March 21, 1939. W. NOBLE 2,151,328

APPARATUS FOR BREAKING MATERIAL

Filed July 30, 1935 3 Sheets-Sheet 1

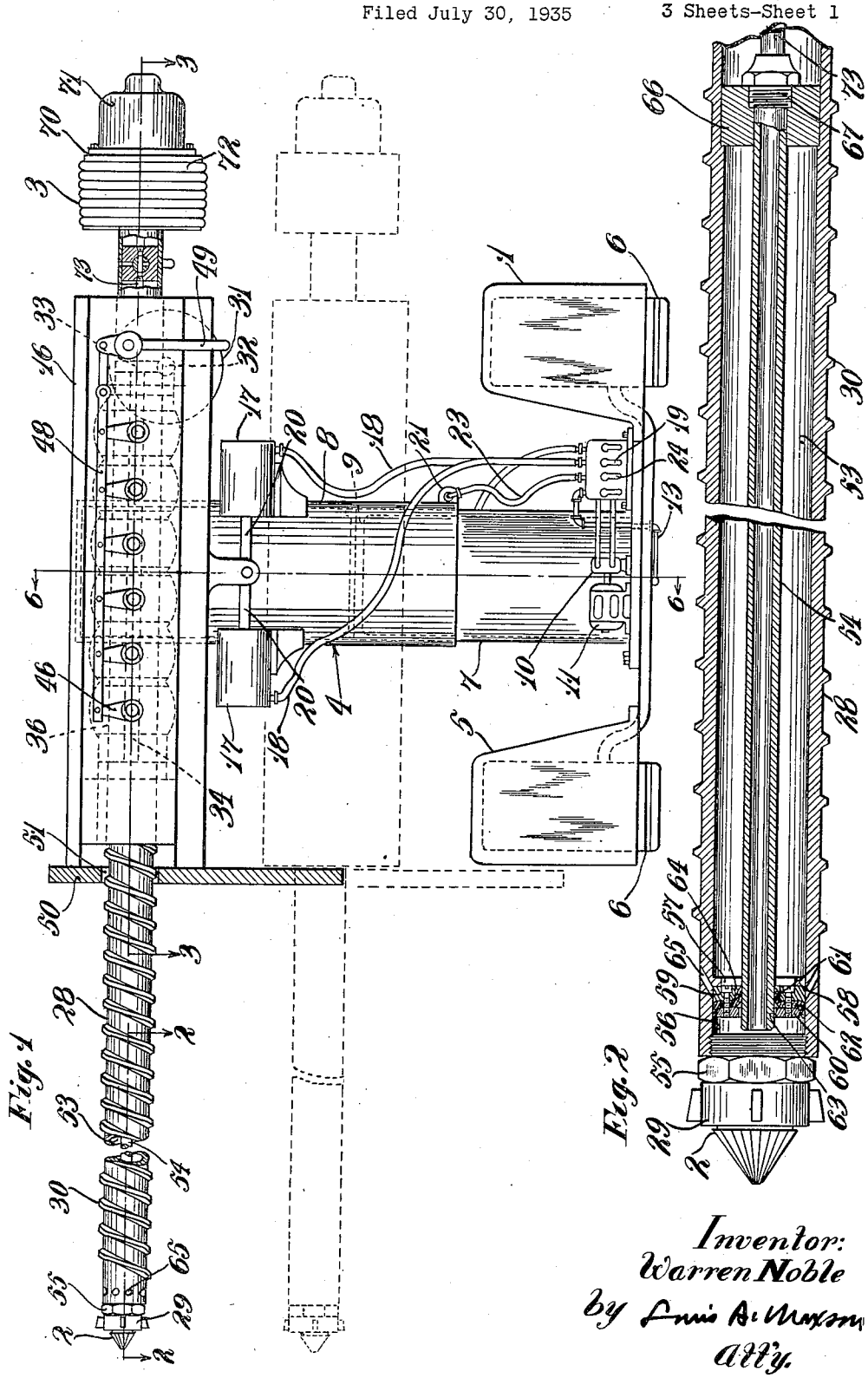


Fig. 1

Fig. 2

Inventor:
Warren Noble
by Louis A. Munson
Atty.

March 21, 1939. W. NOBLE 2,151,328

APPARATUS FOR BREAKING MATERIAL

Filed July 30, 1935 3 Sheets-Sheet 2

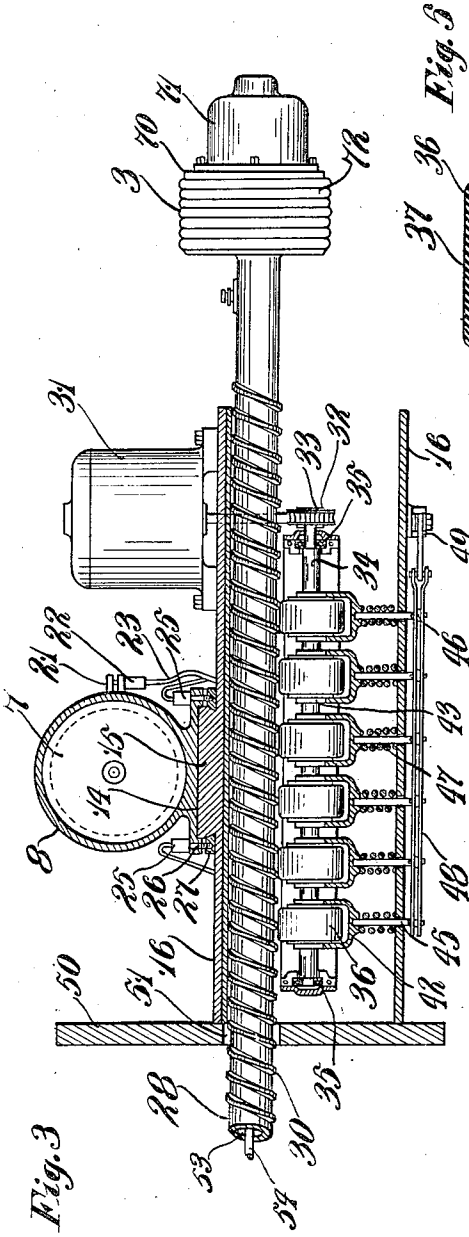


Fig. 3

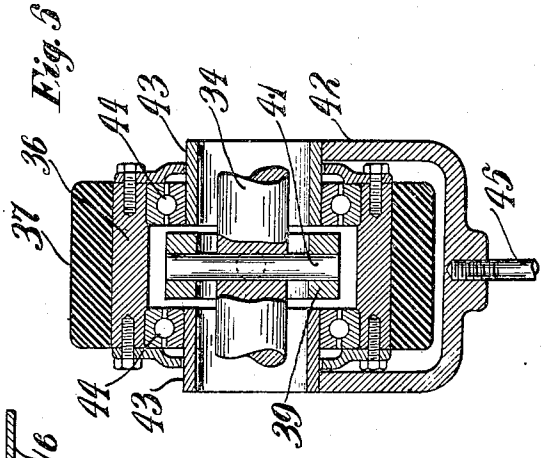


Fig. 3

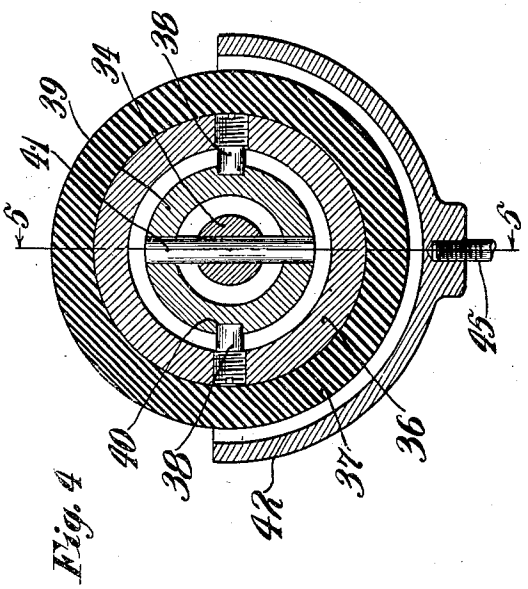


Fig. 4

Inventor:
Warren Noble
by Louis A. Maxon
Atty.

March 21, 1939. W. NOBLE 2,151,328

APPARATUS FOR BREAKING MATERIAL

Filed July 30, 1935 3 Sheets-Sheet 3

Fig. 6

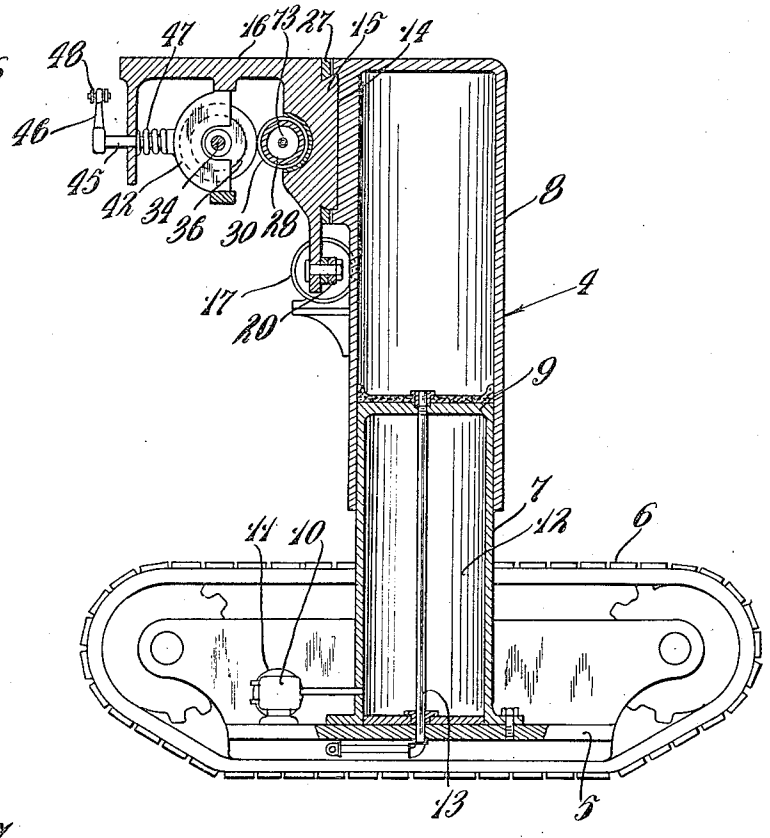


Fig. 7

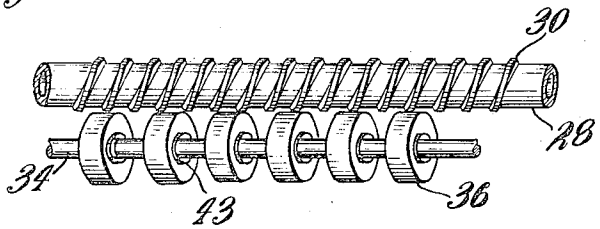
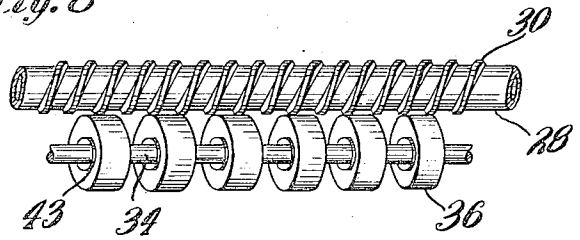


Fig. 8



Inventor:
Warren Noble
by Louis A. Maxson.
Atty.

Patented Mar. 21, 1939 2,151,328

UNITED STATES PATENT OFFICE

2,151,328

APPARATUS FOR BREAKING MATERIAL

Warren Noble, Guilford, N. Y., assignor to Sullivan Machinery Company, a corporation of Massachusetts

Application July 30, 1935, Serial No. 33,876

5 Claims. (Cl. 262—8)

This invention relates to an improved apparatus for drilling and breaking down material, and more particularly to an improved combined drilling and material-breaking apparatus for drilling a hole in the material to be broken and thereafter discharging a material-breaking medium into the drill hole for breaking down the material.

An object of this invention is to provide an improved apparatus for drilling and breaking down material in a mine. Another object is to provide an improved combined drilling and material-breaking apparatus for drilling a hole in a mine wall and thereafter without removing the drilling implement from the drill hole, discharging a material-breaking medium into the hole to break down the material. These and other objects of the invention will, however, hereinafter more fully appear in the course of the following description, and as more particularly pointed out in the appended claims.

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 the illustrative embodiment of the improved drilling and material-breaking apparatus,

Fig. 2 is an enlarged view in longitudinal section taken on line 2—2 of Fig. 1,

Fig. 3 is an enlarged horizontal sectional view taken substantially on line 3—3 of Fig. 1,

Fig. 4 is a cross sectional view taken through one of the rollers for driving and feeding the drill stem,

Fig. 5 is a cross sectional view taken on line 5—5 of Fig. 4,

Fig. 6 is a vertical, sectional view taken substantially on line 6—6 of Fig. 1,

Figs. 7 and 8 are somewhat diagrammatic views, showing the drill stem driving and feeding means in different positions.

In this illustrative embodiment of the invention, there is shown a combined drilling and material-breaking apparatus generally comprising a portable base 1, a drilling implement 2, material-breaking means 3, and an adjustable supporting structure generally designated 4, for supporting and positioning the drilling implement and material-breaking means with respect to the material to be drilled and broken down. The portable base 1 comprises a frame 5 supported and propelled by tractor treads 6 driven and controlled in any suitable manner. Mounted on the base frame 5 substantially centrally thereof is an upstanding column 7 having supported thereon in telescopic relation therewith a cylindrical shell 8, herein in the form of a cylinder, by which the drilling and material-breaking means is adjustably supported. As illustrated, secured to the upper end of the column 7 is a piston 9 contained in the bore of the cylindrical shell 8, and cooperating with the latter for providing a cylinder and piston adjusting means for varying the elevation of the drilling and material-breaking means. For supplying hydraulic pressure to the bore of the cylindrical shell 8 above the piston 9 for moving the shell vertically relative to the column is a pump 10 driven by a motor 11 for supplying liquid pressure from a liquid reservoir 12 formed in the column, through a pipe connection 13 to the shell bore at the upper side of the piston 9 in the manner shown in Fig. 6. Swivelly mounted in a socket 14, formed within the upper portion of the cylindrical shell 8, is a trunnion 15 by which is supported the frame 16 of the drilling and material-breaking means. Also supported by the shell 8 are hydraulic cylinders 17 connected by hose connections 18, controlled by a valve 19, to the pump 10, and these cylinders contain pistons connected by links 20 to a depending portion of the drill frame. When hydraulic pressure is supplied to one or the other of these cylinders the drilling and material breaking means may be swung vertically by power in either direction about the swivel axis. A clamp 21 is provided for locking the cylindrical shell 8 against rotary motion with respect to the column 7 for holding the drilling and material-breaking means in its different positions of angular adjustment about the column axis, and this clamp is provided with a spring applied, hydraulically released piston operating means 22, of a usual design, connected by a hose 23, under the control of a valve 24, to the pump. The trunnion 15 is adapted to be clamped in position within its swivel socket by means of a plurality of operating means 25, 25 similar to the operating means 22. Each of the operating means 25 has an operating rod 26 connected to an annular retaining and clamping ring 27 for holding the trunnion 15 within its socket, and when hydraulic pressure is vented from these operating means the spring means thereof act to move the retaining ring 27 into a position frictionally to clamp the trunnion 15 against movement within its socket. Obviously the valves and piping for the various hydraulic devices may assume various forms, such as four-way valves controlling

communication between the supply connection for the pump and a discharge line to the reservoir and connections to the cylinders; and suitably loaded by-passes to discharge can be used, as usual. From the foregoing it will be evident that the drilling and material-breaking means may be moved into different elevations, and swung horizontally about the column axis and vertically about the axis of the trunnion to vary the horizontal and vertical positions of the drilling implement, and may be held in any of its positions of adjustment. For single-acting cylinders three-way valves suffice.

Now referring to the drilling and material-breaking means, and more particularly to the drilling means, it will be noted that rotatably mounted on the frame 16 is a tubular drill stem 28 carrying at its inner end a drilling implement 29, herein a drill bit of a usual design, for boring a hole in the mine wall to receive the drill stem, and formed externally on the drill stem is a spiral vane 30 so formed as to convey the cuttings created by the drilling implement during drilling, from the drill hole. The means for rotating and feeding the drill stem 28 comprises a motor 31 mounted on the drill frame 16 and having fixed to its power shaft a worm 32 meshing with a worm wheel 33 fixed to a longitudinal shaft 34, herein arranged parallel with the drill stem and journaled in bearings 35, 35 in the drill frame 16. Connected to the shaft 34 through universal mountings, to be later described, is a series of rollers 36 having rubber treads 37 frictionally engaging the exterior periphery of the drill stem 28. When the shaft 34 is rotated by the motor 31 and the rollers are positioned at right angles to the drill stem axis with their axes in alinement and parallel with the drill stem axis, as shown in Fig. 3, the drill stem is rotated without axial motion. When the rollers are tilted in one direction or the other to change their angular relation with respect to the drill stem, as shown in Figs. 7 and 8, the drill stem may be fed axially in one direction or the other while the same continuously rotates. By changing the angular relation of the drive rollers with respect to the drill stem, the rate of feed may, of course, be varied. The rollers are connected by trunnion pins 38 to a ring 39, the trunnion pins seating in bearing recesses 40 formed in the ring. This ring is connected by a pin 41 arranged at right angles to the trunnion pin axes, to the drive shaft 34, the parts thus forming a universal drive connection between the shaft 34 and the rollers. The means for shifting the rollers to change their angular relation with respect to the drill stem, comprises yoke-like elements 42 guided on the frame 16, and which support sleeves 43 carrying bearings 44 on which the rollers are journaled. These yoke-shaped members 42 are fixed to rods 45 journaled in the drill frame 16, and in turn having fixed thereto lever or crank arms 46. Interposed between the drill frame and the members 42, and encircling the rods 45, are coiled springs 47 for yieldingly urging the rollers into frictional contact with the drill stem. The series of levers 46 are pivotally connected to a common operating rod 48 having an operating lever 49. Any suitable lock means may be provided for the operating lever 49 for holding the latter in its different positions of adjustment. In the present instance, secured to the forward end of the drill frame 16 is a shield or guard plate 50 having an opening 51 through which the drill stem passes, and this guard plate prevents the flying of the material during the breaking-down operation, outwardly toward the machine, thereby to protect the operator. In certain instances this guard plate may be placed directly against the working face during the drilling and breaking-down operations.

The improved material-breaking means associated with the drilling means comprises a pressure receiving means embodied in the drill stem, together with means mounted on the drill stem for supplying high pressure air to the receiving means whereby when the hole is drilled in the mine wall the air charge may be released from the receiving means to break down the material. It will be evident that various means might be employed to deliver a breaking down pressure to the drill hole. In this instance, formed within the forward portion of the drill stem 28 is a chamber 53 for receiving a charge of high pressure air, while extending centrally through this chamber is an air-conducting tube 54 connected to a source of high pressure air in a manner to be later described. The inner end of the casing of the air receiving means is closed by a cap 55 threaded within the inner end of the drill stem, and by which the drilling implement 29 is carried. Formed within the inner end of the drill stem in alignment with the chamber 53 is a bore 56 communicating with the chamber 53 through a large axial opening 57. Surrounding this opening is a valve seat 58 with which cooperates an end-seating valve 59. The tube 54 terminates at its inner end within the bore 56 at the outer side of the valve 59 with respect to the chamber 53, and the valve 59 has secured thereto a piston 60 carrying cup leathers 61 and 62. The piston 60 has an axial opening 63, while the valve 59 has an alined opening 64, and the tube 54 extends through these openings into the bore 56. The cup leather 61 tightly embraces the tube 54, while the cup leather 62 tightly engages the walls of the bore 56 to prevent leakage of compressed air from the bore past the piston. The cup leather 61 acts as a check valve for controlling the flow of compressed air from the bore 56 to the chamber 53 while preventing reverse flow of air from the chamber to the bore. Formed in the drill stem near the inner end thereof for connecting the bore 56 to the stem exterior are discharge passages 65. In this instance, the outer end of the chamber 53 is closed by a suitable plug 66 within which the outer end of the tube 54 is secured as by a suitable gland plug 67.

The means for supplying compressed air under relatively high pressure to the air chamber 53 comprises a compressor unit 70 mounted on the outer extremity of the drill stem 28 for rotary and axial movements therewith and embodying a driving motor 71 and a suitable cooling coil 72 encircling the compressor unit casing for cooling the compressed air as it is discharged from the compressor. This compressor and its driving motor may be of any suitable design. The cooling coil is connected through a conduit 73 extending within the drill stem into connection with the tube 54 of the air receiving means. During the drilling operation the compressor 70 operates to supply high pressure air through the conduit 73 to the tube 54, the compressed air flowing from the tube 54 to the bore 56. The pressure in the bore 56 acts on the piston 60 to hold the valve 59 tightly against its seat 58, thereby cutting off communication of the passages 65 with the chamber 53 during charging of the latter. The compressed air flows from the bore 56 past

the cup packing 61 along the exterior periphery of the tube 54, through the openings 63, 64 in the piston and valve to the pressure chamber 53. When the drilling operation has been completed and a predetermined breaking pressure is attained in the chamber 53, the supply of compressed air is cut off and the conduit 73 vented to atmosphere in any suitable manner. This may be accomplished by the use of a three-way valve of a usual design. The pressure in the bore 56 at the inner side of the piston 60 is thereby suddenly reduced, and as a result the highly compressed air in the chamber 53 causes the piston 60 to move suddenly inwardly into its open position, thereby opening communication of the discharge passages 65 with the chamber 53, and as a result the breaking down charge is suddenly released from the chamber 53 through the large axial opening 57 and through the bore 56 and the discharge passages 65, this sudden release of the charge of compressed air acting on the mine wall with an expansive action to break down the material.

The general mode of operation of the improved drilling and material-breaking apparatus is as follows. The apparatus is propelled about the mine by the tractor treads 6 and when the working place is reached hydraulic pressure may be supplied from the pump 10 to the shell bore at the upper side of the piston 9 to move the shell 8 vertically with respect to the column 7 to move the drilling and material-breaking means to the desired elevation. Hydraulic pressure may be supplied to the operating means 22 for the clamp 21 under the control of the valve 24 to effect clamp release, thereby enabling the cylindrical shell 8 to be moved about the column axis to vary the horizontal angular position of the drilling and material-breaking means, the clamp 21 thereafter being applied to hold the shell against rotary motion with respect to the column. The operating means 25, 25 for the swivel clamp may be hydraulically released in a similar manner, and the drilling and material-breaking means swung vertically into the desired angular position by the hydraulic cylinders 17, the retaining ring 27 thereafter being adjusted to hold the trunnion against movement in its socket. When the drill stem has been adjusted into the desired position with respect to the material to be broken, the motor 31 is started, and the operator adjusts the driving rollers 36 into the position shown in Fig. 7 to effect rotation and forward axial motion of the drill stem. As the drill stem is fed forwardly and at the same time rotated, the drilling implement acts to bore a hole into the material to be broken. When the motor 31 is started to effect drilling, the motor 71 of the compressor unit 70 is at the same time started so that during the drilling operation the compressor unit operates to supply high pressure air to the chamber 53 of the air receiving means. When the hole in the mine wall is being drilled to the desired depth, breaking down pressure is being built up within the chamber 53 and upon completion of the drill hole this highly compressed air is released into the drill hole to effect breaking down of the material. After the completion of the drilling and breaking down operations, the drill stem may be fed rearwardly by moving the drive rollers into the reverse feed position shown in Fig. 8.

As a result of this invention it will be noted that an improved apparatus is provided whereby the drilling and breaking down of a working face may be accomplished in an extremely rapid manner. It will further be noted that an improved combined drilling and material-breaking apparatus is provided whereby a hole may be drilled in the material to be broken and thereafter without removing the drilling implement from the hole a charge of material-breaking medium may be discharged into the drill hole to break down the material. It will further be evident that by providing an air-compressing means which operates to supply air to the air receiving means during the drilling operation, the drilling and breaking down functions may be effected in rapid succession. Further, by combining the drilling and material-breaking means in a single apparatus, the time consumed in the drilling and breaking down of the material is not only substantially reduced but the expense necessitated by the use of separate pieces of equipment is greatly reduced. These and other uses and advantages of the improved drilling and material-breaking apparatus will be clearly apparent to those skilled in the art.

While I have in this application specifically described one form which my invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration, 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 an apparatus of the character described, a drilling implement for drilling a hole in the material to be broken, a drill stem for operating said implement, a chamber formed in said drill stem for receiving a charge of expansible pressure fluid at material-breaking pressure, and associated means operative while the drilling implement remains in the hole drilled thereby, for discharging the pressure fluid into the drill hole to break down the material by the expansive action of the fluid thereon.

2. In an apparatus of the character described, a drilling implement for drilling a hole in the material to be broken, a drill stem for operating said implement, a chamber formed in said drill stem for receiving a charge of compressed air at material-breaking pressure, a compressor unit for supplying air under relatively high pressure to said charge-receiving chamber, and associated means operative while the drilling implement remains in the hole drilled thereby for discharging the pressure from said chamber into the drill hole to break down the material by the expansive action of the air pressure thereon.

3. In an apparatus of the character described, a tubular drill member adapted to drill a hole in the material to be broken, means embodied in said member for receiving a charge of expansible material-breaking fluid, and means for releasing said charge when said member is in material-breaking position in the drill hole and subsequent to the drilling operation for breaking down the material by the expansive action of the fluid thereon.

4. In an apparatus of the character described, a drill member adapted to drill a hole in the material to be broken, means embodied in said member for receiving a charge of material-breaking medium, means for supplying material-breaking medium to said charge-receiving means during the drilling operation, and means for releasing the charge from said receiving means

when said drill member is in material-breaking position in the drill hole and subsequent to the drilling operation.

5. In an apparatus of the character described, a drilling implement, means for operating the same, means associated with said drilling implement for receiving a charge of material-breaking medium, means for supplying a material-breaking medium to said charge-receiving means during the drilling operation, and means for releasing said charge from said receiving means into the drill hole subsequent to the drilling operation and while said drilling implement remains in said drill hole.

WARREN NOBLE.