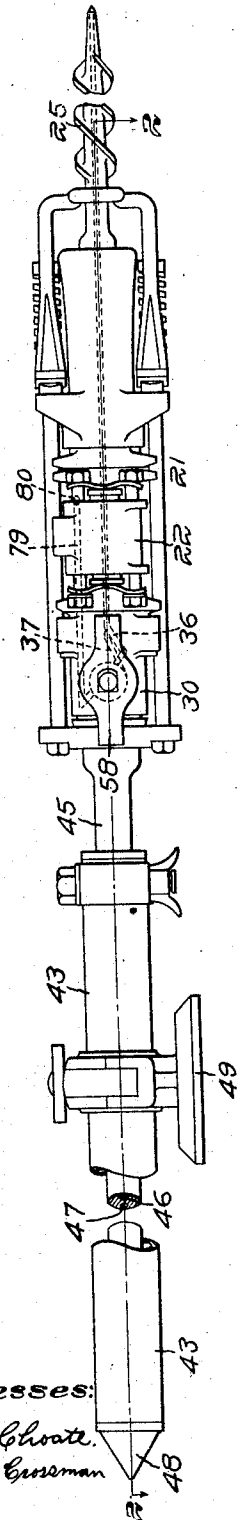


1,175,745.

G. H. GILMAN.
DRILLING APPARATUS.
APPLICATION FILED JULY 22, 1914.

Patented Mar. 14, 1916.
5 SHEETS—SHEET 1.

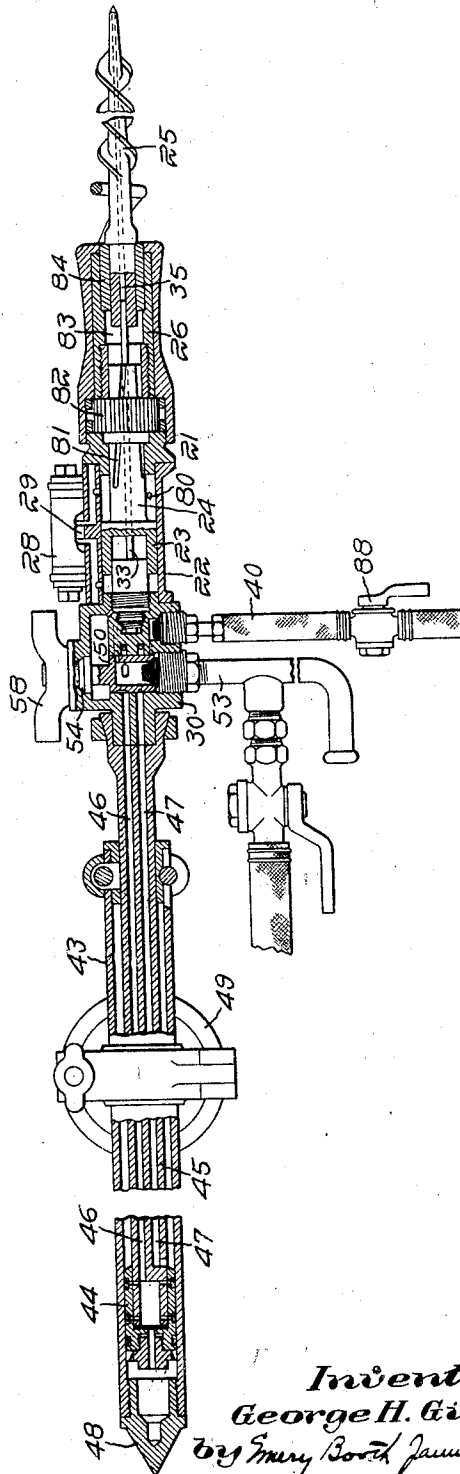
Fig. 1.



Witnesses:

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Fig. 2.

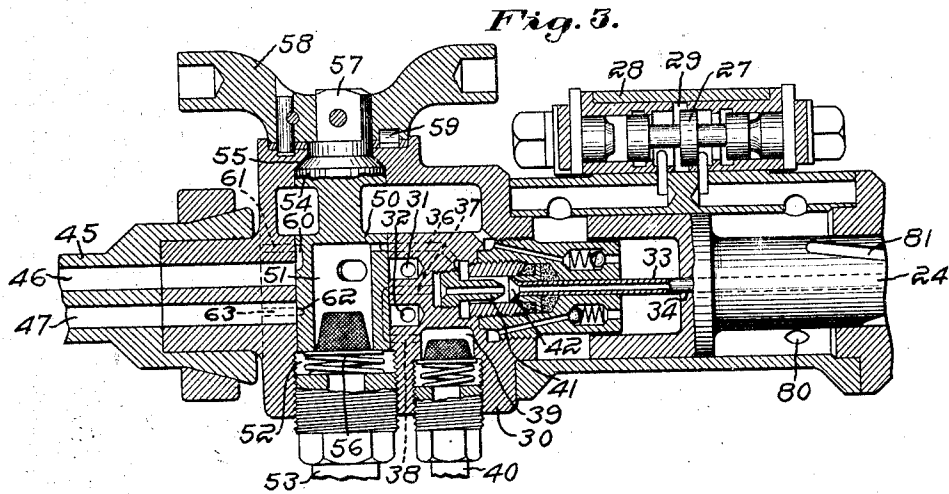
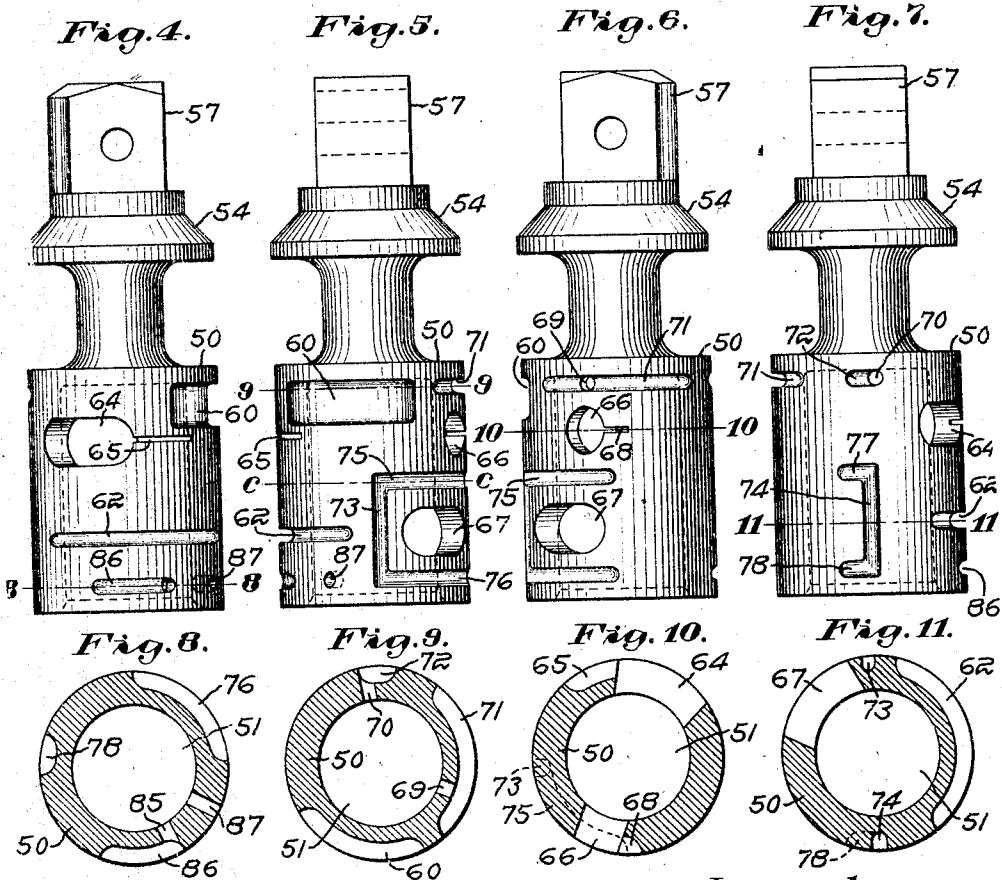


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 5 SHEETS—SHEET 2.



Witnesses:

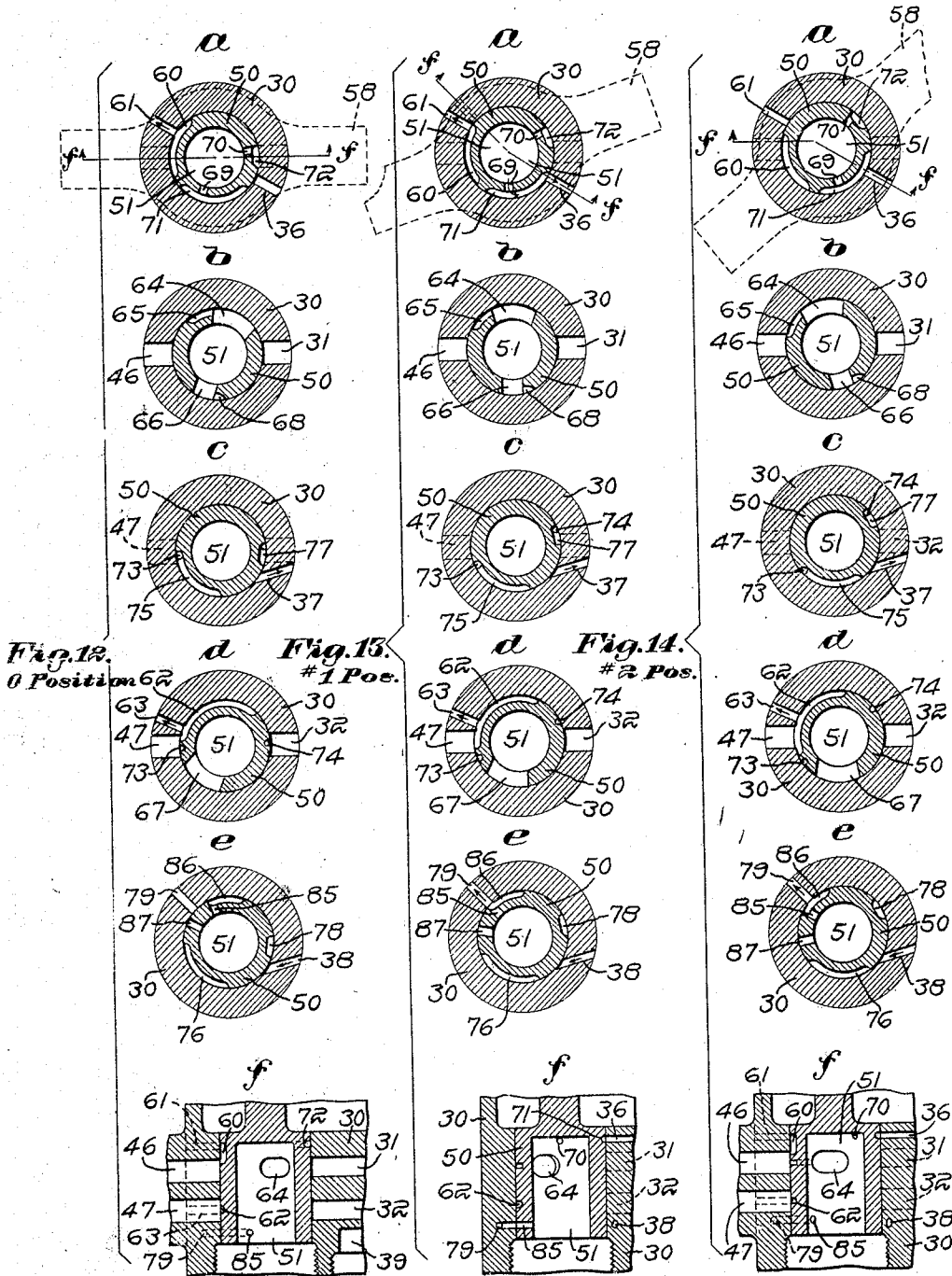
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1,175,745.

Patented Mar. 14, 1916.

5 SHEETS—SHEET 3.



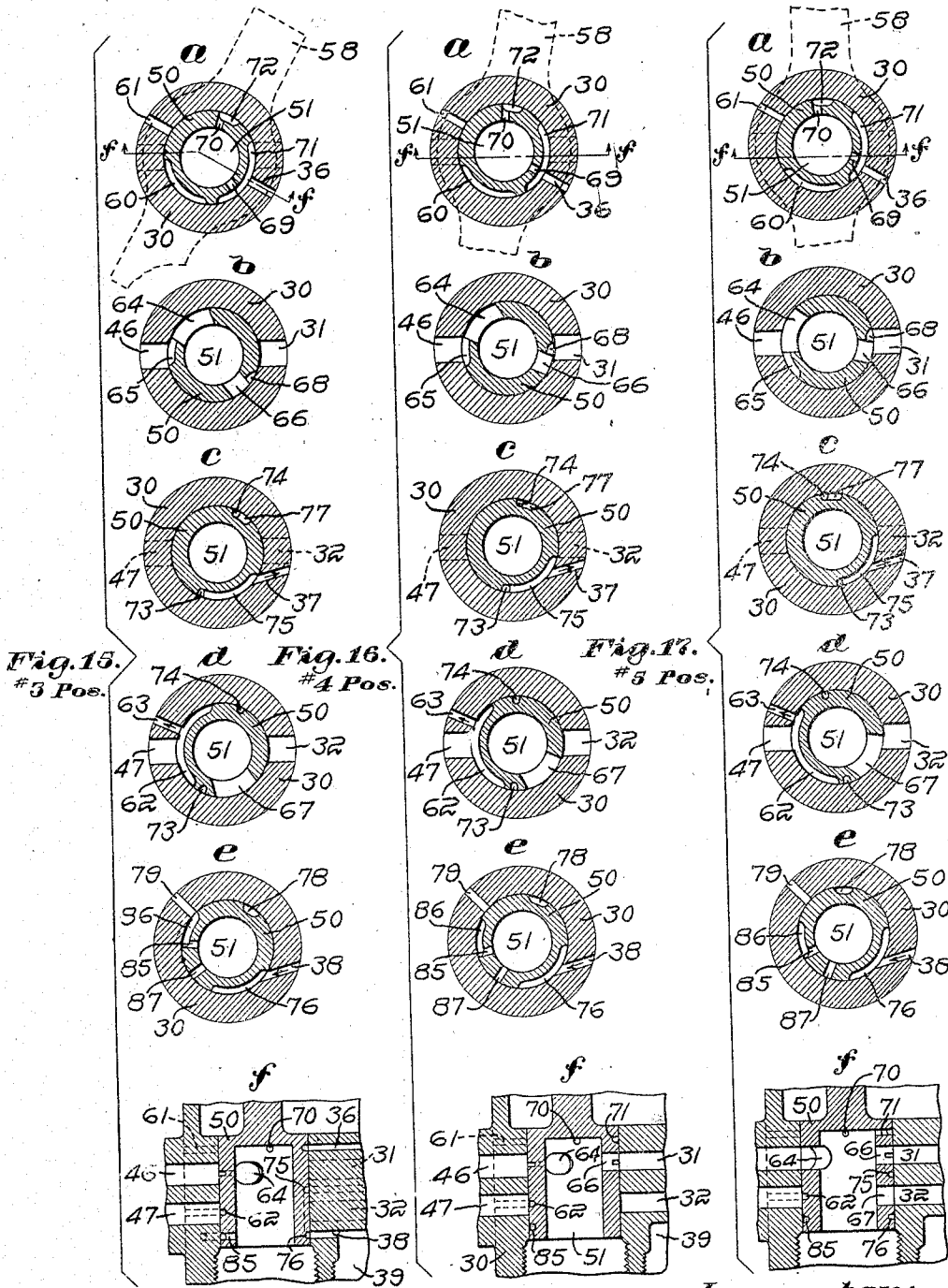
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1,175,745.



Witnesses:

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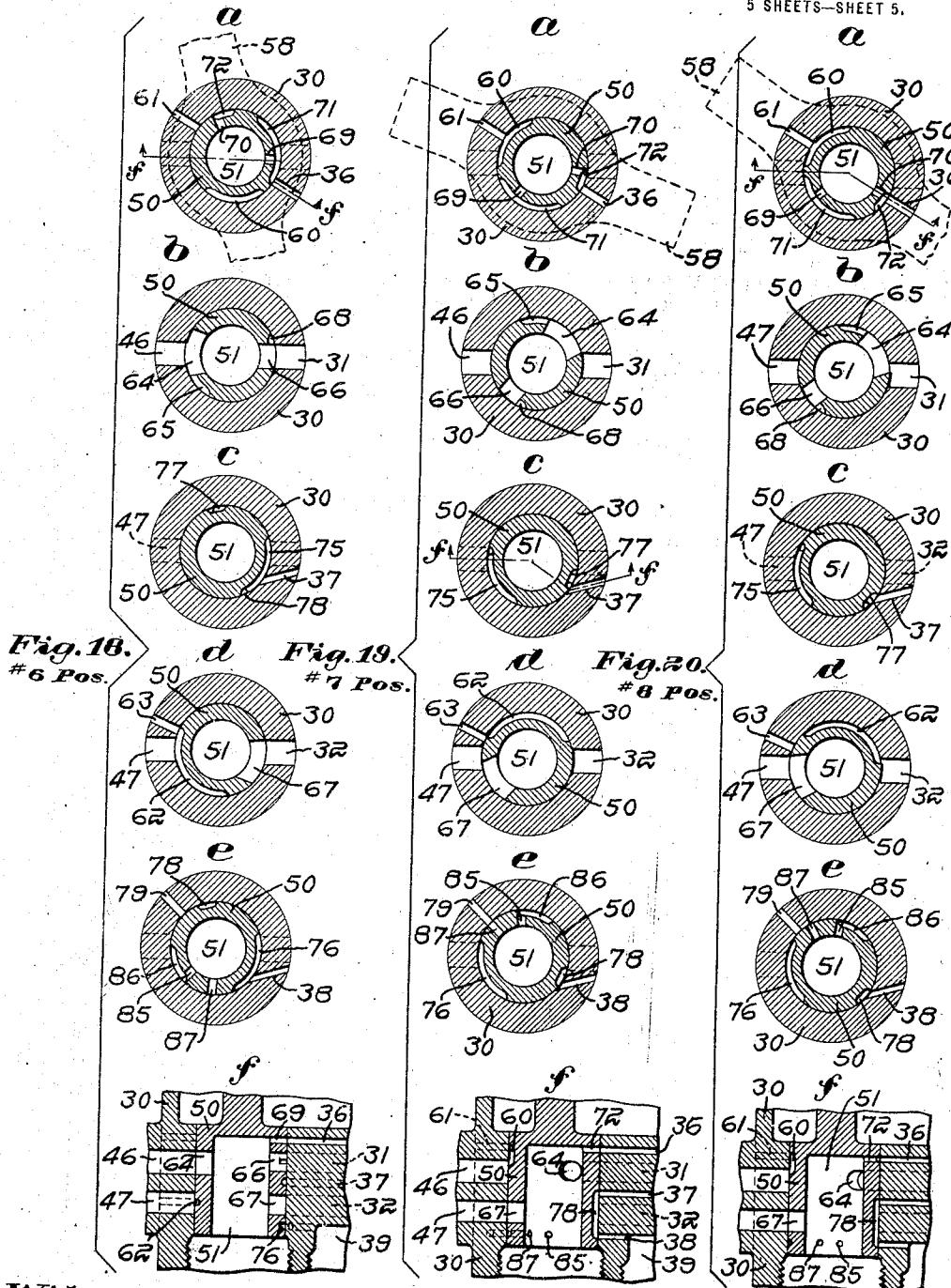
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1,175,745.

Patented Mar. 14, 1916.

5 SHEETS—SHEET 5.



Witnesses:

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UNITED STATES PATENT OFFICE.

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DRILLING APPARATUS.

1,175,745.

Specification of Letters Patent.

Patented Mar. 14, 1916.

Application filed July 22, 1914. Serial No. 852,497.

To all whom it may concern:

Be it known that I, GEORGE H. GILMAN, a citizen of the United States, and a resident of Claremont, county of Sullivan, and State of New Hampshire, have invented an Improvement in Drilling Apparatus, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to pressure fluid motors, and feeding devices therefor, and to their control, and is more especially, though not exclusively, concerned with a pressure fluid impact or percussive drilling tool having pressure fluid feeding means for advancing the tool toward or retracting it from its work, means for ejecting the cuttings from and cleansing the drilled hole, and means for coordinately controlling the tool, its feeding means, and the hole clearing means.

My invention will be best understood by reference to the following specification, when taken in connection with the accompanying drawings of one specific embodiment thereof, while its scope will be more particularly pointed out in the appended claims.

In the drawings: Figure 1 is a side elevation of a drilling apparatus of the general type known as a stoping drill, a portion of the feed means and the drill-bit being broken away; Fig. 2 is a sectional view on line 2—2 of Fig. 1; Fig. 3 is a detail longitudinal sectional view, also on line 2—2 of Fig. 1, but on an enlarged scale, showing the cylinder with its head block and adjacent parts; Fig. 4 is a detail elevation of the valve on a much enlarged scale; Fig. 5 is a detail elevation of the valve, also on an enlarged scale, as viewed from the right-hand side of Fig. 4; Fig. 6 is a detail elevation of the valve, also on an enlarged scale, as viewed from the right-hand side of Fig. 5, that is, the opposite side to that shown in Fig. 4; Fig. 7 is a detail elevation of the valve, also upon an enlarged scale, as viewed from the right-hand side of Fig. 6, that is, the side opposite to that shown in Fig. 5; Fig. 8 is a plan section on line 8—8 of Fig. 4; Fig. 9 is a plan section on line 9—9 of Fig. 5; Fig. 10 is a plan section on line 10—10 of Fig. 6; Fig. 11 is a plan section on line 11—11 of Fig. 7; Figs. 12 to

20, inclusive, are groups of detail sectional views illustrating the throttle valve in various positions of adjustment, each group comprising six views, namely: *a, b, c, d, e, f*, inclosed by a bracket. In each group, the view *a* is a sectional view corresponding to Fig. 8, on line 8—8 of Fig. 4; the view *b* is a sectional view corresponding to Fig. 9, on line 9—9 of Fig. 5; the view *c* is a sectional view on line *c—c* of Fig. 5; the view *d* is a sectional view corresponding to Fig. 10 on line 10—10 of Fig. 6; the view *e* is a sectional view corresponding to Fig. 11 on line 11—11 of Fig. 7; and the view *f* is a sectional view corresponding in a general way to the axial section of the valve in Fig. 3, though in some instances, the plane of the section is varied, as shown by the section lines *f—f* in each figure.

Referring to the drawings, and to the embodiment of my invention which I have selected for illustration, I have there shown a drilling apparatus comprising a drilling tool 21, having a cylinder 22, within which a piston 23 is mounted to reciprocate. This piston may actuate a working tool in any other appropriate manner, but is herein provided with a reduced portion 24, constituting a hammer bar extension adapted to deliver a rapid succession of blows upon the inner end of a drill-bit 25, held in a chuck 26 in any usual or desired manner.

The drilling tool may be either the valveless or the valved type, but the latter is preferred, and is herein provided with a pressure fluid distributing valve 27, working in a valve casing 28, the latter having a pressure supply space 29, from which the pressure fluid under the control of the valve is delivered to opposite ends of the cylinder, and is exhausted therefrom in any appropriate manner, which it will be unnecessary herein to describe, since it forms no essential part of my present invention. The cylinder is herein provided with a rear cylinder head in the form of a head block 30, having one or more, herein two, pressure fluid supply passages 31 and 32, leading through the valve block to and through the cylinder casing to the constant pressure space 29 of the distributing valve casing.

A fluid supply tube 33, passing through an axial perforation 34 in the piston and its hammer bar extension, terminates at its for-

ward end in an axial perforation 35 in the drill-bit, whereby the latter may be supplied with gaseous fluid and water for the purpose of laying the dust or cleansing the drilled hole, or both. In the present instance, the fluid supply tube is supported at its rear end in the valve block 30 in any suitable manner, which it is unnecessary herein to describe, and receives gaseous fluid, such for example as air under pressure, through a passage 36, and water through a passage 38, both of which will be referred to more fully hereinafter. The passage 37 may be placed in communication at will with a water supply passage 38 leading from a water supply chamber 39, the latter communicating with a water supply conduit 40, whereby water may be supplied to the passage 37 and conducted therefrom by a nozzle 41 to a chamber 42, there commingled with the air or other pressure fluid from the passage 36, and delivered through the fluid supply tube 33 to the hollow drill-bit 25. The passages 36, 37 and 38 are, as a matter of fact, in front of the plane of the section, Fig. 3 (see Fig. 1), but for the sake of clearness of illustration, these passages are shown in broken lines in Fig. 3.

The drilling tool may be fed by pressure fluid feeding means, herein comprising a feed cylinder member 43, and a feed piston member 44, either of which may be connected to the drill tool, but herein the piston member is provided with a piston rod 45, secured to the head block 30, and thus to the cylinder of the drilling tool. The feeding device may be, and preferably is, double-acting,—that is to say, it has capacity for advancing the drilling tool toward or retracting it from its work,—and to that end, the piston rod is herein provided with a passage 46 terminating at the rear side of the piston 44, and a passage 47 terminating at its other side. Assuming that the feed cylinder 43 is held fixed when pressure fluid is supplied to the passage 46 and withheld from the passage 47, the drilling tool is advanced toward its work, while on the other hand, if pressure fluid be supplied to the passage 47, and withheld from the passage 46, the tool will be retracted. The feed cylinder 43 may be held fixed in any appropriate manner, and if desired may be provided with a spur 48, to be placed against a suitable abutment on the floor or wall of the mine, but the tool is particularly intended and adapted to be mounted upon a post or column, and to that end, is provided with a mounting comprising a swivel member 49 formed in the usual manner for support upon a saddle, and is secured to the feed cylinder in any appropriate manner, which it will be unnecessary herein to describe, as it forms the subject matter of a separate application.

Preferably mounted in the head block 30

is a controlling device, herein in the form of a throttle valve 50, having capacity for co-ordinately controlling the drilling tool, feeding device, the supply of pressure fluid to the drill-bit, the supply of water to the drill-bit, and the supply of pressure fluid to the front end of the cylinder and the drill-bit chuck, to prevent the entrance of water and sludge, as will appear more fully hereinafter.

The throttle valve is herein provided with an axial chamber 51, receiving a supply of pressure fluid from a pressure fluid inlet 52, to which is connected a pressure fluid supply conduit 53. The valve is herein provided with a shouldered portion 54 resting upon a seat 55 against which it is held by a suitable spring 56 pressing against the lower end of the valve. As a means for turning the valve, the latter is herein provided with a stem 57, to which is secured a handle 58, and if desired, the valve may be held in the selected position of adjustment by a detent spring 59. The throttle valve may be otherwise suitably formed with ports and passages for the control of the tool, the feeding means, the supply of pressure fluid to the drill-bit, the supply of water to the drill-bit, and the supply of pressure fluid to the front end of the cylinder and the drill chuck, but I prefer to employ the arrangement of ports and passages which I will now describe.

The circumferential surface of the valve is herein provided with a groove 60, which in the zero or initial position of the valve establishes communication between the "forward feed" passage 46 and the exhaust port or vent 61 leading to the atmosphere. (See Fig. 12, particularly views *a* and *f*.) The circumferential surface of the valve is also provided with a groove 62, which in the zero or initial position of the valve establishes communication between the "reverse or rearward feed" passage 47 and a second exhaust port or vent 63, leading to the atmosphere (see Fig. 12, particularly views *d* and *g*). Thus when the valve is in its zero or initial position, communication is established between both ends of the feed cylinder and the atmosphere, whereby the feed piston may be adjusted manually without restraint. At certain times in the operation of the machine, the communication of the "forward feed" passage 46 with the atmosphere by way of the groove 62 is closed, and communication is established between said passage and the pressure fluid supply, thereby to feed the tool forward. At certain times in the operation of the machine, the communication between the "reverse or rearward feed" passage 47 and the atmosphere by way of the groove 62 is closed, and communication is established between said passage and the pressure fluid supply, thereby to cause

the tool to be retracted. All of this will more fully appear hereinafter.

The "forward feed" passage 46 leading to the rear end of the feed cylinder is supplied with pressure fluid to advance the tool by a port 64 extending entirely through the circumferential wall of the valve, and communicating with its interior pressure fluid supply chamber 51. This port is herein provided with a laterally-extending circumferential groove 65, whereby at certain positions of the valve, a smaller quantity of air may be supplied to the feed cylinder than is supplied when the port 64 itself registers with the passage 46. The port 64 is also utilized at a certain time in the operation of the machine, as hereinafter described, to establish communication between the pressure fluid supply and the passage 31. During the normal operation of the tool, the passage 31 is placed in communication with the pressure fluid supply by a port 66, extending entirely through the circumferential wall of the valve into communication with its interior pressure fluid supply chamber 51. It will be remembered that the passage 31 leads to the distributing valve chamber of the drill tool. The passage 32, which also leads to the distributing valve chamber of the tool, is also placed in communication with the pressure fluid supply by a port 67, extending entirely through the circumferential wall of the valve, and communicating with its interior pressure fluid supply chamber 51. When the pressure fluid is to be supplied to the cylinder to cause the tool to be retracted, the port 66 at such time is utilized to establish communication between the pressure fluid supply and the "reverse or rearward feed" passage 47. As a means for causing a very small supply of pressure fluid to be delivered to the drilling tool to run the same slowly and "spot" the hole, the port 66 is herein provided with a circumferential groove 68, which is adapted to register with the passage 31 leading to the tool in advance of the main portion of the port 64.

I will now describe the ports in the valve whereby pressure fluid is supplied to the fluid supply tube 33 at certain periods in the operation of the machine. For this purpose, the valve is herein provided with two ports 69 and 70, leading from the internal chamber 51 of the valve through its circumferential wall. Either of these ports may be brought into register with the hereinbefore described passage 36, leading to the chamber 42, and the fluid supply tube 33. In order to maintain communication between each of these ports and the passage 36 during a considerable part of the turning movement of the valve, the latter is herein provided with two circumferential grooves 71 and 72, communicating respec-

tively with and forming in effect parts of the ports 69 and 70. It will be observed that in positions Nos. 1, 2, 3, 4, 5, and 6, shown in Figs. 13, 14, 15, 16, 17, and 18, respectively, the groove 71 is in register with the passage 36, and thus causes pressure fluid to be supplied to the drill-bit, while in positions Nos. 7 and 8, shown in Figs. 19 and 20, respectively, the groove 72 is in register with the passage 36, and thus causes pressure fluid to be supplied therethrough to the drill-bit.

I will now describe the grooves in the valve, whereby water is supplied to the fluid supply tube 33 at certain periods in the operation of the machine. For this purpose, the valve is herein provided with two grooves 73 and 74, each having a generally U-shaped form. The groove 73 is provided with an upper circumferential portion 75, adapted at certain times in the operation of the machine to register with the upper passage 37. The groove 73 is also provided with a lower circumferential portion 76 adapted at such times to register with the lower water supply passage 38. Similarly, the groove 74 is provided with an upper circumferential portion 77, which at certain times in the operation of the machine is adapted to register with the upper port 36 and is also provided with a lower circumferential portion 78, which at such times is adapted to register with the lower water supply passage 38. When the valve is in the position shown in Figs. 15, 16, 17 and 18, the groove 73 maintains communication between the water supply and the water passage 37 leading to the fluid supply tube 33. When, however, the valve is in the position shown in Figs. 19 and 20, the groove 74 maintains communication between the water supply and the passage 37 leading to the fluid supply tube.

It now remains to describe the ports and passages whereby pressure fluid is supplied to the forward end of the cylinder and to the chuck bushing at certain periods in the operation of the machine.

The valve block is herein provided with a passage 79, leading therethrough to and through the walls of the cylinder, and having a port 80 opening into the forward end of the cylinder. The piston extension 24 hereinbefore described may be provided with one or more, herein a plurality of rifle grooves 81, utilized for the actuation of a chuck rotating mechanism 82, the latter being preferably the same or similar to that which forms the subject matter of United States Letters Patent No. 1,034,010, granted to Sullivan Machinery Company, July 30, 1912, as my assignee. When the piston 23 moves rearwardly to a certain point, the rear ends of the grooves 81 enter into the forward end of the cylinder, and thus es-

establish communication between the latter and a chamber 83 within the chuck 26, and at the rear end of its chuck bushing 84. During the normal operation of the machine, sufficient pressure fluid is conducted from the cylinder through the grooves 81 to the chamber 83 to prevent the entrance of water or sludge, which might otherwise find its way through the chuck bushing, and thus into the cylinder. It will be readily appreciated that the entrance of such water and sludge would be apt to produce serious injury to the drill tool. When, however, the pressure fluid for the actuation of the cylinder is excluded from the latter when the piston is at rest, and when the drill-bit is in the drilled hole and water would be apt to enter the chuck bushing and cylinder, pressure fluid may then be supplied to the forward end of the cylinder by way of the passage 79 and port 80. Such pressure fluid is automatically supplied at the proper time, under the control of the described throttle valve, by the use of the ports in the valve which I will now describe.

Extending through the circumferential wall of the valve is a port 85, and leading therefrom is a circumferential groove 86 forming in effect a circumferential continuation thereof. When the valve is in the position illustrated in Figs. 13, 14, and 15, the port 85 and its groove 86 maintain communication between the pressure fluid supply and the passage 79, leading to the port 80 at the front end of the cylinder. When the valve is in the position shown in Fig. 19, communication between the pressure fluid supply and the passage 79 is established by a port 87 extending through the circumferential wall of the valve. It should here be observed that the communication thus established between the pressure fluid supply and the port 80 at the forward end of the cylinder occurs only at such times as the supply of pressure fluid is cut off from the supply space 29 of the distributing valve 27.

Having described the several ports of the controlling valve, I will now describe the general operation of the controlling apparatus and the various events which occur in turning the valve to its several positions, reference being had to Figs. 12 to 20, inclusive, showing the different positions which the valve occupies in the use of the machine. The initial or neutral position of the valve is shown in Fig. 12. It will be observed that in this position of the valve, communication between both ends of the feed cylinder and the atmosphere is established by way of the exhaust ports or atmospheric vents 61 and 63, while the supply of motive fluid is entirely cut off from the feed cylinder, the drilling tool, the drill-bit, and the chuck bushing, and the water supply is cut off as well. When the valve is

in this position, the feed cylinder may be moved freely to and fro with relation to the feed piston, so that the preliminary adjustment of the machine may be accomplished. The drill is then placed so that when the end of the drill-bit is against or adjacent the work, the feeding device is contracted,—that is to say, the feed piston is adjacent the rear end of the feed cylinder. Having properly arranged the machine, as will be readily understood by those skilled in the art, the operator then grasps the handle 58 and turns the same contra-clockwise from the initial or zero position shown in Fig. 12 toward the No. 1 position shown in Fig. 13. The first event which takes place is the admission of pressure fluid to the chuck bushing by way of the port 85 and passage 79, and the admission of pressure fluid to the fluid supply tube 33 by way of the port 69, groove 71, and passage 36 (see Fig. 13). The next event which takes place is the closing of the communication between the rear end of the feed cylinder, due to the movement of the groove 60 out of register with the atmospheric air vent or exhaust port 61. Simultaneously therewith, a limited supply of pressure fluid is admitted to the rear end of the feed cylinder by way of the port 64, groove 65, and passage 46, thereby causing the tool to be advanced slowly. Pressure fluid is still excluded from the front end of the feed cylinder, and the same is still open to the atmosphere. Pressure fluid is still supplied to the chuck bushing and to the fluid supply tube, as in the position shown in Fig. 13. It will be understood that at this time, the supply of water is shut off. The next event which takes place is the admission of water to the fluid supply tube 33, by way of the passage 37, groove 76, groove 73, groove 75, and passage 37 (see Fig. 15). It will be understood that in other respects, the conditions prevailing in the position shown in Fig. 14 are still maintained, and it will be understood that the drill-bit is now firmly pressed against the work and a supply of commingled pressure fluid and water is delivered to the cutting end of the drill-bit, while water is prevented from entering the chuck bushing because of the fact that pressure fluid is supplied to the latter. The fourth event which takes place is the admission of a limited supply of pressure fluid to the hammer drill by way of the port 66, its grooves 68 and the passage 31, whereby the hammer is caused to operate slowly to "spot" the hole. Simultaneously therewith, the pressure fluid supplied through the passage 79 and port 80 to the forward end of the cylinder and to the chuck bushing is cut off by the movement of the port 85 and its passage 86 to a position out of register with the passage 75 (see Fig. 16). In other respects, the con-

ditions obtaining in the position shown in Fig. 15 are still continued. The operator now continues to move the valve, first to the No. 5 position illustrated in Fig. 17, and then to the No. 6 position illustrated in Fig. 18. In the No. 5 position, conditions are the same as in the No. 4 position, except that the supply of pressure fluid to the cylinder of the drilling tool is one-half of the full capacity. In the No. 6 position, the conditions are the same as in the No. 4 and No. 5 positions, except that the ports leading to the cylinder of the drilling tool are now opened to their fullest extent, and the tool is in full operation. At such times, it is to be noted that both pressure fluid and water are supplied to the drill-bit, thus causing the laying of the dust and the expulsion of the cuttings from the drilled hole. The valve is maintained in this position until the hole has been drilled to the desired depth, whereupon the valve is turned clockwise to its initial or neutral position. This reversal of the valve is of course accompanied by a reversal of the order of events leaving the machine with all ports closed, as before. Continuing to turn the valve clockwise from its initial or neutral position toward the No. 7 position shown in Fig. 19, it will be observed that the passage 46 leading to the rear end of the feed cylinder is now placed in communication with the atmosphere, by way of the groove 60 and atmospheric vent or port 61 (see Figs. 19 *a* and *f*.) Pressure fluid is now supplied by way of the port 67 and passage 47 (see Figs. 19 *d* and *f*) to the front end of the feed cylinder, thus causing the tool to be retracted and withdrawn from the drilled hole. At the same time, a supply of gaseous fluid or gaseous fluid and water is delivered to the drill-bit, because of the fact that at this time, the groove 74 registers with the water supply passage 38, and the passage 37, the latter leading to the fluid supply tube. Thus it will be apparent that as the drill-bit is being withdrawn from the drilled hole, the latter will be cleared of the cuttings. At this moment, the supply of pressure fluid to the drilling tool is cut off, but it will be noted that the port 87 is in register with the passage 79 leading to the front end of the cylinder and the chuck bushing, whereby water and sludge are excluded therefrom. The operator now continues to turn the valve toward the No. 8 position shown in Fig. 20. Conditions now continue to exist as in the No. 7 position, except that the port 67 supplying pressure fluid to the feed is now fully opened and the port 64 is partially open to the passage 31 leading to the drill tool, thus causing the latter to reciprocate slowly to free the drill-bit while withdrawing it. It should here be observed that the port 64, which was heretofore used

to deliver pressure fluid to the feed (see Figs. 14, 15, 16, 17 and 18), is now utilized to deliver fluid to the drilling tool, while on the other hand, the port 67, which was heretofore employed to deliver pressure fluid to the drilling tool by way of the passage 32 (see Figs. 17 and 18), is now utilized to deliver pressure fluid to the feed reverse by way of the passage 47 (see Figs. 19 and 20). It will be noted that, in the No. 8 position of the valve, shown in Fig. 20, the drilling tool is operated, and pressure fluid supplied to the front end of the cylinder and chuck bushing, by way of the passage 79 and port 80, is cut off by the movement of the port 87 from the position shown in Fig. 19 to that shown in Fig. 20. When the drill-bit has been withdrawn from the drilled hole, the operator turns the controlling valve back to its initial or neutral position, thus reversing the order of events, and leaving the tool as before with the pressure fluid shut off from all ports. Owing to the provision of the described means for conjointly controlling the drilling tool, its feeding device, the supplies of gaseous fluid and water to the drill-bit, and the supply of pressure fluid to the front end of the cylinder and chuck bushing, the desired operations take place in their proper sequence, without any attention on the part of the operator other than to simply turn the handle continuously from one position to another according to the circumstances.

If the nature of the work does not call for water, the supply may be discontinued entirely by the use of a shut off valve 88, and the supply of pressure fluid to the drill-bit is continued as before.

While I have herein shown and described one specific embodiment of my invention for illustrative purposes, and have disclosed and discussed in detail the construction and arrangement incidental to one specific application thereof, it is to be understood that the invention is limited neither to the mere details or relative arrangement of parts, nor to its specific embodiment herein shown, but that extensive deviations from the illustrated form of embodiment of the invention may be made, without departing from the principles thereof.

Having thus described my invention, what I claim and desire by Letters Patent to procure is:

1. The combination of a drilling tool having means for conducting water to the drilled hole; means for feeding said drilling tool; and means for coördinately controlling said drilling tool, the water to the drilled hole, and said feeding means.

2. The combination of a drilling tool having means for conducting pressure fluid and water to the drilled hole; means for feeding said drilling tool; and means for coördi-

nately controlling said drilling tool, the pressure fluid and water to the drilled hole, and said feeding means.

3. The combination of a drilling tool having means for conducting water to the drilled hole; means for feeding said drilling tool; and means to cause said feeding means to advance said tool toward the work, the water conducting means to conduct water to the work, and the drilling tool to operate in the order named.

4. The combination of a drilling tool having means for conducting pressure fluid and water to the drilled hole; means for feeding said drilling tool; and means to cause said feeding means to advance said tool toward the work, the pressure fluid and water conducting means to conduct the pressure fluid and water to the work, and the drilling tool to operate in the order named.

5. The combination of a drilling tool having means for conducting water to the drilled hole; means for feeding said drilling tool; and means to cause said drilling tool to operate, the feeding means to retract the tool while it is operating, and the water conducting means to conduct water to the work while the tool is being retracted.

6. The combination of a drilling tool having means for conducting pressure fluid and water to the drilled hole; means for feeding said drilling tool; and means to cause said drilling tool to operate, the feeding means to retract the tool while it is operating, and the pressure fluid and water conducting means to conduct pressure fluid and water to the work while the tool is being retracted.

7. A rock drill having a cylinder, a piston working therein, a chuck, a hollow drill-bit mounted in said chuck and operated by said piston, means to conduct water to and through said drill-bit, means to conduct pressure fluid to said cylinder for the actuation of said piston, and means to cause pressure fluid to be supplied to said chuck to prevent the entrance of water or sludge thereto.

8. A rock drill having a cylinder, a piston working therein, means to conduct pressure fluid to said cylinder for the actuation of said piston, means to cause said piston to reciprocate, a chuck, a hollow drill-bit mounted in said chuck and operated by said piston, means to conduct water to said drill-bit, and means to cause pressure fluid to be supplied to said chuck to prevent the entrance of water or sludge thereto when said piston is at rest.

9. A rock drill having a cylinder, a piston working therein, means to conduct pressure fluid to said cylinder for the actuation of said piston, means to cause said piston to reciprocate, a chuck, a hollow drill-bit mounted in said chuck and operated by said piston, means to conduct water to said drill-

bit, and means to cause a cessation of the operation of said piston and to cause pressure fluid to be supplied to the front end of said cylinder and said chuck to prevent the entrance of water and sludge thereto when the piston is at rest.

10. A rock drill having a cylinder, a piston working therein, means to conduct pressure fluid to said cylinder for the actuation of said piston, means to cause said piston to reciprocate, a chuck, a hollow drill-bit mounted in said chuck and operated by said piston, means to conduct water to said drill-bit, and means to cause the withholding of actuating pressure fluid utilized to reciprocate said piston and to cause pressure fluid to be supplied to the front end of said cylinder and said chuck to prevent the entrance of water and sludge thereto when the piston is at rest.

11. The combination of a pressure fluid tool having means to conduct gaseous fluid and water to the work; pressure fluid means for feeding said tool; and controlling means having ports so arranged that in one position thereof gaseous fluid is supplied to the work, the supply of water is cut off, and the supply of pressure fluid to the tool and feeding means is cut off.

12. The combination of a pressure fluid tool having means to conduct gaseous fluid and water to the work; pressure fluid means for feeding said tool; and controlling means having ports so arranged that in one position thereof gaseous fluid is supplied to the work, the supply of water is cut off, the supply of pressure fluid to the tool is cut off, and pressure fluid is supplied to the feeding means to cause the tool to be advanced.

13. The combination of a pressure fluid tool having means to conduct gaseous fluid and water to the work; pressure fluid means for feeding said tool; and controlling means having ports so arranged that in one position thereof gaseous fluid and water are supplied to the work, the supply of pressure fluid to the tool is cut off, and pressure fluid is supplied to the feeding means to cause the tool to be advanced.

14. The combination of a pressure fluid tool having means to conduct gaseous fluid and water to the work; pressure fluid means for feeding said tool; and controlling means having ports so arranged that in one position thereof gaseous fluid and water are supplied to the work, and pressure fluid is supplied to the tool and to the feeding means to cause the tool to be operated and advanced.

15. The combination of a pressure fluid tool having means to conduct gaseous fluid and water to the work; pressure fluid means for feeding said tool; and controlling means having ports so arranged that in one position thereof gaseous fluid and water are

supply of pressure fluid to the tool and feeding means is cut off; and in another position gaseous fluid is supplied to the work, the supply of water is cut off, the supply of

the supply of water is cut off, the supply of pressure fluid to the tool is cut off, and pressure fluid is supplied to the feeding means to cause the tool to be advanced; and in another position gaseous fluid and water are supplied to the work, the supply of pressure fluid to the tool is cut off, and pressure fluid is supplied to the feeding means to cause the tool to be advanced; and in another position gaseous fluid and water are supplied to the work, and pressure fluid is supplied to the tool and to the feeding means to cause the tool to be operated and advanced.

21. The combination of a pressure fluid tool having means to conduct gaseous fluid and water to the work; pressure fluid means for feeding said tool; and controlling means having ports so arranged that in one position thereof gaseous fluid is supplied to the work, the supply of water is cut off, and the supply of pressure fluid to the tool and feeding means is cut off; and in another position gaseous fluid is supplied to the work, the supply of water is cut off, the supply of pressure fluid to the tool is cut off, and pressure fluid is supplied to the feeding means to cause the tool to be advanced; and in another position gaseous fluid and water are supplied to the work, the supply of pressure fluid to the tool is cut off, and pressure fluid is supplied to the feeding means to cause the tool to be advanced; and in another position gaseous fluid and water are supplied to the work, and pressure fluid is supplied to the tool and to the feeding means to cause the tool to be operated and advanced, and in another position gaseous fluid and water are supplied to the work, the supply of pressure fluid to the tool is cut off, and pressure fluid is supplied to the feeding means to retract the tool.

22. The combination of a pressure fluid tool having means to conduct gaseous fluid and water to the work; pressure fluid means for feeding said tool; and controlling means having ports so arranged that in one position thereof gaseous fluid is supplied to the work, the supply of water is cut off, and the supply of pressure fluid to the tool and feeding means is cut off; and in another position gaseous fluid is supplied to the work, the supply of water is cut off, the supply of pressure fluid to the tool is cut off, and pressure fluid is supplied to the feeding means to cause the tool to be advanced; and in another position gaseous fluid and water are supplied to the work, the supply of pressure fluid to the tool is cut off, and pressure fluid is supplied to the feeding means to cause the tool to be advanced; and in another position gaseous fluid and water are supplied to the work, and pressure fluid is

20. The combination of a pressure fluid
80 tool having means to conduct gaseous fluid
and water to the work; pressure fluid means
for feeding said tool; and controlling means
having ports so arranged that in one position
thereof gaseous fluid is supplied to the
65 work, the supply of water is cut off, and the

supplied to the work, and pressure fluid is 130

supplied to the tool and to the feeding means to cause the tool to be operated and advanced; and in another position gaseous fluid and water are supplied to the work, the supply of pressure fluid to the tool is cut off, and pressure fluid is supplied to the feeding means to retract the tool, and in another position gaseous fluid and water are supplied to the work, and pressure fluid is supplied to the tool and the feeding means to cause the tool to be operated and retracted.

23. A rock drill having a cylinder; a piston working therein; a chuck; a hollow drill-bit mounted in said chuck and operated by said piston; pressure fluid means for feeding said cylinder; and controlling means having ports so arranged that in one position thereof gaseous fluid is supplied to said drill-bit, the supply of water to the drill-bit is cut off, the supply of pressure fluid to reciprocate said piston is cut off, the supply of pressure fluid to the feeding means is cut off, and pressure fluid is admitted to said chuck.

24. In a rock drill having a cylinder; a piston working therein; a chuck; a hollow drill-bit mounted in said chuck and operated by said piston; pressure fluid means for feeding said cylinder; and controlling means having ports so arranged that in one position thereof gaseous fluid is supplied to said drill-bit, the supply of water to the drill-bit is cut off; the supply of pressure fluid to reciprocate said piston is cut off, and pressure fluid is supplied to the feeding means to advance the cylinder, and pressure fluid is admitted to said chuck.

25. A rock drill having a cylinder; a piston working therein; a chuck; a hollow drill-bit mounted in said chuck and operated by said piston; pressure fluid means for feeding said cylinder; and controlling means having ports so arranged that in one position thereof gaseous fluid and water are supplied to the drill-bit, the supply of pressure fluid to reciprocate said piston is cut off, pressure fluid is supplied to the feeding means to advance the cylinder, and pressure fluid is admitted to said chuck.

26. A rock drill having a cylinder; a piston working therein; a chuck; a hollow drill-bit mounted in said chuck and operated by said piston; pressure fluid means for feeding said cylinder; and controlling means having ports so arranged that in one position thereof gaseous fluid and water are supplied to the drill-bit, pressure fluid is supplied to reciprocate the piston, and pressure fluid is supplied to the feeding means to advance the cylinder.

sure fluid is supplied to the feeding means to advance the cylinder.

27. A rock drill having a cylinder; a piston working therein; a chuck; a hollow drill-bit mounted in said chuck and operated by said piston; pressure fluid means for feeding said cylinder; and controlling means having ports so arranged that in one position thereof gaseous fluid and water are supplied to the drill-bit, the supply of fluid to reciprocate the piston is cut off, pressure fluid is supplied to retract the cylinder, and pressure fluid is admitted to the chuck.

28. A rock-drill having a cylinder; a piston working therein; a chuck; a hollow drill-bit mounted in said chuck and operated by said piston; pressure fluid means for feeding said cylinder; and controlling means having ports so arranged that in one position thereof gaseous fluid and water are supplied to the drill-bit, and pressure fluid is supplied to reciprocate the piston, and to retract the cylinder.

29. Drilling apparatus comprising in combination, a drill bit, a drill cylinder, percussive means, automatic drill bit rotating means, pressure fluid actuated drill feeding means, fluid actuated drill retracting means, and conduit means for conducting pressure fluid to said drill bit rotating means and to said drill retraction means; said drill cylinder, said drill bit and said drill retracting means being substantially axially aligned, whereby said drill retracting means may exert a direct pull on said drill bit to retract said bit from the work, while said drill is automatically rotating.

30. Drilling apparatus comprising in combination, feed mechanism including two telescopic, pressure fluid actuated, relatively slidable members; a drill cylinder substantially axially aligned with, in advance of, and exterior to said feeding mechanism; a drill bit; percussive means; automatic drill bit rotating means; and conduit means for conducting pressure fluid to said feeding mechanism and said drill cylinder; whereby said drill bit may be automatically subjected to percussive action, rotated and fed to the work, while said drill cylinder is supported between said feed mechanism and said drill bit.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

GEORGE H. GILMAN.

Witnesses:

LOUIS A. JONES,
CLARA L. STUART.