CONTROL SYSTEM FOR DRILLS

Inventors: Laurence B. Hanson, Pine; Wallace W. Arthur, Denver, both of Colo.

Assignee: Gardner-Denver Company, Quincy, Ill.

Filed: Sept. 11, 1970

Appl. No.: 71,403

Related U.S. Application Data


U.S. Cl. .................................................. 173/4

Int. Cl. .................................................. E21c 5/10

Field of Search ........................................... 173/4, 9, 10, 159

References Cited

UNITED STATES PATENTS

2,125,287 11/1971 Gartin................................. 173/4

ABSTRACT

An automatic control system for a guide shell mounted rock drill including a control circuit having pneumatically operated valves for providing pressure fluid to the drill hammer, rotation motor and feed motor and for controlling drill hole flushing medium. Sensors mounted on the drill guide shell provide for reversal of the feed motor and reduced drill power upon reaching the forward end of the guide shell, and shutdown of the drill upon reaching the rearward end of the guide shell. The control circuit includes a series of control valves for selection, at will, by the drill operator of a particular operating sequence or condition of the drill. A control valve is included for providing an operating sequence which includes operation of the drill at reduced power for a predetermined period of time for collaring a drill hole. The control system also includes pressure proportioning valves for automatically regulating the feed motor pressure to be proportional to the drill percussion motor supply pressure.

4 Claims, 5 Drawing Figures
CONTROL SYSTEM FOR DRILLS

This is a division of application, Ser. No. 808,925 and now Pat. No. 3,561,542 filed Mar. 20, 1969.

BACKGROUND OF THE INVENTION

In underground mining and tunnel construction it is common practice to drill blast holes with multiple rock drill units commonly known in the art as jumbos. Jumbos usually comprise a plurality of pressure fluid operated percussion rock drills slidably mounted on elongated supports known as guide shells which in turn are mounted on positionable booms. Operation of the rock drills is normally controlled from a remote operator station or control panel mounted on a vehicle or undercarriage carrying the boom and drill assemblies.

Hereinafter control of plural drills has been largely a manual operation carried out by manipulation of a number of control valves located on the operator control panel to feed and retract the drills along their respective guide shells and to regulate feed pressure and drill motor impact and rotation. As the number of drills mounted on a jumbo is increased, it becomes difficult for an operator to monitor and control all drills simultaneously and accordingly drill accuracy decreases and efficiency is impaired. It therefore becomes desirable to provide an automatic control system for each drill so that a greater number of drills can be monitored by one operator.

An example of an automatic control system for a guide shell mounted rock drill is disclosed in U.S. Pat. No. 3,381,761 to C.A. Hanson. In addition to the automatic functions performed by the Hanson system it is desirable to provide for operating the drill at reduced percussion motor impact power, feed rate, and drill steel rotation rate at the beginning of the drilling cycle to collar or spot the hole.

Another problem associated with the operation of a guide shell mounted drill is the regulation of the feed force to prevent overheating or underfeeding the drill during penetration of the rock face. In large mines and tunneling operations the pressure fluid supply systems from which jumbo units operate are often subject to supply pressure fluctuations which in turn make necessary the adjustment of the supply pressure to the feed motor to keep the feed rate of the drill at a proportional rate relative to the drill percussion motor power which will prevent overheating or underfeeding of the drill.

SUMMARY OF THE INVENTION

The present invention provides for a rock drilling apparatus having a control system which is operable to control automatically a predetermined operating cycle of the drill. The control system of the present invention provides for an operating cycle which commences with operation of the drill percussion motor and subsequent rotation motor at reduced power for a predetermined period of time to collar or spot a hole. After the collaring operation is completed, the drill is automatically fed to the desired hole depth, then retracted along the support while operating at reduced power, and finally shut off upon being fully retracted along the support.

The present invention also provides for control of valve means which may be actuated to provide for continuous operation at reduced power to the drill. The present invention also provides for control means operable to provide full power to the drill percussion motor at any phase of the drill operating cycle, reversing of the drill feed motor at any point in the forward feed phase of the operating cycle, and stopping all functions at any phase of the drill operating cycle.

An important aspect of the present invention is the provision of valve means for automatically maintaining a regulated pressure to a drill feed motor which is proportional to the drill percussion motor supply pressure to prevent underfeeding or overfeeding the drill due to variations in pressure of the working fluid supply system.

Another aspect of the present invention is the provision of automatic time delay means operable to delay the retraction of the drill upon completion of the drill hole until sufficient hole cleansing medium has been provided to flush the drill hole completely free of drill cuttings which could interfere with removal of the drill steel and bit, and so that a clean hole is provided for ease in placing blasting charges therein.

The apparatus of the present invention further provides for an improved method of drilling blast holes wherein a complete cycle comprising collaring, drilling, cleaning the hole, and withdrawal of the drill steel is accomplished automatically with predetermined time intervals for the collaring and hole cleaning phases.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 and FIG. 2 comprise a schematic view of the automatic control system and are intended to be read together.

FIG. 3 is a perspective view of an enclosure for the pilot operated supply valves.

FIG. 4 is a sectional view of a proportional pressure regulator valve for controlling pressure to a rock drill feed motor.

FIG. 5 is a sectional view of an alternate embodiment of a proportional pressure regulator valve.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The schematic representation of the automatic control system shown in FIGS. 1 and 2 is for the purpose of ease in understanding the circuitry of the system. Generally, diagrams of valve and flow control elements are in accordance with accepted standards for graphic symbols for fluid power diagramming. Exceptions have been made for nonstandard components and where standard symbols are not particularly descriptive.

Referring to FIG. 1 an elongated drill support 10 is shown having slidably mounted thereon a pressure fluid operated rock drill 12. The rock drill 12 includes a fluid operated rotation motor 14 operable to rotate a hollow drill steel 16. The rock drill 12 is of a well known type which operates to deliver percussion blows to the drill steel 16 by means of a fluid actuated percussion motor 17 housed within the drill. The drill 12 is operable to use compressed air as the working fluid although the present control system with obvious modifications could be used with hydraulic working fluid. The drill support 10 also includes a fluid operated feed motor 18 which is operable to feed the drill 12 reversibly along the support 10 by one of several well known mechanisms, not shown.

A portion of the automatic control system of the instant invention is diagrammatically shown as being contained in an enclosure 20 which could take many forms. One practical embodiment of such an enclosure is described herein in some detail.

The enclosure 20 has a main pressure air supply conduit 22 (see FIG. 2) leading from a source, not shown, into a first supply valve 26 having a position a and a position b. All two position valves will be designated as having a position a and position b. As an example to define the symbols, the valve 26 has a spring actuator 26a to maintain the position a and a pilot actuator 26b to maintain the position b when energized with pressure fluid. When pressure fluid is exhausted from the pilot actuator to deenergize the valve the spring actuator returns the valve to the position a. Quite conceivably, the pilot actuated valves of FIG. 1 could have pilot actuators using a hydraulic or electric signal if the control circuit were so designed to operate with these mediums. Numeral 28 designates the flow restrictor and conduit which comprises an internal pilot supply for pilot actuator 26b. A conduit 30 leads from supply valve 26 through an adjustable flow control valve 32 to the drill rotation motor 14. The main supply air conduit 22 has a branch 34 which supplies a second supply valve 36 comprising means to supply the drill 12 with fluid at substantially supply pressure. The valve 36 is also pilot air actuated and has an internal pilot conduit. The branch 34 is also in communication via conduit 38 with a third pilot actuated supply valve 40 having an internal pilot conduit. The valve 40 comprises means for operating the drill and feed motor in the
reverse condition. Also mounted in the enclosure 20 is a two-position pilot actuated valve 42 for controlling the supply of drill hole flushing water to the drill via conduits 44 and 46. Drill hole flushing water is supplied internally through the drill 12 to the hollow drill steels 16 in a manner well known.

The enclosure 20 further includes valves 48 and 50 which comprise proportional pressure regulator means for regulating pressure fluid to the feed motor. Valves 48 and 50 are shown schematically in FIG. 1 and structurally in FIGS. 4 and 5. A forward feed supply valve 52 which is pilot actuated to be in positions a or b is also included in the enclosure 20.

FIG. 1 also illustrates schematically a front position sensing element comprising a two-position mechanically actuated valve 54 engaging the front position sensor 56 on the drill 12. A rear position sensing valve 58 similarly has an actuator 58b engageable by the projection 60. The sensing valves 54 and 58 may be positioned as desired along the length of the drill support 10 and mounted thereon for actuation by the drill projections 56 and 60 to limit the forward and rearward movement of said drill by the automatic control system as explained below.

Referring to FIG. 2, the remainder of the automatic control system is schematically illustrated as comprising a plurality of control valves and associated circuitry housed within an enclosure 62 which would preferably be mounted at the drill operator control station of the rock drilling unit, not shown. The enclosure 62 has a branch conduit 64 leading thereto which is in communication with the main air supply line 22 and leads to the several control valves to be described. The operator control enclosure 62 houses a two-position valve 68 labeled COLLAR which receives supply air at line pressure from conduit 70 connected to branch supply conduit 64. A manual control valve 69 or push button is depicted by the symbol 60. The valve 68 may be actuated manually to the posi-

65 70
tion b or by a supply of pilot pressure fluid. Release of operator force or pilot pressure will result in the return to the position a. The control enclosure 62 similarly includes two-position manual and pilot actuated valves 72, 74, and 76 labeled START DRILL and REVERSE, respectively. The valves 72, 74 and 76 are respectively connected to the branch supply conduit 64 by conduits 78, 80 and 82. A manual and pilot actuated valve 84 labeled STOP is also within the enclosure 62 for actuation by the operator. The enclosure 62 further includes a pilot actuated exhaust valve 86 and a similar exhaust valve 88.

An important aspect of the present invention includes a variable timing means which is provided for by the reservoir 90 and the adjustable timing valve 92 labeled COLLAR TIME. The reservoir 90 is in communication with the start valve 72 via the conduit 94, and with the pilot actuator of the drill control valve 74 by way of the conduit 96. The reservoir 90 also includes an orificed exhaust line 98. The conduit 164, in communication with conduit 94, includes a typical check valve 165. Flow is one way only as indicated by the arrow in conduit 164.

The circuitry can be easily traced and the control system can be best understood by an explanation of the improved operating cycles which the drill can be controlled to perform. From the accompanying drawings it will be evident how the circuitry is interconnected to the various components. Referring to FIGS. 1 and 2 a normal drilling cycle begins with the drill 12 retracted over the rear position sensing valve 58 so that the valve is actuated to be in the position b. All valves labeled for positions a and b will be in position a pressure except as noted. Water control valve 42 is assisted to the position b by water pressure in line 44 due to internal construction of the valve.

With pressure air supplied to conduit 22 and its branch con-

55 60 65
duit 64, air will flow through conduit 100 to the rear sensing valve 58 and through conduit 102 to the pilot actuator of exhaust valve 88 to hold the same in position b. Conduit 104 leading from conduit 100 to the front position sensor 56 will be bleeding through orificed conduit 106 to continually air wash the actuator 58b to prevent debris from collecting thereon. Air washing of the rear sensing valve actuator 58b occurs similarly through orificed conduit 108. To commence a complete drill operating cycle the operator will momentarily manually actuate the START valve 72 shifting the same to position b which permits pilot air to flow from conduit 78 through conduit 110 to shift the first or collapsing supply valve 26 to position b (FIG. 1). Valve 26 then supplies air through its internal pilot 28 to maintain position b and pressure air flows through conduit 30 to operate the drill rotation motor at reduced speed as controlled by the adjustable valve 32. Pressure air will also flow through conduit 111 through an adjustable flow control valve 112 to conduit 114 and to the drill 12 for operation of reverse or percussion motor 17 at reduced position.

Valve 26 also supplies pilot air through conduit 116 to hold the drill hole flushing water valve 42 open in position b to provide water to the drill hole, and through conduit 118 to hold the forward feed valve 52 in position a. Supply air from conduit 118 also flows through the proportional pressure regulator 48 and conduit 119 to supply fluid at proportionately reduced pressure through the forward feed valve 52 and conduit 120 to the feed motor 18. Referring to FIG. 1 it appears that air can flow through conduit 111 and conduit 113 to operate the internal pilot of the second or drilling supply valve 36 to shift same to position b and provide full power to the drill. However, the pilot actuator of valve 36 is set to operate at line pressure only and therefore will not actuate at the proportionately reduced pressure set by the adjustable valve 112. The drill 12 thus commences to operate at reduced forward force feeding for collaring the hole. Such operation is particularly desired to prevent deflection of the drill steel when the steel and bit are inclined to the surface of the rock face. As the projection 60 moves off the actuator 58b of the rear sensing valve 58, said valve returns to position a and exhaust valve 88 returns to position a.

As previously mentioned the operator need only actuate the START valve 72 momentarily whereupon release of the manual actuator the start valve returns to position a.

The collapsing supply valve 26, having shifted to position b, now also supplies air at line pressure from its internal pilot conduit 28, through conduit 110, valve 72 and conduit 94 to the reservoir 90 at a rate controlled primarily by the timing valve 92. The setting of valve 92 will regulate the amount of time required for pressure to increase in the reservoir sufficiently to cause the drill control valve 74 to shift to position b. The reservoir 90 may take many forms including being em-

75 80 85
bedded in conduit 96 depending on the volume thereof. When the control valve 74 has shifted to position b air at line supply pressure will flow through conduit 80 and conduit 124 to activate the drilling supply valve 36 to position b to supply air at substantially line supply pressure to the drill percussion motor 17 through conduits 113 and 114. Air at line supply pressure will also flow through conduit 111 and bypass conduit 126 to conduit 30 to operate the drill rotation motor 14 at full power. Conduit 113 will also supply air through conduit 128 and the proportional pressure regulator 50 which in turn will provide a regulated supply of pressure air through conduit 129, the forward feed valve 52, and conduit 120 to the feed motor 18. The feed motor will be exhausting through conduits 130 and 132 and the third or rear position sensor 54 which in turn actuates the reservoir 137 to the pilot actuator of the REVERSE con-

70 75

3,670,826

4 control valve 76. The flow control valve 135 and the reservoir 137 comprise a variable time delay means to delay the shifting of the control valve 76 to position b for reasons to be explained below. The REVERSE control valve 76, when shifted to position b by pilot pressure fluid from conduits 134 and 139, will...
cause pressure air to flow through conduits 82 and 136 to the pilot actuator of reverse supply valve 40 shifting same to position b. The REVERSE control valve 76 will also cause a pressure signal in conduit 138 to shift the exhaust valve 86 to position b exhausting air from the pilot actuator of the DRILL control valve 74 by way of conduits 140 and 142 causing valve 74 to shift to position a which will cause a shift of the drilling supply valve 56 to position a interrupting the full power supply to the drill percussion motor, rotation motor and proportional regulator 50. Collar supply valve 26 will also actuate to position a having exhausted its pilot actuator through conduit 110, START valve 72 in position a, conduit 165,160, and 142 to the exhaust valve 86. The reverse supply valve 40 will also now supply pressure air through conduit 132 to conduit 144 shifting the forward feed supply valve 52 to position b exhausting conduit 120. Pressure air will also now flow through conduit 130 at full supply pressure to the feed motor 18 running the same in reverse to retract the drill along the support. Pressure air is further now being supplied to conduit 146 and 148 simultaneously shifting the flushing water valve 42 to position a shutting off the flow of water and changing the flushing mechanism from flushing the hole as the drill steel is withdrawn. Hole cleaning air is not required to be controlled by valve 42 with the system of the present invention. The drill 12 is now also being supplied with a reduced supply of air through conduit 132 to adjustable valves 32 and 112 to operate the rotation motor 14 and drill percussion motor 17 at reduced power to facilitate withdrawal of the drill steel from the hole. After the drill projection 56 moves off the front position sensing actuator 54 the valve 54 returns to position a causing the pilot actuator of the REVERSE control valve 76 to exhaust through conduit 134 and a shift of said valve to position a. The reverse supply valve 40 remains in position b due to its own internal pilot supply. The drill 12 continues to retract along the support 10 until the projection 60 strikes the rear position sensing actuator 53b causing the valve 58 to shift to position b which in turn will send a pressure signal through conduit 102 to the pilot actuator of the Exhaust valve 88 shifting the same to position b. The reverse supply valve 40 will now shift to position a having exhausted its pilot actuator through conduits 136, 138, and 150 and the exhaust valve 88. All supply air to the drill and feed motor is now interrupted and the drill is shut down. The exhaust valve 86 will also return to position a having exhausted its pilot actuator through conduits 138. The drill will thus have operated through a completely automatic cycle of operation with regulated pressure on the feed motor 18 automatically compensating for variations in supply line pressure during the collaring of a hole. Various other operational modes are selectable, at will, by the operator with the control system of the present invention. For example, if it is desired to prolong operation of the drill at collaring power, that is prior to the drill engaging the front position sensing valve 54, manual actuation of the COLLAR control valve 68 to move to position b will operate the pilot actuator of the START valve 72 by supplying pressure air through conduits 70, 152, and 154 to move the START valve to position b. The collar supply valve 26 will then be actuated as previously described and the drill will operate at collaring power. Upon actuation of the exhaust valve 86 to position b, caused by the drill actuating the front position sensing valve 54, the collar control valve pilot actuator would be exhausted through conduits 156, 160, 142 and the valve 86 and the START valve 72 would return to position a after bleeding its pilot actuator through conduit 154 and orifice 158. During any operating mode of the control system, full power to the drill percussion motor and rotation motor may be applied by manual actuation of the drill control valve 74 to position b which will supply line pressure air to the pilot actuator of the drill supply valve 56 as previously described. If the drill is in the reverse feed mode, however, the DRILL control valve 74 must be manually held in position b to operate the percussion motor and rotation motor at full power, otherwise the drill supply valve pilot actuator would exhaust through the DRILL control valve, in position a, and conduits 140 and 142 and the exhaust valve 86 which, during reverse feed of the drill, is in position b.

The control system may also be operated to commence the reverse feed mode at any point in the forward collaring or drilling mode by manual actuation of the REVERSE control valve 76 to position b. Such actuation would cause a pressure signal to be sent to the reverse supply valve 40 and via conduit 138 to exhaust valve 86 shifting the valve to position b and resulting in operation previously described. With the control system of the present invention only one control valve is required for reversing the feed motor which thereby eliminates the need for a so-called five-port four-way valve as found in certain prior art systems.

At any operating condition of the control system all pressure air to the drill and feed motor may be interrupted by manual actuation of the STOP control valve 84 to position b which will cause the COLLAR control valve 68 to exhaust its pilot actuator through conduits 156, 160, and 162. The START valve 72 will exhaust through conduits 164, 160 and 162 and the DRILL control valve 74 will exhaust its pilot actuator through conduits 140 and 162. The valves 68, 72, and 74 will then return to position a. The collar supply valve 26 and drill supply valve 56 will, with the control valves 72 and 74 in position a, exhaust their pilot actuators through STOP valve 84 and return to position a. Reverse supply valve 40 will also exhaust its pilot actuator through conduits 136, 138, 166 and 162, and through the STOP valve to return to position a. Therefore, regardless of the operating mode, actuation of the STOP valve to position b will result in the interruption of the line of pressure fluid to the drill, rotation motor, and feed motor. As shown in FIG. 2 the STOP valve may be operated from a remote pilot pressure air through conduit 170 as may the START valve 72 by way of a pilot supply through conduit 172. As previously mentioned, the adjustable valve 135 and reservoir 137 operate as a variable time delay means to delay the pressure signal necessary to shift the REVERSE control valve 76 to position b when the drill projection 56 has actuated the position sensing valve 54 to position b. This delay in operation of the REVERSE control valve and, consequently, the reverse supply valve 40 permits through flushing of the drill hole to assure the removal of all drill cuttings while the drill steel is still at the bottom of the hole. As pressure fluid flows through conduit 134 into the reservoir 137 the pressure would eventually increase to a predetermined value required collaring of the REVERSE cycle. The drill projection 56 is then to 76 to shift said valve to position b and the drill would be operated to retract along the support as hereinbefore described. A conduit 180 is connected to conduits 134 and 138 so that pilot pressure fluid is supplied to the actuator of the exhaust valve 86 to effect the closure of the drilling supply valve 36 without delay when the front sensing valve 54 is actuated to position b. A check valve 182 prevents pressure fluid from flowing into conduit 136. A preferred construction of the enclosures 20 and 62 is illustrated in FIG. 3. The enclosure 20 is shown as consisting of a series of flat plate elements 184, 186, 188, 190 and 192 as assembled and fastened together by fasteners 194. All of the hereinbefore described conduits within the enclosure 20, as shown on the schematic of FIG. 1, are machined or machined into the matching surfaces of the plates. All valve elements would also be housed within the enclosure formed by the assemblage of plates. This construction provides for a compact arrangement of valves and conduits and also eliminates a large number of tube and pipe fittings. The operator adjustment handles for valves 32 and 112 are shown protruding from plate 186 and the right sections of pilot actuator conduits 110, 124, and 136 are shown. The remaining eight connections required as shown by the schematic of FIG. 1 would be made on the bottom of plate 184, not shown.
The section view of FIG. 4 illustrates an embodiment of the proportional pressure regulator valve 50 previously described and illustrated schematically in FIG. 1. The valve 48 of FIG. 1 is of similar construction. Referring to FIG. 4, the valve 50 comprises a movable closure member 200 having a stem portion 202 and a resilient seating member having an area forming a pressure surface 204. The closure member 200 is interposed between conduits 128 and 129 formed by plates 184, 186, and 188. The upper end of stem 202 projects through the end wall of a spacer 206 pressed into the bore 208 in plate 188 and is threadedly secured to a hollow piston 210. The piston 210, forming a part of member 200, extends into the bore 212 of a cap 214 which is secured to plate 188 by fasteners 216. An adjusting screw 218 is operative to vary the compression of a coil spring 220 which is operable to bias the closure member 200 in the closed position. The space 222 within the spacer 206 is vented to atmosphere through passage 224. A passage 226 in the stem of closure member 200 communicates pressure fluid from conduit 128 to the interior space 228 of the hollow piston 210 and to the bore 212 of the cap 214. The piston 210 is slidable housed in the bore 212 in close fitting relationship thereto and leakage of pressure fluid into space 222 is desirably kept to a minimum. The piston 210 includes an area 230 and an annular area 232 forming a second pressure surface operable to oppose the pressure acting on the surface 204 bounded by the seat 234. An annular area 236 formed on the closure member 200 comprises a third pressure surface and is operable to bias the closure member to the closed position under the action of pressure fluid at the reduced pressure in conduit 129 acting thereon.

As previously mentioned it is desirable to maintain the feed motor pressure at a proportional value to the supply pressure to the drill percussion motor to prevent underfeeding or overfeeding the drill when fluctuations in supply pressure occur. In prior art drills it is often a problem which requires the constant attention of the drill operator to adjust a manual valve to maintain the proper proportion. However, with the use of the proportional pressure regulator 50 in the feed control system of FIGS. 1 and 2 feed motor pressure is automatically maintained at the desired proportional value. The valve 50 or its equivalent may, of course, be used with other rock drill control systems.

A single proportional pressure regulator valve of the type disclosed could be used in the control system shown in FIG. 1. However, a system of the type disclosed, having provisions for operating the drill at reduced pressure for collaring the hole, desirably has a separate pressure regulator due to the fact that the proportioning of the feedback motor pressure to supply pressure for collaring a hole is usually less than the value desired for operation at full drilling power. The provision of two regulator valves is therefore desirable in a completely automatic system to eliminate the need for adjustment of a single valve after the collaring phase of operation.

In operation of the valve 50, pressure fluid at supply pressure introduced into conduit 128 would act on surface 204 to open the valve closure member 200 permitting flow past the valve seat 234 to be throttled to a reduced pressure into conduit 129. Pressure fluid at supply pressure would also flow through passage 226 into space 228 and between the adjusting screw 218 and the inner wall of piston 210 into the bore 212 to act on the annular area 232. Fluid at supply pressure acting on areas 230 and 232 and fluid at the reduced pressure in conduit 129 acting on area 236 will operate to close the closure member 200. By an algebraic summation of pressure forces acting on the valve closing member 200 it may be seen that the areas 230, 232, and 236 may be proportioned such that the closure member will move to throttle across the ori- fice formed by the closure member and the seat 234 until a balanced position is reached. Accordingly, the pressure in conduit 129 may be regulated to a fixed percentage of the supply pressure in conduit 128 regardless of what value the supply pressure may be. For example, if the sum of areas 230 and 232 is 70 percent of area 204 and the area 236 is 90 per-
conduit means in communication with said source and said feed motor for supplying pressure fluid to feed said drill along said support, and the improvement comprising:
pressure regulator means comprising a valve interposed in said conduit means and including a closure member for throttling the flow of pressure fluid supplied to said feed motor to maintain a reduced pressure proportional to the pressure of said fluid supplied to said percussion motor, said closure member including a first pressure surface operable to be acted on by fluid at supply pressure to open said valve, a second pressure surface operable to be acted on by fluid at supply pressure to close said valve, and a third pressure surface operable to be acted on by pressure fluid at the pressure reduced by said valve to close said valve, and said valve including biasing means comprising piston means connected to said closure member and slidably housed in a bore forming a pressure chamber, passage means in communication with said bore for supplying pressure fluid thereto, and a valve in communication with said bore for controlling the pressure of said fluid in said chamber to vary the proportionality of said reduced pressure to said supply pressure, and said piston means is operable in response to pressure fluid acting thereon to bias said closure member to the closed position.

2. Improved rock drilling means comprising:
an elongated support;
a pressure fluid operated rock drill slidably mounted on said support and having a percussion motor operable to actuate a drill steel;
a fluid operated feed motor mounted on said support operable to feed said drill reversibly therealong;
a source of pressure fluid;
supply means in communication with said source and said drill for supplying pressure fluid to operate said percussion motor;
conduit means in communication with said source and said feed motor for supplying pressure fluid to feed said drill along said support, and the improvement comprising:
pressure regulator means comprising a valve interposed in said conduit means for throttling the flow of pressure fluid supplied to said feed motor to a reduced pressure proportional to the pressure of said fluid supplied to said percussion motor, said valve including a closure member having a first pressure surface operable to be acted on by fluid at supply pressure to open said valve, a second pressure surface operable to be acted on by fluid at supply pressure to close said valve, and a third pressure surface operable to be acted on by fluid at the pressure reduced by said valve to close said valve.

3. The invention set forth in claim 2 wherein: said second pressure surface and said third pressure surface on said closure member have areas proportional to the area of said first pressure surface whereby the pressure of said fluid reduced by said regulator valve is a fixed percentage of the pressure of said fluid supplied to said valve.

4. Improved rock drilling means comprising:
an elongated support;
a pressure fluid operated rock drill slidably mounted on said support and having a percussion motor operable to actuate a drill steel;
a fluid operated feed motor mounted on said support operable to feed said drill reversibly therealong;
a source of pressure fluid;
supply means comprising a first fluid circuit in communication with said source and said drill for supplying pressure fluid to said percussion motor at reduced pressure for collar change a hole;
a second fluid circuit in communication with said source and said drill for supplying pressure fluid to said percussion motor at substantially supply pressure; and,
presence regulating means comprising a first pressure regulating valve in communication with said first fluid circuit and said feed motor and operable to automatically supply pressure fluid to said feed motor at a pressure proportional to said pressure fluid supplied to said percussion motor at said reduced pressure, and a second pressure regulating valve in communication with said second fluid circuit and said feed motor and operable to automatically supply pressure fluid to said feed motor at a pressure proportional to said pressure fluid supplied to said percussion motor at substantially supply pressure.

* * * * *