turn, secured to the side of a mining machine 14 (FIGURE 4). Although the mining machine 14 illustrated in FIGURE 4 is an oscillating arm-type mining machine wherein there are rotatable cutter heads secured to forwardly extending cutter arms having cutter bits secured to their periphery for dislodging the material from the mine face 16 by oscillating in a horizontal arc across the mine face, it should be understood that the roof bolter hereinafter described may be secured to the side of any continuous mining machine, as, for example, a boring type mining machine or an endless chain ripper type mining machine. Also, although the roof bolter 10 is illustrated as being secured to the side of a mining machine 14, it should be understood that the hereinafter described invention is intended to encompass the use of the roof bolter secured to the side of an auxiliary loading device such as a "surge vehicle" positioned beneath the discharge end portion of the mining machine conveyor. The surge vehicle may, with the hereinafter described roof bolting mechanism, be connected to and move with the mining machine as the mining machine advances during the mining operation. The roof bolter mechanism may also be connected to a separate loading machine that gathers material from the mine floor and discharges the material into a haulage vehicle. Although a single roof bolter 10 is illustrated connected to one side of the mining machine 14, it should also be understood that a similar roof bolter 10 may be connected to the other side of the same mining machine to simultaneously set a pair of bolts in the mine roof 18 while the mining machine 14 continues to advance and dislodge material from the mine face 16.

Referring to FIGURE 1, the roof bolter 10 has a carriage 20 with a bolter mast 22 connected thereto and extending vertically therefrom. A bolter drill unit 24 is arranged to move vertically in suitable guideways provided on the bolter mast 22 and has a receiver 26 for a

drill steel 28. A torque motor 30 is provided to rotate the drill steel so that the drill bit 32 connected to the end of the drill steel 28 may penetrate the mine roof 18 and form a vertical bolt hole 34. The receiver 26 also serves as a torque device to tighten the roof bolt that is positioned in the bolt hole 34. A bolter feed unit 36 is arranged through a connecting means such as chains or the like to move the bolter drill unit 24 vertically on the mast 22 to advance and retract the drill bit 32 and drill steel 28 in the bolt hole 34. A feed motor 38 is connected to the bolter feed unit 36 and provides the torque to advance or retract the bolter drill unit 24 on the mast 22. The torque motor 30 and feed motor 38 are preferably conventional hydraulic motors supplied with fluid under pressure from the mining machine hydraulic system or from a separate hydraulic power source. The elements of the roof bolter 10 are of conventional construction and are disclosed in the roof bolters enumerated in the previously referred to United States patents.

A roof jack generally designated by the numeral 40 has a cylinder 42 connected to the carriage 20 with a piston rod 44 telescopically positioned therein. The roof jack 40 is aligned transversely with the drill steel 28 and provides roof support during the drilling operation. The piston rod 44 has a pedestal end portion 46 that is arranged to abut the mine roof 18 and provide a bearing surface for roof support during the bolting operation. A floor jack generally designated by the numeral 50 has a cylinder 52 secured to the carriage 20 with a piston rod 54 telescopically positioned therein. The piston rod 54 has an enlarged end portion 56 that is arranged to abut the mine floor 58. The roof jack cylinder 42 and floor jack cylinder 52 have openings adjacent the end portions to permit hydraulic fluid to flow into or out of the cylinders on opposite sides of the piston (not shown) to extend or retract the respective piston rods 44 and 54. The cylinders 42 and 52 are connected to a common source of hydraulic fluid under pressure so that the end portions of the respective piston rods 44 and 54 will move into abutting relation with the mine roof 18 and mine floor 58 and fixedly secure the roof bolter 10 in a predetermined position within the mine entry. The fluid under pressure maintains the jacks 40 and 50 in extended position and provides roof support during the bolting operation. Where transverse roof supports such as metal channel members or wood planks are used, the pedestal end portion 46 of roof jack 40 supports the channel or plank while the roof bolt is set in the roof to secure the transverse support thereto.

The mining machine 14 has a pair of outwardly extending brackets 60 and 62 secured to the machine side wall. The bracket 60 has a pair of inwardly extending arms 64 and 66 with aligned apertures therethrough. The bracket 62 has a similar pair of inwardly extending arms 68 and 70 with aligned apertures therethrough. The frame member 12 has a pair of horizontal rails 72 and 74 secured at their end portions by vertical members 76 and 78. The vertical member 76 has a pair of spaced outwardly extending arms 80 and 82 with aligned apertures therethrough. Similarly, the vertically extending member 78 has a pair of outwardly extending arms 84 and 86 with vertically aligned apertures therethrough. The frame member 12 is positioned with the vertical member outwardly extending arm portions 80 and 82 between the inwardly extending arm portions 64 and 66 of the bracket 60. A pin member 88 extends through the aligned apertures in the arms 64, 80, 82 and 66 and has transverse pin members 90 and 92 extending therethrough to maintain the pin members in the respective apertures. Spring member 94 is positioned between arm members 64 and 80 and urges the respective arm members away from each other. Similarly, spring member 96 is positioned between arms 82 and 66 to maintain the respective arm members in spaced relation to each other. A pair of springs 98 and 100 are positioned between the inwardly and outwardly extending arm members 68, 84, 86 and 70 on the opposite side of frame mem-

ber 12 and provide a similar resilient support for the frame member 12. With this arrangement, the frame member 12 is free to move vertically to a limited extent between the arm members 64 and 66 on bracket 60 and arm members 68 and 70 on bracket 62 to provide a floating support for the frame member 12. This resilient support of the frame member 12 on the mining machine 14 absorbs the stresses and shock forces exerted to the assembly as the mining machine 14 advances over uneven terrain and the bolter mechanism 10 is fixedly positioned to drill bolt holes in the roof and set roof bolts therein.

The rails 72 and 74 are angular in configuration, as illustrated in FIGURE 2, with the corner of rail 72 facing upwardly and the corner of rail 74 facing downwardly. The carriage 20 has a rear plate member 102 with a pair of upper axles 104 and 106 positioned therebetween in spaced relation to each other. The axle 104 has a trolley wheel 108 rotatably positioned thereon and axle 106 has a trolley wheel 110 rotatably positioned thereon. The wheels have recessed center portions that conform to the configuration of the angular rail 72 and are arranged to ride on the upper surface of rail 72. The carriage 20 has another pair of spaced lower axles 112 and 114 with trolley wheels 116 and 118 mounted thereon. The trolley wheels 116 and 118 also have recessed center portions that conform to the angular configuration of rail 74. With this arrangement, the carriage 20 is supported on the rails 72 and 74 for longitudinal movement on the frame 12. The arrangement of the trolley wheels 108, 110, 116 and 118 and rails 72 and 74 prevent vertical movement of the carriage 20 relative to the frame 12.

The carriage 20 has a carriage motor 120 mounted thereon with a drive shaft 122. A sprocket 124 is non-rotatably secured to the drive shaft 122 and meshes with a chain 126. The chain 126 is anchored to the brackets 76 and 78 by means of the resilient securing devices 128 and 130. Idler rollers 132 and 134 extend from the carriage 20 and are arranged to maintain the chain 126 in meshing relation with the sprocket 124. With this arrangement, the carriage motor 120 rotates the sprocket 124 and moves the carriage 20 longitudinally on the frame 12 by means of the chain 126.

OPERATION

The roof bolter 10 is arranged to drill holes in the mine roof 18 and set bolts therein while the mining machine continuously advances in the following manner. During the mining operation, the mining machine 14 advances into the mine face 16 and dislodges material therefrom. The dislodged material is gathered by suitable gathering means and conveyed rearwardly by a conveyor on the mining machine 14 and discharged into a receiver behind the mining machine. To set a roof bolt with bolter 10, the roof jack 40 and floor jack 50 are first retracted away from the mine roof 18 and mine floor 58 to permit forward movement of the carriage 20 on the frame 12. The carriage drive motor 120 is then actuated to rotate the sprocket 124 and advance the roof bolter 10 toward the front end of the frame member 12 and the front bracket 76. When the roof bolter reaches this position, the carriage positioning motor 120 is de-energized and a hydraulic valve is opened to supply hydraulic fluid pressure to the under side of the roof jack pistons to extend the roof jack piston rod 44 into abutting relation with the mine roof 18 and extend the floor jack piston rod 54 into abutting relation with the mine floor 58. Sufficient fluid pressure is applied to the pistons to provide roof support with the roof jack 40.

When the roof jack 40 and floor jack 50 are extended, the roof bolter 10 is fixed relative to the mine entry. The mining machine 14 and the frame 12 are free, however, to continue to move forwardly. As the mining machine 14 moves forwardly, the roof bolter 10 is displaced rearwardly, or moves rearwardly, on the frame 12, as is illustrated in FIGURE 1. The dotted outline of the frame

12 indicates the advance of the frame 12 and mining machine 14, while the roof bolter 10 remains stationary. While the roof bolter 10 is fixed within the mine entry, and the mining machine 14 continues to advance relative thereto, a drill steel 28 with a drill bit 32 is positioned in receiver 26 and the torque motor 30 is actuated to rotate the drill bit 32. The drill feed motor 38 is energized to move the bolter drill unit 24 vertically on the mast 22 by means of the bolter feed unit 36. After the drill steel 28 has penetrated and formed a vertical bolt hole 34 in the mine roof of a preselected depth, the feed motor is reversed to actuate the bolter feed unit in the opposite direction to remove the drill steel 28 from the bolt hole 34. The drill steel 28 is removed from the receiver 26 and a bolt is inserted in the bolt hole 34. The feed motor is again actuated to move the bolter drill unit 24 vertically on the mast 22 to connect the receiver 26 to the roof bolt head. The torque motor 30 is then actuated to apply torque to the roof bolt and tighten the wedge type locking device within the bolt hole 34 to secure the roof bolt in the roof bolt hole 34 in a conventional manner.

It will be appreciated that, while the bolt hole 34 is being drilled in the mine roof 18, while the roof bolt is being positioned in the bolt hole 34 and while the bolt is being secured or tightened in the bolt hole 34, the mining machine 14 is continually advancing and dislodging material. The frame 12 is moving forwardly relative to the fixed roof bolter 10 with the mining machine so that in essence, the mining machine 14 is advancing relative to the roof bolter 10. While the bolt hole 34 is being drilled in the roof and the roof bolt positioned therein and tightened by the bolter drill unit 24, the roof jack 40 and the floor jack 50 are extended to serve two purposes, the first being to maintain the roof bolter 10 in a fixed position relative to the mine entry and the second being to also serve as a roof support.

After the roof bolt has been set, the floor and roof jacks 40 and 50 are retracted and the carriage positioning motor 120 is actuated to again advance the bolter unit 10 on the frame 12 to a position adjacent the front bracket 76 where the roof bolting and setting operation is again repeated.

I claim:

1. Apparatus for connecting a roof bolter to a machine arranged to move in a mine entry comprising, support means for said roof bolter connected to said machine, means to permit vertical movement of said machine relative to said support means, means to move said roof bolter on said support means, and means to fixedly position said roof bolter relative to the roof while permitting said support means and said machine to move longitudinally relative to said roof, and said machine to move vertically relative to said support means, said roof bolter operable to perform a drilling and bolt setting operation while said machine moves relative to said roof bolter and said support means.
2. Apparatus for connecting a roof bolter to a machine arranged to move in a mine entry as set forth in claim 1 in which, said support means includes a frame member mounted on brackets extending laterally from the side of said machine, said frame member having longitudinally extending parallel rail members, and means to move said roof bolter longitudinally on said support means including wheels rotatably secured to said roof bolter and mounted on said frame rail members.
3. Apparatus for connecting a roof bolter to a machine arranged to move in a mine entry as set forth in claim 1, in which,

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said means to fixedly position said roof bolter relative to said roof includes,

a telescopic floor jack connected to said roof bolter and operable to be extended into abutting relation with the mine floor, and

a telescopic roof jack connected to said roof bolter and operable to be extended into abutting relation with said mine roof,

said floor jack and said roof jack operable to secure said roof bolter in a fixed position in said mine entry.

4. Apparatus for connecting a roof bolter to a machine arranged to move in a mine entry as set forth in claim 2 in which,

said means to move said roof bolter includes, a chain member extending longitudinally on said frame member,

a sprocket rotatably mounted on said roof bolter and meshing with said chain,

drive means for rotating said sprocket and moving said roof bolter forwardly and rearwardly on said frame rail members.

5. Apparatus for connecting a roof bolter to a machine arranged to move in a mine entry as set forth in claim 1 in which,

said support means includes a frame member mounted on brackets extending laterally from the side of said machine,

said frame member having longitudinally extending parallel rail members,

said means to move said roof bolter relative to said support means including wheels rotatably secured to said roof bolter and mounted on said frame rail member,

a chain member extending longitudinally on said frame member,

8

a sprocket rotatably mounted on said roof bolter and meshing with said chain,

drive means for rotating said sprocket and moving said roof bolter forwardly and rearwardly on said frame rail members,

a telescopic floor jack connected to said roof bolter and operable to be extended into abutting relation with the mine floor,

a telescopic roof jack connected to said roof bolter and operable to be extended into abutting relation with said mine roof, and

said floor jack and said roof jack operable to secure said roof bolter in a fixed position in said entry.

6. Apparatus for connecting a roof bolter to a machine arranged to move in a mine entry as set forth in claim 2 which includes resilient means connecting said frame member to said bracket, said resilient means operable to permit vertical movement of said frame member relative to said bracket and said machine.

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ERNEST R. PURSER, Primary Examiner

U.S. Cl. X.R.

173—34; 175—315; 299—33