Aug. 18, 1936. W. A. MORRISON 2,051,616

VALVE MECHANISM FOR ROCK DRILLS

Filed July 19, 1935

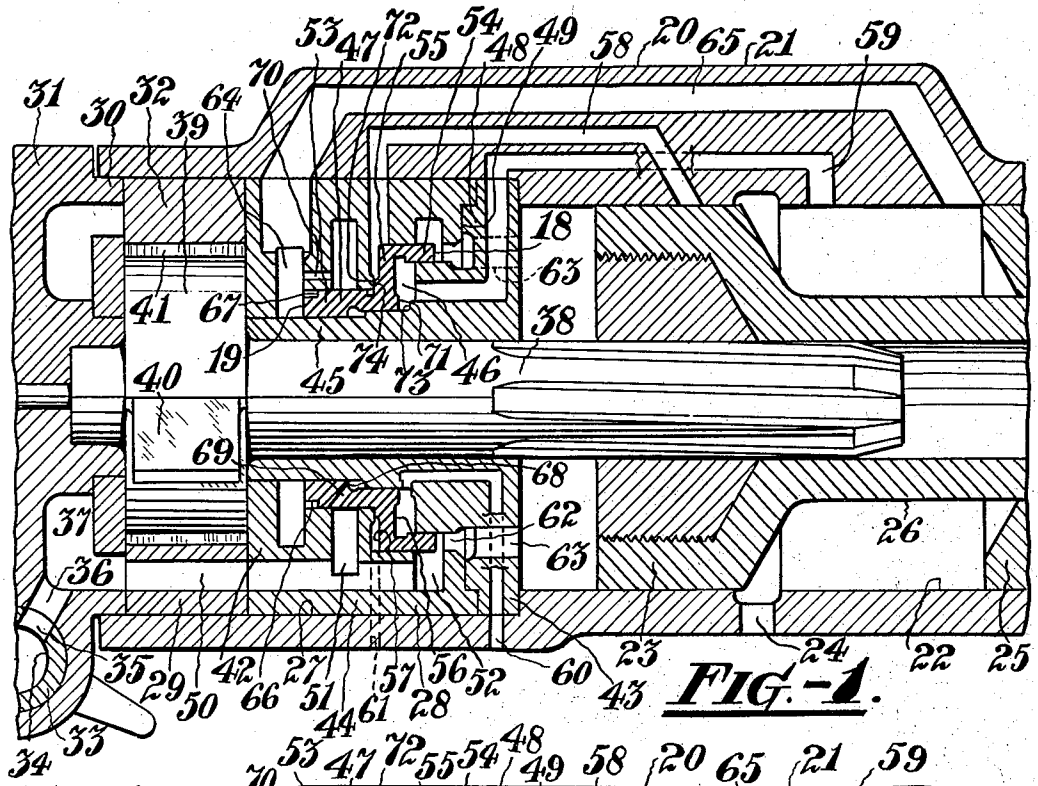


FIG. -1.

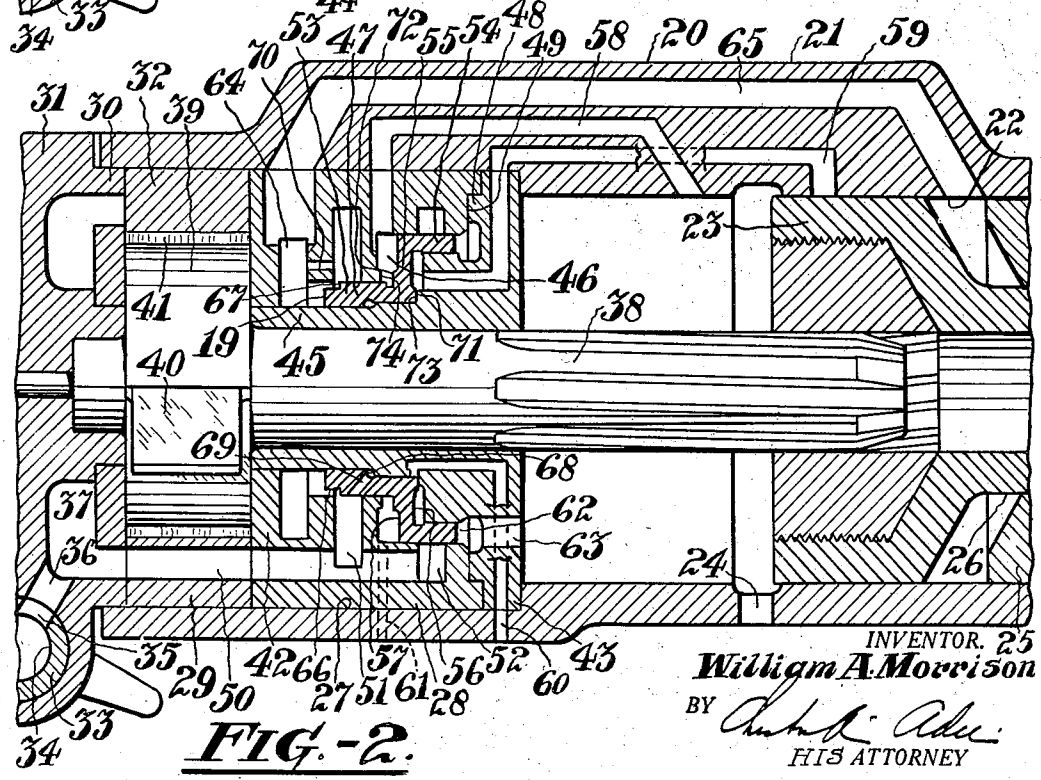


FIG. -2.

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Patented Aug. 18, 1936 2,051,616

UNITED STATES PATENT OFFICE

2,051,616

VALVE MECHANISM FOR ROCK DRILLS

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Application July 19, 1935, Serial No. 32,203

5 Claims. (Cl. 121—18)

This invention relates to rock drills, and more particularly to a distributing valve for rock drills of the fluid actuated type.

One object of the invention is to obtain a quick and positive action of the valve and, therefore, a rapid reciprocatory movement of the percussive element of the drill.

Another object is to effect the charging of the cylinder ends in accordance with their requirements.

Other objects will be in part obvious and in part pointed out hereinafter.

In the drawing accompanying this specification and in which similar reference numerals refer to similar parts,

Figures 1 and 2 are longitudinal sectional elevations of a rock drill equipped with valve mechanism constructed in accordance with the practice of the invention and showing the valve in the limiting positions.

Referring more particularly to the drawing, 20 designates, in general, a rock drill comprising a cylinder 21 having a piston chamber 22 containing a reciprocatory hammer piston 23. The piston chamber 22, in the present instance, is provided with a free exhaust port 24 which is controlled by the piston 23, and a closure 25 for the front end of the piston chamber is bored to serve as a guide for a stem 26 of the piston 23.

In the rear end of the cylinder 21 is an enlarged bore 27 for the accommodation of valve mechanism and rotation mechanism 28 and 29, respectively, and also for a flange 30 of a back head 31 which forms a closure for the rear end of the bore 27 and may be fixedly secured to the cylinder 21 in any suitable manner.

The rotation and valve mechanisms are clamped in fixed position by the back head which seats upon a ratchet ring 32 constituting a part of the rotation mechanism. The ratchet ring in turn seats upon the valve mechanism which serves as a rear bounding surface for the piston chamber 22.

An additional function of the back head 31 is to serve as a housing for a throttle valve 33, illustrated as being of the rotary type and whereby the admission of pressure fluid into the drill is controlled. The throttle valve has a central chamber 34 which may be in constant communication with a source of pressure fluid supply, and a port 35 in the wall of the throttle valve affords communication between the chamber 34 and a passage 36 in the back head and leading to a supply reservoir 37 in the front end of the back head.

In addition to the ratchet ring 32, the rotation mechanism comprises the usual rifle bar 38 which extends through the valve mechanism 28 and interlockingly engages the piston 26 in a well known manner. The rifle bar has a head 39 which carries the usual pawls 40 for engagement with the teeth 41 on the ratchet ring 32 to hold the rifle bar stationary during one stroke of the piston 23 and thereby cause the piston to describe a partial revolution for rotating the working implement (not shown) but which the piston is intended to actuate.

The valve mechanism 28 constructed in accordance with the practice of the invention comprises a valve chest consisting of a pair of plates 42 and 43 having annular extensions 44 and 45, respectively, which define a valve chamber 46 for the accommodation of a valve 47 whereby the pressure fluid is distributed to the piston chamber 22. The plate 43 is seated in the bottom of the enlarged bore 27 adjacent the piston chamber 22, and the interior of its extension 45 serves as a bearing for the rifle bar 38.

The free end of the extension 45 is in telescopic engagement with the plate 42, and on the rear surface of the plate 43 is a boss 48 which extends into a recess 49 in the front end of the extension 44 to centralize the plates 42 and 43 with respect to each other.

Pressure fluid distributed by the valve 47 is conveyed from the supply reservoir 37 by a supply passage 50 located in the ratchet ring 32, the plate 42 and the extension 44. The passage 50 opens into annular channels or grooves 51 and 52 from which pressure fluid flows to the front and rear ends, respectively, of the piston chamber 22.

The valve 47, which is in the form of a sleeve, comprises a rear reduced annular portion 53 and a front enlarged annular portion 54. The adjacent ends of the portions 53 and 54 are connected by a lateral wall 55 of which the front and rear surfaces constitute actuating surfaces 56 and 57, respectively, and pressure fluid employed for actuating the valve is conveyed to the actuating surfaces by kicker passages 58 and 59.

The kicker passage 58 opens into the piston chamber 22 rearwardly of the exhaust port 24 and conveys pressure fluid to the actuating surface 55, while the kicker passage 59 opens into the piston chamber 22 forwardly of the exhaust port 24 and conveys pressure fluid to the actuating surface 56. The actuating surfaces 56 and 57 are preferably communicated with the atmosphere through vents 60 and 61, resepectively, in order to effect a reduction in the value of the pressure fluid em-

ployed for actuating the valve immediately after the valve has been shifted.

In the arrangement shown, the enlarged portion 54 of the valve controls the admission of pressure fluid to the rear end of the piston chamber, and during the reciprocations of the valve is adapted to move into and out of an annular groove 62 defined by the extensions 44 and 45. In the plate 43 are rear inlet passages 63 through which pressure fluid flows from the groove 62 to the rear end of the piston chamber. The front end of the enlarged portion constitutes a holding surface 18 against which the pressure fluid flowing to inlet passages 63 acts for holding the valve.

In like manner, the reduced annular portion 53 of the valve controls the flow of pressure fluid from the groove 51 into a recess 64 at the rear end and in direct communication with the valve chamber 46. The recess 64 forms a portion of a front inlet passage 65 which extends through the cylinder 21 and opens into the front end of the piston chamber 22. The rear end surface of the reduced portion 53 serves as a holding surface 19 and is subjected to the pressure fluid flowing thereover to the front end of the cylinder for holding the valve during this charging period.

As a preferred form of construction an annular groove 66 is formed in the periphery of and at the rearmost extremity of the reduced portion 53 of the valve to define a restrict flow area for the pressure fluid from the groove 51 to the recess 64. The annular groove 66 is of such length that when the valve occupies its foremost limiting position to admit air to the front end of the piston chamber the shoulder 67 constituting the front end of the groove 66 will lie in the plane of the groove 51.

In order to assure prompt starting of the reciprocable elements of the rock drill, irrespective of the relative positions which they may occupy in their chambers, the valve is provided in its interior with a pressure surface 68 to which pressure fluid is admitted by a port 69, in the valve, communicating constantly with the groove 51. Thus, should the valve and the piston occupy positions in which the supply groove 51 would be in direct communication with the free exhaust port 24 the pressure fluid acting against the pressure surface 68 will immediately actuate the valve into position to admit pressure fluid to the other side of the piston.

The plate 42 is, moreover, provided with a leak port 70 to permit a constant slight flow of pressure fluid from supply, in the present instance from the groove 51, to the front inlet passage 65. It will be readily seen, therefore, that when the piston lies forwardly of the exhaust port and the valve in a position to communicate the exhaust port 24 with pressure fluid supply the pressure fluid leaking into the front end of the piston chamber will move the piston rearwardly and cause the valve to be set in operation.

In the construction shown the front and rear surfaces of the wall 55 serve as seating surfaces 71 and 72, respectively, which cooperate with shoulders 73 and 74 on the extensions 45 and 44 for determining the limiting positions of the valve.

The operation of the device is as follows: With the valve 47 and the piston 23 in the positions illustrated in Figure 1, pressure fluid flows from the groove 52 through the groove 62 thence through the inlet passages 63 to the rear end of the piston chamber 22 to actuate the piston 23 on its working stroke. As the piston proceeds forwardly it uncovers the kicker passage 58. Pressure fluid then passes to the actuating surface 57 and the valve is shifted forward thereby.

During the shifting of the valve and when it reaches an intermediate position in the valve chamber both grooves 51 and 52 are blanked off by the valve. At this point in the cycle of operation of the valve the piston uncovers the exhaust port 24, pressure fluid in the rear end of the piston chamber is then exhausted to the atmosphere and, inasmuch as the ends of the piston chamber are then cut off from pressure fluid supply, the direct passage of pressure fluid from the valve chamber to the atmosphere will be prevented.

In the new position of the valve 47 pressure fluid flows from the groove 51 through the annular groove 66 in the valve into the groove 64, thence through the inlet passage 65 into the front end of the piston chamber and returns the piston. During its return movement the piston uncovers the kicker passage 59. Pressure fluid then flows to the actuating surface 56 and returns the valve to its initial position for again admitting pressure fluid into the rear end of the piston chamber.

During its passage over the end of the portions 53 and 54 the pressure fluid acts against the holding surfaces 18 and 19 and holds the valve immovable in its extreme positions. These holding surfaces being in direct communication with the ends of the piston chamber through the inlet passages will, of course, also be exposed to the compression formed by the piston in the ends of the piston chamber so that this force will also assist in actuating the valve. The force of compression is, however, not relied upon to shift the valve since it is well understood that it is an unreliable factor, particularly when the reciprocable parts and the elements containing them become worn.

From the foregoing description it will readily be apparent to those skilled in the art that, through the use of differential annular portions on the valve for determining the flow areas between supply and the points of application, substantially correct volumes of pressure fluid may be admitted to the ends of the piston chamber in accordance with their requirements for a given lift of the valve. For example, in the structure illustrated the annular portion 54 serves this function for charging the rear end of the piston chamber to actuate the piston on its working stroke. This arrangement has been found to be highly desirable since it assures an abundant charge of pressure fluid rearwardly of the piston chamber and causes the piston to deliver a forceful blow against the working implement. Inasmuch as a smaller volume of pressure fluid is required for returning the piston the front end of the piston chamber may be charged accordingly by providing a smaller flow area between the source of supply and that end of the piston chamber.

I claim:

1. In a fluid actuated rock drill, the combination of a casing having a piston chamber and a piston therein, an exhaust port for the piston chamber controlled by the piston, a valve chest having a valve chamber and a supply passage, front and rear inlet passages leading from the valve chamber to the piston chamber, a valve in the valve chamber to control communication between the supply passage and the inlet passages, opposed actuating surfaces on the valve intermittently exposed to pressure fluid valved by the piston for throwing the valve, and opposed differential holding surfaces exposed to pressure fluid flowing thereover to the inlet passages for holding the valve in the limiting positions.

2. In a fluid actuated rock drill, the combination of a casing having a piston chamber and a piston therein, an exhaust port for the piston chamber controlled by the piston, a valve chest having a valve chamber and a supply passage, front and rear inlet passages leading from the valve chamber to the piston chamber, a valve in the valve chamber comprising a reduced annular portion and an enlarged annular portion to control communication between the supply passage and the inlet passages, a wall connecting said portions, opposed actuating surfaces on the wall intermittently exposed to pressure fluid valved by the piston for throwing the valve, and holding surfaces on the annular portions exposed to pressure fluid flowing from the supply passage to the inlet passages for holding the valve in the limiting positions.

3. In a fluid actuated rock drill, the combination of a casing having a piston chamber and a piston therein, an exhaust port for the piston chamber controlled by the piston, a valve chest having a valve chamber and a supply passage, front and rear inlet passages leading from the valve chamber to the piston chamber, a valve in the valve chamber comprising a reduced portion to control communication between the supply passage and the front inlet passage, there being a lateral flange on the reduced portion, an enlarged annular portion on the periphery of the flange to control communication between the supply passage and the rear inlet passage, opposed actuating surfaces on the flange intermittently exposed to pressure fluid valved by the piston for throwing the valve, and holding surfaces on the free ends of the reduced and enlarged portions exposed to pressure fluid flowing from the supply passage to the inlet passages for holding the valve in the limiting positions.

4. In a fluid actuated rock drill, the combination of a casing having a piston chamber and a piston therein, an exhaust port for the piston chamber controlled by the piston, a valve chest having a valve chamber and a supply passage, front and rear inlet passages leading from the valve chamber to the piston chamber, a valve in the valve chamber comprising a reduced portion to control communication between the supply passage and the front inlet passage, means on the reduced portion cooperating with the valve chest to restrict the flow of pressure fluid to the front inlet passage, an enlarged annular portion on the valve to control communication between the supply passage and the rear inlet passage, a wall connecting the adjacent ends of the reduced and enlarged portions and having opposed actuating surfaces, kicker passages for conveying pressure fluid from the cylinder to the actuating surfaces for throwing the valve and being controlled by the piston, and holding surfaces on the free ends of the reduced and enlarged portions exposed to pressure fluid flowing from the supply passage to the inlet passages for holding the valve in the limiting positions.

5. In a fluid actuated rock drill, the combination of a casing having a piston chamber and a piston therein, an exhaust port for the piston chamber controlled by the piston, a valve chest having a valve chamber and a supply passage, front and rear inlet passages leading from the valve chamber to the piston chamber, a valve in the valve chamber comprising a reduced portion to control communication between the supply passage and the front inlet passage, means on the reduced portion cooperating with the valve chest to restrict the flow of pressure fluid to the front inlet passage, an enlarged annular portion on the valve to control communication between the supply passage and the rear inlet passage, a wall connecting the adjacent ends of the reduced and enlarged portions and having opposed actuating surfaces, crossed kicker passages for conveying pressure fluid from the cylinder to the actuating surfaces for throwing the valve and being controlled by the piston, a pressure surface on the valve constantly exposed to pressure fluid tending to throw the valve to one limiting position, and holding surfaces on the free ends of the reduced and enlarged portions subjected to compression to assist in throwing the valve and being exposed to pressure fluid flowing from the supply passage to the inlet passages for holding the valve in the limiting positions.

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