April 6, 1954 J. C. CURTIS 2,674,441

SELF-SUPPORTING STOPER ROCK DRILL

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Fig. 1.

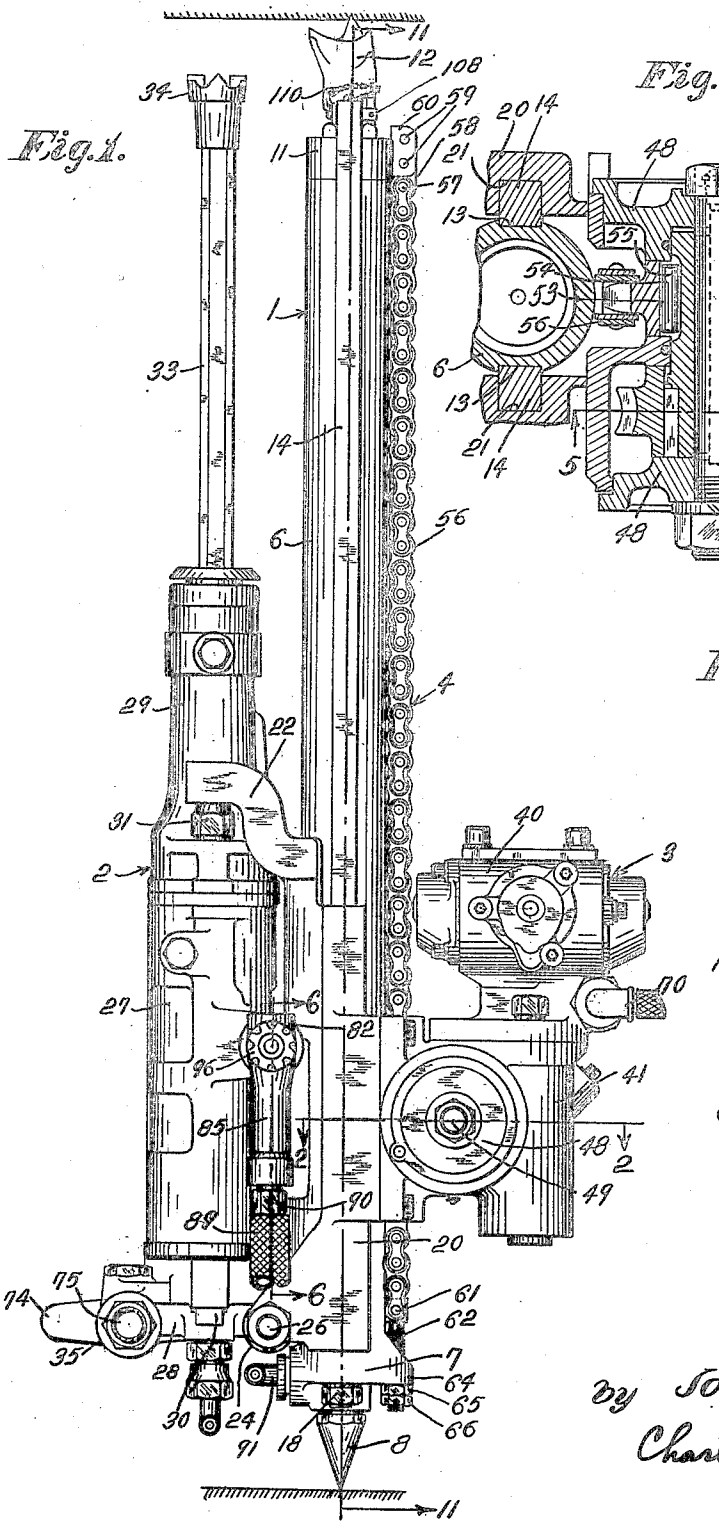
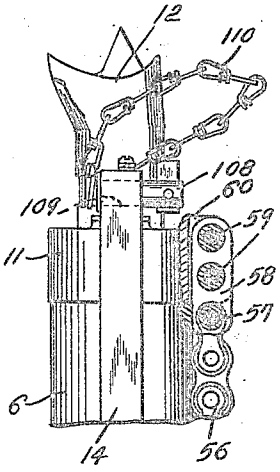


Fig. 2.

Fig. 3.



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Fig. 4.

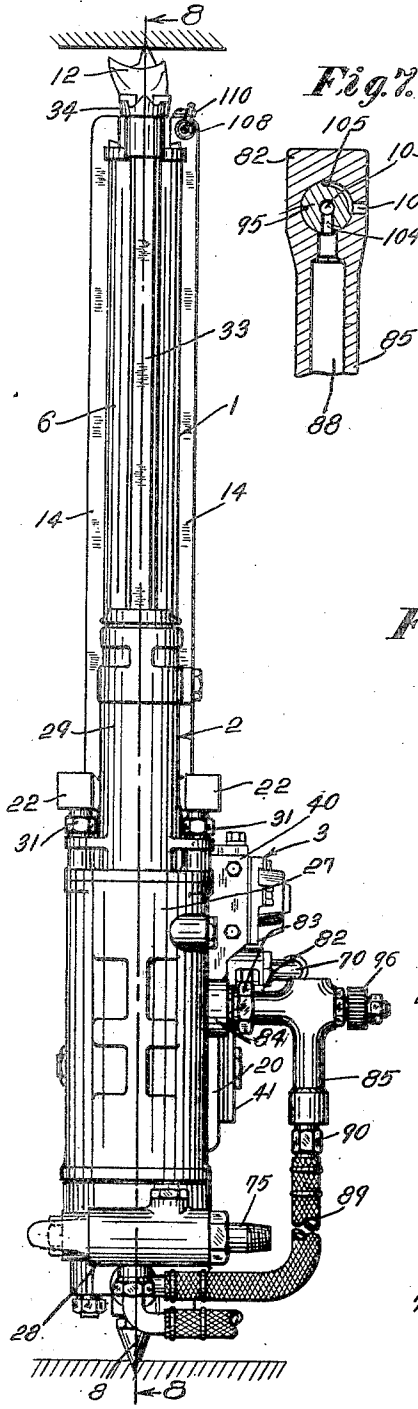


Fig. 7.

Fig. 5.

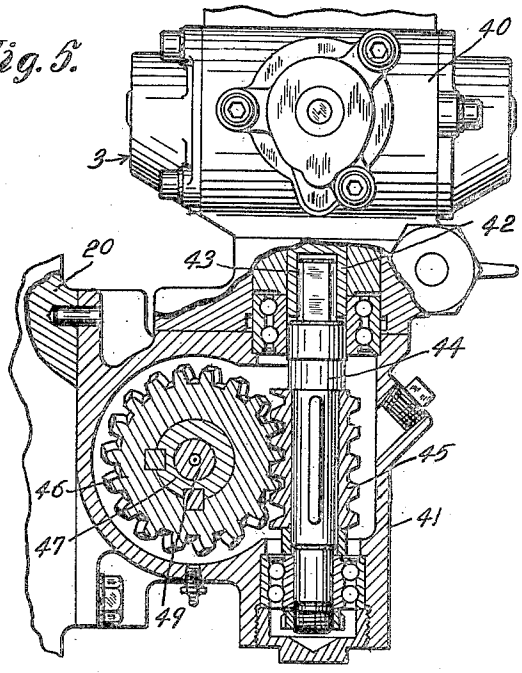
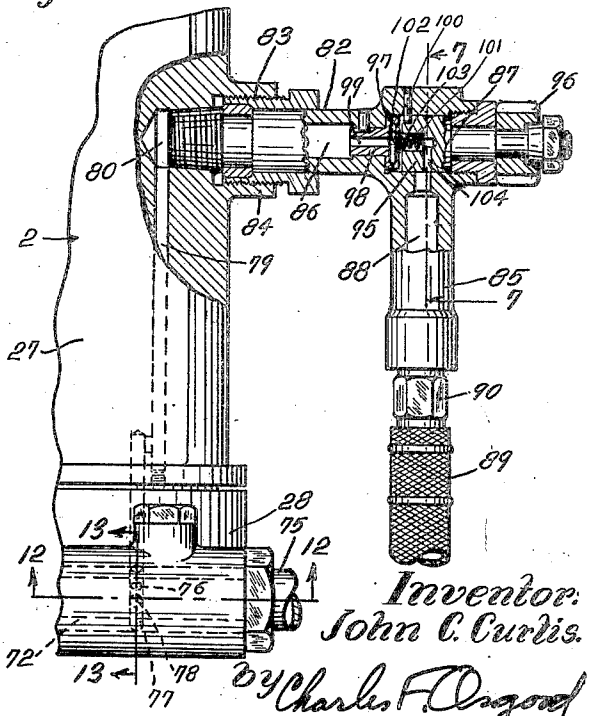


Fig. 6.



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Fig. 8.

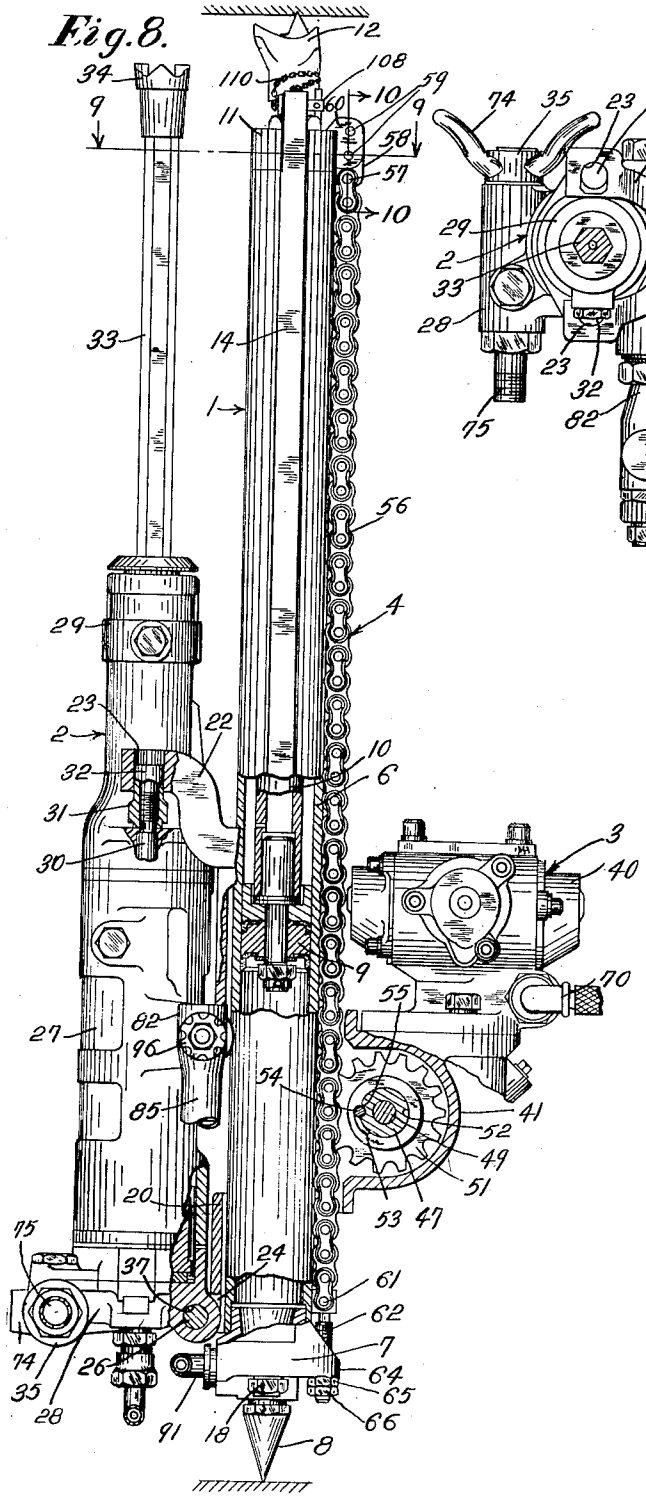


Fig. 9.

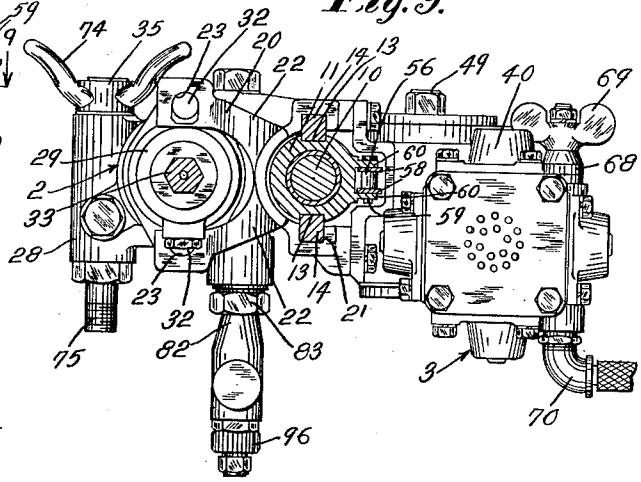
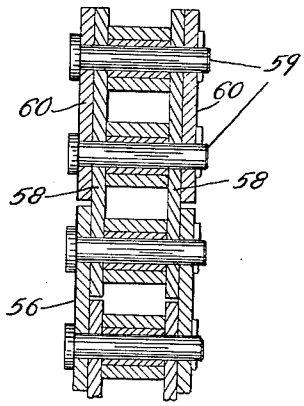


Fig. 10.



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SELF-SUPPORTING STOPER ROCK DRILL

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Fig. 11.

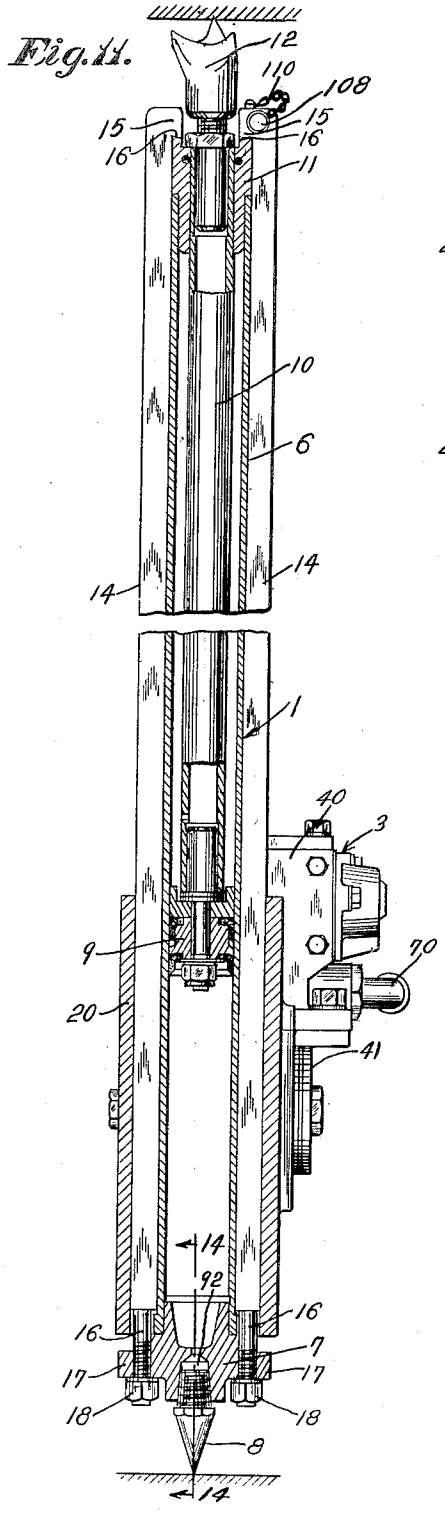


Fig. 12.

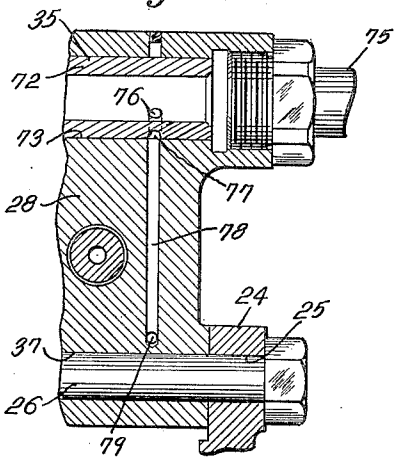


Fig. 13.

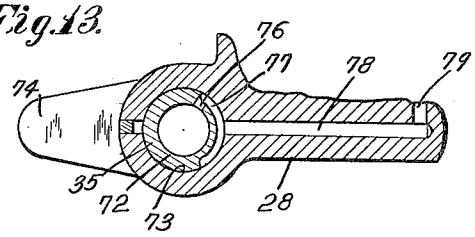
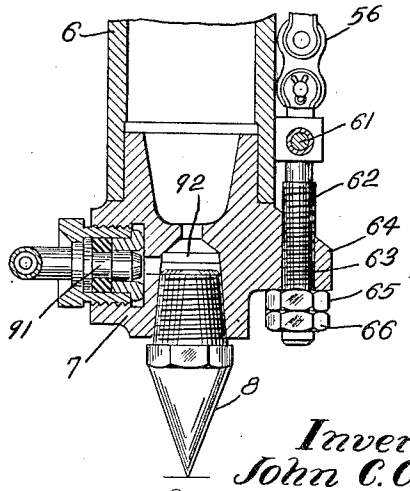


Fig. 14.



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2,674,441

UNITED STATES PATENT OFFICE

2,674,441

SELF-SUPPORTING STOPER ROCK DRILL

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Application May 20, 1949, Serial No. 94,341

9 Claims. (Cl. 255—53)

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This invention relates to rock drills and more particularly to a hammer rock drill of the self-supporting stoper type which is extremely longitudinally compact in design.

In the drilling of upright or substantially upright holes in the rock strata of the roof of a subterranean excavation and particularly in underground metal mines, it is common practice to use stoper type drills of the pneumatic feed leg type which have a cylinder and piston type feeding device aligned with the drilling motor and which engages the mine floor and feeds the drill bit toward the work during the hole drilling operation. Conventional types of stoper rock drills have supporting handles and are manually supported with respect to the work during the drilling operation but a known type of stoper rock drill is made self-supporting by the provision of a pneumatically operated roof engaging device, and the drilling motor is arranged at one side of the pneumatic feed cylinder but in this latter type of stoper rock drill it has not been found possible to obtain the desired longitudinal compactness such as is necessary in certain underground mines where the spaces are relatively restricted. The present invention contemplates improvements over known types of stoper rock drills in that not only is the drill made self-supporting but also the overall length of the drill is reduced to a minimum, enabling drilling of upright holes in the mine roof in such restricted spaces as has heretofore not been found possible. The drill of the present invention is provided with a pneumatic cylinder or column having a pointed floor engaging element and including a fluid actuated piston having a pointed roof engaging element carried by the outer end of its piston rod. The drilling motor is arranged and mounted at one side of the supporting cylinder or column and is guided on longitudinal guides at the sides of the supporting cylinder or column and is preferably fed by an independent feeding motor arranged at the opposite side of the supporting cylinder or column and mounted to move with the drilling motor along the guides during the feeding operation. The feeding means of the present invention, in a preferred embodiment, is of the mechanical chain and sprocket type providing a relatively long range of feed, and includes a feed chain extending longitudinally along one side of the supporting cylinder or column substantially coextensive therewith and driven by the independent feeding motor, and a feed sprocket engaging the feed chain, and the latter is attached at its opposite ends to the opposite ends of the cylinder or column. Due

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to the novel structure and relationship of parts, the drill is made relatively simple and rugged, has a relatively long feeding range and is of extreme longitudinal compactness, while at the same time it is made self-supporting thereby making it much safer to operate particularly when drilling in the relatively restricted spaces for which it was designed.

An object of the present invention is to provide an improved stoper rock drill for drilling upright or substantially upright holes in the overlying rock strata of a mine roof. Another object is to provide an improved stoper rock drill of the self-supporting type. A further object is to provide an improved rock drill having improved mechanical feeding means which is associated with the drill supporting means. Yet another object is to provide an improved stoper rock drill which, due to its novel design, is extremely longitudinally compact thereby facilitating handling and use of the drill in the relatively restricted spaces encountered in underground mines. Another object is to provide an improved feeding mechanism having a relatively long range of feed. A still further object is to provide an improved rock drill having a novel arrangement and combination of parts. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawings there is shown for purposes of illustration one form which the invention may assume in practice.

In these drawings:

Fig. 1 is a side elevational view of a stoper rock drill constructed in accordance with a preferred illustrative embodiment of the invention.

Fig. 2 is an enlarged cross sectional view taken substantially on line 2—2 of Fig. 1.

Fig. 3 is an enlarged side elevational view, with parts broken away in section, illustrating the forward or upper portion of the drill supporting means.

Fig. 4 is a front elevational view of the drill shown in Fig. 1, on a slightly reduced scale.

Fig. 5 is a vertical sectional view taken substantially on line 5—5 of Fig. 2.

Fig. 6 is a detail vertical sectional view taken on line 6—6 of Fig. 1, with parts in full.

Fig. 7 is a detail vertical sectional view taken on line 7—7 of Fig. 6.

Fig. 8 is a central longitudinal vertical sectional view taken substantially on line 8—8 of Fig. 4, with parts shown in full to facilitate illustration.

Fig. 9 is a cross sectional view taken on line 9—9 of Fig. 8.

Fig. 10 is a detail vertical sectional view taken

on line 10—10 of Fig. 8, showing the attaching means for the upper end of the feed chain.

Fig. 11 is a central longitudinal vertical sectional view taken substantially on line 11—11 of Fig. 1.

Fig. 12 is a detail horizontal sectional view taken on line 12—12 of Fig. 6.

Fig. 13 is a detail vertical sectional view taken on line 13—13 of Fig. 6.

Fig. 14 is an enlarged detail vertical sectional view taken on line 14—14 of Fig. 11, showing the attaching means at the lower end of the feed chain and the fluid inlet connection for the supporting cylinder.

In this illustrative embodiment of the invention, the improved stoper rock drill, as shown in the drawings, generally comprises an upright supporting cylinder and piston device or supporting column 1, a drilling motor 2 guided on the supporting device or column for the vertical movement longitudinally thereon, and a feeding motor 3 which drives a mechanical chain and sprocket feeding mechanism 4 associated with the supporting device or column 1. The drilling and feeding motors 2 and 3 are arranged and mounted at opposite sides of the supporting device or column and are so constructed that a stoper drill which is relatively longitudinally compact results.

The upright supporting device or column 1 comprises a vertical cylinder 6 having a bottom head 7 provided with a pointed floor engaging element 8, and contained in the cylinder is a reciprocable piston 9 (Fig. 8) having its piston rod 10 extending upwardly through the packed top cylinder head 11. The upper end of the piston rod 10 is provided with a pointed roof engaging element 12. When fluid under pressure is supplied to the lower end of the cylinder 6 beneath the piston 9 the latter is moved upwardly within the cylinder to bring the pointed element 12 into engagement with the mine roof, so that the supporting device or column may be supported in an upright position between the mine floor and roof, firmly to support the drill in position during the drilling operation. Arranged longitudinally along the sides of the supporting cylinder 6 and seated in longitudinal grooves 13 formed exteriorly of the cylinder are longitudinal guides 14, 14 which have hook-shaped upper end portions 15 provided with inclined bottom surfaces which hook over or overlie inwardly inclined surfaces 16 on the upper or front cylinder head 11 as shown in Fig. 11. The lower ends of the guides 14 have reduced threaded portions 16 which pass through openings in lateral ears 17 integral with the lower or rear cylinder head 7, and nuts 18 threaded on these reduced portions are operative, when tightened, to place the guides under longitudinal tension thereby to secure the guides firmly in position in their seats along the sides of the cylinder. A frame or cradle 20 partially surrounds the column and has guideways 21 which slidingly engage the longitudinal guides 14 so that the cradle is supported for sliding movement longitudinally relative to the supporting device or column 1. This cradle has laterally spaced arms 22, 22 integral with its forward portion and these arms are provided with longitudinal openings or bores 23. The rearward portion of the cradle has laterally spaced lugs 24 having aligned transverse openings 25 for receiving a cross bolt 26. The drilling motor 2 comprises a conventional motor cylinder 27 having a rear head 28 and a front chuck housing 29, and the motor parts are secured together by usual longitudinal side rods or bolts 30. Threaded on the front ends of these side-bolts 30 are tightening nuts 31 formed with cylindrical forward projections 32. The cylinder of the motor contains a conventional fluid actuated reciprocable hammer piston which delivers impact blows to the shank of a drill steel 33 supported within a conventional chuck within the front chuck housing 29. Attached to the forward end of the drill steel is a conventional rock drill bit 34. The rear motor head 28 carries a usual throttle valve mechanism 35 which is manually operable to control the flow of fluid under pressure to the automatic fluid distributing system of the motor cylinder, for effecting reciprocation of the hammer piston in a well-known manner. The drilling motor is a self-contained unit and may be readily attached to the cradle 20 simply by inserting the cylindrical portions 32 of the side bolt nuts within the longitudinal bores 23 in the cradle side arms 22, by locating a cross bore 37 in the rear cylinder head in alignment with the openings 25 in the rear cradle lugs 24, and by inserting the cross bolt 26 through the aligned openings, thereby rigidly to secure the drilling motor in position on the sliding cradle. Simply by releasing the cross bolt 26 and withdrawing the nut-projections 32 from the arm-openings 23 the drilling motor may be readily detached from the cradle. The feeding motor 3 is of a conventional fluid actuated, reciprocating piston type and has its casing 40 secured to a gear housing 41 which in turn is secured as by screws to the adjacent side of the sliding cradle 20 as shown in Fig. 5. The feeding motor is arranged and mounted on the cradle 20 at the opposite side of the supporting device or column 1 from the drilling motor 2 as shown in Fig. 8. The feeding motor has an upright rotating power shaft 42 coupled at 43 to a vertical worm shaft 44 suitably journaled within the gear housing 41 (Fig. 5). A worm 45 keyed to the shaft 44 meshes with a worm wheel 46 in turn keyed to a transverse horizontal shaft 47 (see also Fig. 2). This shaft is suitably journaled on a center bolt 49 supported by end covers 48 secured by the bolt to the gear housing. A feed sprocket 51 has its hub surrounding the shaft 47 and the wall of the hub bore 52 is arcuately slotted or grooved at 53. A key-pin 54 is seated in a groove 55 on the exterior of the shaft 47 and is received in the arcuate groove 53 in the sprocket hub. Thus, as shown in Fig. 8, key-pin 54 may move arcuately in the slot 53 so as to provide a limited "lost-motion" connection between the feed sprocket and its drive shaft for a purpose to be later explained. The feed sprocket engages a feed chain 56 arranged along one side of the supporting cylinder 6 (Fig. 8) and extending between the feed motor and the supporting cylinder in the manner shown. Evidently, a rack and pinion may be employed in lieu of the chain and sprocket. The feed chain is attached at 57 at its upper end to side straps 58 which are in turn secured by cross pins 59 to parallel longitudinal lugs 60 integral with the upper cylinder head 11. The lower end of the feed chain is attached at 61 to a screw 62 which passes through an opening 63 (Fig. 14) in a lateral lug 64 integral with the lower cylinder head 7. Threaded on this screw and engaging the bottom of the lug is a nut 65 which, when tightened, placed the feed chain under longitudinal tension thereby to hold the chain firmly in place longitudinally of the supporting cylinder. Also,

engaging the screw and acting against the nut 65 is a conventional lock nut 66. The feeding motor has a usual manual reversing valve mechanism 68 provided with an operating handle 69, for controlling fluid flow from a supply connection 70 to the fluid distribution system of the motor in a well-known manner.

The throttle valve mechanism 35 of the hammer drilling motor 2 comprises, as shown in Figs. 6, 12 and 13, a rotary throttle valve 72 contained in a transverse bore 73 formed in the rear motor head 28 and provided with a manual operating handle 74. Fluid under pressure may be supplied to the interior of the throttle valve through a supply connection 75. A port 76 traversing the wall of the throttle valve (Fig. 13) communicates with an arcuate, circumferentially extending groove 77 on the valve exterior, and this groove may communicate with a passage 78 in all controlling positions of the throttle valve. The passage 78 extends transversely in the rear motor head 28 and communicates with a longitudinal passage 79 in the motor cylinder and this latter passage in turn communicates with a chamber 80 (Fig. 6). A handle 82 is attached at 83 within a threaded boss 84 integral with the motor cylinder and is provided with a laterally located, longitudinally extending grasping portion 85. A passage 86 in the handle communicates with the chamber 80 and is communicable, under the control of a valve device 87, with a passage 88 in the grasping portion 85. A flexible pipe connection or hose 89 is attached at 90 to the lower end of the grasping portion 85 and leads to a connection 91 with the lower cylinder head 7. A passage 92 in the lower cylinder head connects the pipe 91 with the lower end of the bore of the supporting cylinder 6.

The control valve device 87, in this instance, comprises a rotary control valve 95 having an operating handle 96 located at the outer end of the handle 82. A sleeve portion 98, fixed in the bore of the handle 82, is formed with an axial passage 99. A member 100 has an axial passage 102 which communicates with an axial passage 103 in the valve. A right angle passage 104 communicates with the passage 103 and is communicable with the passage 88. The valve has an arcuate circumferentially extending groove 105 on its exterior and this groove communicates with a vent port 106, and the valve may be rotated to so position the groove 105 as to connect the passage 88 with the vent port 106, and to cut off communication of the passage 104 with the passage 88. Thus the control valve 95 may be positioned to regulate fluid flow to the supporting cylinder 6 or to vent the supporting cylinder as desired.

A stop pin 108 is receivable in a transverse opening 109 in the upper end of one of the guides 14 and this stop pin limits the forward movement of the drilling motor by engagement of the front end of the sliding cradle therewith. When this stop pin is removed from the guide the cradle may be slid forwardly from the supporting cylinder to permit ready dismantling of the drill in an obvious manner. A short chain section 110 is connected between the upper end of the guide and the stop pin to prevent the latter from becoming lost.

When the drill is set up in the upright position shown in Figs. 1, 4 and 8, fluid under pressure may be supplied from the throttle valve 72 to the passages 78, 79, chamber 80, passage 86 and through the control valve 95 to the passage 88 which leads to the lower end of the supporting

cylinder 6. The pressure fluid flowing into the supporting cylinder 6 acts on the lower pressure area of the piston 9 to move the latter upwardly to bring the pointed element 12 into engagement with the mine roof. Thus the drill may be supported firmly in upright position between the mine floor and the roof. The throttle valve 72 may be positioned to supply fluid under pressure to the fluid distribution system of the drilling motor to effect reciprocation of the hammer piston thereby to actuate percussively the drill steel. The reversing valve 68 may then be positioned to supply fluid under pressure to the feeding motor 3 to effect drive of the feed sprocket 51 through the worm gearing 45, 46 in a counterclockwise direction as viewed in Fig. 8, to feed the drilling motor 2 upwardly in a longitudinal direction along its guideways relative to the supporting cylinder 6. The pin and slot connection 54, 53 between the drive shaft 47 and the feed sprocket 51 permits limited relative rotary movement between the drilling and feeding motors so that the transmission of shocks to the drive gearing is substantially reduced. Thus as the drill bit 34 is percussively actuated it may be fed upwardly toward the work to effect drilling of a hole in the overlying roof strata. By proper adjustment of the valve mechanism 68 the feeding motor may be reversed to effect retraction of the drilling motor. When the drilling and feeding motors are stopped, the control valve 95 may be positioned to vent the lower end of the supporting cylinder 6 to permit retraction of the pointed element 12 from the roof, thereby to enable removal or repositioning of the drill.

As a result of this invention an improved stoper rock drill is provided which is self-supporting and which, due to the novel arrangement of the parts, is extremely longitudinally compact. By guiding the sliding cradle on the supporting cylinder or column, and by arranging the drilling and feeding motors on the cradle at the opposite sides of the supporting cylinder or column, such longitudinal compactness is made possible. The several control valves and fluid connections enable easy control of the several functions of the drill. The drilling motor by the provision of its detachable mounting on the cradle may be readily removed as a unit when desired, yet it is normally firmly secured in place on its mounting. The novel arrangement of the mechanical chain and sprocket feeding mechanism with respect to the supporting cylinder or column not only serves to provide a relatively simple and rugged feed but also provides for a relatively long feeding range and extreme longitudinal compactness. The "lost motion" connection between the drive shaft and the feed sprocket substantially reduces the transmission of shocks to the gearing thereby reducing the possibility of breakage. By the novel arrangement of parts disclosed, the drill is well adapted to use in the restricted spaces encountered in underground mines. Other advantages of the invention will be clearly apparent to those skilled in the art.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form is shown for purposes of illustration only and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a rock drill, the combination comprising an upright extensible fluid actuated support having abutment elements at its opposite extremities respectively engageable with the floor and roof of a mine and which is extended by the action of pressure fluid to support the drill firmly in position between the mine floor and mine roof, means providing a guide extending lengthwise of said support, a frame slidable longitudinally along said guide relative to said support, a drilling motor carried by said frame and arranged in parallelism with said support at one side of the latter, feeding means for moving said frame along said guide to feed said drilling motor toward the work including a feeding motor carried by said frame at the opposite side of said support from said drilling motor, said feeding means also including a feeding element extending longitudinally along one side of said support and secured to the latter and a coacting relatively rotatable feeding element carried by said frame and driven through reduction gearing by said feeding motor, and means providing a limited lost motion connection between said rotatable feeding element and the terminal driving element of said gearing for reducing the transmission of shocks from said drilling motor to said gearing.

2. In a rock drill, the combination comprising an upright supporting cylinder having a pointed element at its bottom engageable with the floor of a mine and containing a reciprocable piston having an upwardly extending piston rod provided with a pointed element engageable with the mine roof, means for supplying fluid under pressure to said cylinder beneath said piston to move said piston upwardly to bring said upper pointed element into engagement with the roof thereby firmly to support the drill in upright drilling position in the mine, longitudinal guides secured to the sides of said cylinder and arranged substantially coextensive with said cylinder, a cradle mounted on said cylinder to slide longitudinally relative thereto along said guides, a drilling motor of the hammer type carried by said cradle at one side of said supporting cylinder, and means for feeding said cradle longitudinally along said guides to feed said drilling motor toward the work including a feeding motor carried by said cradle at the opposite side of said cylinder from said drilling motor, said feeding means also including a feed chain extending lengthwise of said cylinder along one side of said cylinder and secured at its ends to the opposite ends of said cylinder and a feed sprocket carried by said cradle and engaging said feed chain, driving gearing between said feeding motor and said sprocket including a shaft coaxial with and having limited rotation relative to said sprocket, a pin secured to said shaft, and an arcuate groove in the sprocket hub and in which said pin is received, said pin being engageable with the end walls of said groove in the different positions of said shaft relative to said sprocket, and said groove providing a lost motion connection between said sprocket and said shaft to permit such limited relative rotation of said shaft and sprocket.

3. In a stoper rock drill, the combination comprising an extensible fluid actuated supporting column engageable at its opposite extremities respectively with the floor and roof of a mine, a frame slidably guided for movement lengthwise of said column, means for feeding said frame along said column, a fluid actuated drilling motor carried by said frame and having a throttle valve

mechanism, a handle secured to said drilling motor and projecting laterally therefrom, passage means including a passage in said handle for conducting pressure fluid from said throttle valve mechanism to said column for extending the latter, and a control valve mechanism carried by said handle for controlling fluid flow through said passage and positionable to vent said column.

4. In a rock drill, the combination comprising a support providing a longitudinal guideway, a frame movable along said guideway, a hammer drilling tool carried by said frame, feeding means for moving said frame along said guideway to effect feeding of the drilling tool including a feeding motor carried by said frame, a rotatable feeding element carried by said frame and journaled thereon, a feeding element extending longitudinally along said support in parallelism with said guideway and with which said rotatable feeding element cooperates and a driving connection between said motor and said rotatable feeding element including a terminal driving element coaxial with said rotatable element, and means providing a limited lost motion connection between said coaxial rotatable feeding element and said terminal element for reducing the transmission of shocks from said drilling tool to said terminal driving element.

5. A rock drill as set forth in claim 4 wherein said lost motion providing means includes a pin secured to said terminal element and an arcuate groove in the rotatable element and in which said pin is received, said pin being engageable with the end walls of said groove in the different positions of said terminal element relative to said rotatable element, and said pin and groove providing said limited lost motion connection and permitting limited relative rotation between said terminal element and said rotatable element.

6. In a rock drill, the combination comprising longitudinal supporting and guiding means including an elongated cylindrical tubular supporting member, detachable guides extending longitudinally along opposite sides of said cylindrical tubular member and closely fitted against the sides of the latter, said guides having inwardly directed end projections overlying and detachably engaging one end of said tubular member, an adjustable connection between said guides and the opposite end of said tubular member for placing said guides under longitudinal tension, a drilling tool adapted to actuate a drilling implement, means for mounting said tool in rigid parallelism with said tubular supporting member for guided movement along said guides longitudinally relative to said tubular member exteriorly of the latter, and means for feeding said tool at a drilling speed longitudinally along said guides relative to said tubular supporting member.

7. In a rock drill, the combination comprising an elongated fluid extensible support engageable at its opposite extremities with extraneous abutments, a fluid actuated drilling tool guided for movement lengthwise of said support, said tool having a throttle valve mechanism connected to a source of pressure fluid supply, means for feeding said drilling tool longitudinally along said support, a handle secured to said drilling tool and projecting laterally therefrom, passage means including a passage in said handle for conducting pressure fluid from said throttle valve mechanism to said support for extending the latter, and a control valve mechanism car-

ried by said handle for controlling fluid flow through said passage and positionable to vent said extensible support.

8. In a rock drill, the combination comprising an upright supporting cylinder having a pointed element at its bottom engageable with the floor of a mine and containing a reciprocable piston having an upwardly extending piston rod provided with a pointed element engageable with the mine roof, means for supplying fluid under pressure to said cylinder beneath said piston to move said piston upwardly to bring said upper pointed element into engagement with the roof thereby firmly to support the drill in drilling position in the mine, longitudinal guides secured to the sides of said cylinder in parallelism therewith and arranged substantially coextensive with said cylinder, a cradle mounted on said cylinder to slide longitudinally relative thereto along said guides and having guideways for receiving said guides, said guides holding said cradle against rotative movement relative to said cylinder about the longitudinal axis of the latter whereby said cradle is maintained along a fixed longitudinal path, a drilling motor of the hammer type carried by and rigidly attached to said cradle at one side of said supporting cylinder with the longitudinal axis of said drilling motor extending in parallelism with said cylinder, and means for feeding said cradle longitudinally along said guides to feed said drilling motor toward the work including a feeding motor carried by and rigidly attached to said cradle at the diametrically opposite side of said cylinder from said drilling motor with the longitudinal axis of the latter extending in parallelism with said cylinder, said feeding means also including a feed chain extending lengthwise of said cylinder along the side of the exterior of said cylinder at which said feeding motor is located and secured at its ends to the opposite ends of said cylinder with the intermediate portion of said chain lying against the exterior of said cylinder, a feed sprocket carried by said cradle at the feeding motor side of said support and engaging the intermediate portion of said feed chain, and driving gearing carried by said cradle and connected between said feed sprocket and said feeding motor.

9. In a rock drill, the combination comprising longitudinal guiding means including a cylindrical tubular supporting member having front and rear heads, detachable guides extending longitudinally along and fitted against opposite sides of the exterior of said cylindrical tubular member and having inwardly directed hook-shaped outer ends engaging said front head, said guides having threaded rearward portions extending through openings in lateral lugs on said rear head and nuts threaded on said portions and engaging said lugs for placing said guides under longitudinal tension to hold said supporting member and said heads in assembled relation and to secure said guides in position, a drilling motor adapted to actuate a drilling implement and extending longitudinally in parallelism with said supporting member, said motor mounted on said supporting member for guided movement along said guides relative to said tubular member, and means for feeding said drilling tool and said supporting member along said tensioned guides, said feeding means including a feeding element extending substantially coextensive with and disposed between said guides on said supporting member.

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