

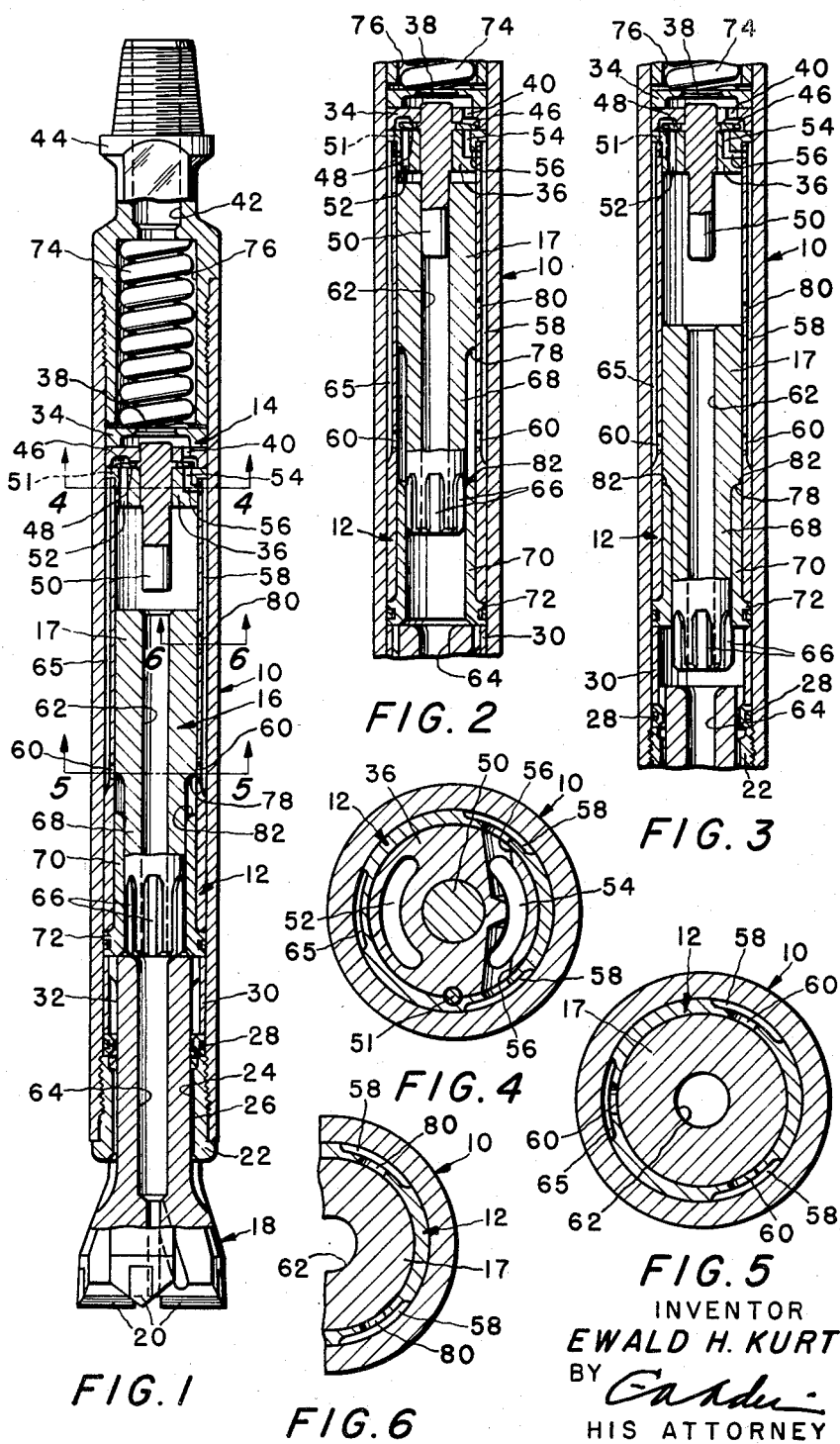
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HOLE CLEANING DEVICE

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HOLE CLEANING DEVICE

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This invention relates to improvements in rock drills, and more particularly to a blowing device for pneumatically operated percussive drills of the type adapted to be inserted into the hole being drilled thereby and commonly known as "down-the-hole" drills.

An object of the present invention is to provide a rock drill that will permit the introduction of an uninterrupted flow of pressure fluid, under full line pressure, into the drill hole to remove the cuttings therefrom without the necessity of having the piston of the drill reciprocate.

Other objects will become obvious from the following specification and drawings in which

Figure 1 is a longitudinal elevation, partly in section, of the preferred form of the drill,

Figs. 2 and 3 are longitudinal elevations, partly in section, of the preferred form of the drill showing the piston in various operating positions, and

Figs. 4, 5 and 6 are cross sectional views of Fig. 1 taken along the lines 4—4, 5—5, and 6—6, respectively, looking in the direction of the arrows.

Referring to the drawings, the drill as shown in Fig. 1 comprises, in general, a tubular casing 10 housing a sleeve 12 and valve 14 slidably mounted therein and constantly urged against longitudinal movement relative to the casing 10 by retainers at the opposite ends of the casing 10. The sleeve 12 is formed of a considerably harder material than the casing 10 to withstand the wear of a piston 16 reciprocated in the sleeve by pressure fluid valved alternately to the opposite ends of the piston by the valve 14. A working implement 18 is mounted at the forward end of the drill casing 10 with an end positioned to be struck by the piston 16.

Referring now in greater detail to the construction of the drill, the working implement 18 includes a head having cutters 20 arranged to cut a hole of slightly greater diameter than the diameter of the casing 10 such that the drill casing may be lowered into the hole being drilled. The working implement is retained in the casing 10 and engaged for rotation therewith by means of a chuck. The chuck includes an end member 22 threaded in the end of the casing 10 and having internal splines 24 interlockingly engaged in grooves 26 in the shank of the working implement 18. The chuck also includes a ring 28 clamped between the end member 22 and a sleeve 30, and extending into the groove 32 in the shank of the working implement for limiting the longitudinal movement of the working implement 18 relative to the casing 10.

The chuck part, or sleeve, 30 is split longitudinally on one side (not shown) and has a tight spring fit in the casing 10. The purpose of this is that the sleeve 30 will hold the parts, such as the valve 14 and sleeve 12, in the casing when the chuck parts 22 and 28 are disconnected to remove the working implement 18 for repair or replacement.

The valve 14, shown by way of illustration only, includes a two piece cage 34 and 36. The upper portion 34 of the cage is provided with ports 38 and 40 for the passage of pressure fluid from the fluid supply passage 42

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in the backhead 44 to the valve chamber 46. The flow of pressure fluid from the valve chamber 46 for actuating the piston 16 is controlled by means of a conventional flapper type valve 48, which can be of the type shown in U.S. Patent No. 1,598,440. The valve 46 is mounted for rocking movement about a central stem 50 extending through the lower piece 36 of the valve cage and mounted on said lower piece 36 by means of an enlargement at its upper end portion.

In furtherance of this end a port 52 is formed in the valve piece 36 leading from the chamber 46 to the rearward end portion of the interior of the sleeve 12 and is positioned to be covered by the flapper valve 48 when rocked in the position shown in the drawings. Positioned on the opposite side of the cage piece 36 is a port 54 arranged to be covered by the flapper valve 48 when rocked into its opposite position. Port 54 is communicated through a port 56, longitudinal passage 58 and a port 60 with the forward end portion of the interior of the sleeve 12.

The valve 14 is engaged against rotational movement relative to the sleeve 12 by means of a pin 51 to insure that the port 54 is at all times in alignment with the ports 56 in the sleeve 12. In the particular embodiment shown, two such longitudinal passages 58 are shown to insure an adequate supply of air for reversing the piston. Also shown is a passage 65 communicated with the forward end only of the sleeve 12. This passage serves as a cushioning chamber for air trapped into the forward end of the sleeve during the working stroke of the piston.

Pressure fluid is exhausted from the opposite ends of the sleeve 12. The exhaust is utilized as a cleansing fluid for blowing drill cuttings free of the hole. In furtherance of this end, pressure fluid is exhausted from the rearward end of the sleeve through central bores 62 and 64 in the piston 16 and working implement 18, respectively, whenever the piston is in the forward limiting position of its working stroke. Exhaust through these bores is cut off when the piston approaches the rearward limiting position of its stroke by means of the extension of the stem 50 into the bore 62 with a sliding fit.

At approximately the same time that the exhaust from the back end of the sleeve is cut off, the forward end of the cylinder is exhausted through grooves 66 in the reduced extension 68 of the piston 16 and thence through the bore 64 of the working implement. It is to be noted that with this type of piston construction, a tubular guide piece 70 is mounted at the forward end of the sleeve 12 and includes a flange 72 clamped between the sleeve 30 and the forward end of the sleeve 12. A sealing ring is mounted in the flange to limit the escape of pressure fluid leaking from the passage 58 between the sleeve 12 and casing 10.

All inner parts of the drill are held in position in the casing 10 by the chuck part 22 and the backhead 44, both internally threaded in the casing 10. As shown the rear retainer includes a relatively heavy spring 74 mounted in a recess 76 in the backhead 44 and biased between the end surface of the recess 76 and the valve cage piece 34. In this way the cage is constantly urged into engagement with the rearward end of the sleeve 12, forcing the sleeve into contact at its forward end with the flange 72 which is restrained against forward longitudinal movement by abutting the sleeve 30, ring 28 and rearward end of the chuck and member 22. The spring serves as a shock absorber in transmitting shock from the working implement to the drill rod, not shown, connected to the backhead 44.

In accordance with an object of the invention, means are provided for periodically effecting a thorough cleansing of the drill hole whenever the detritus resulting from drilling accumulates and interferes with the progress of the work. To this end a port 80 is formed in the sleeve

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12 between the port 56 and the port 60 at a location such that the port 80 is covered by the sliding-contact surface of the greater-diametered portion 17 of the piston 16 when it ranges between its forward and rearward limiting positions during the normal operation of the drill. The distance of the port 80 from the stop, or rearward end, 82 of the tubular guide piece 70 must be greater than the sliding-contact length of the greater-diametered portion 17 of the piston 16. Port 80 is opened when the piston 16 moves forward beyond the normal forward limiting position, as for example when the surface 78 contacts the stop 82. In the particular embodiment shown, there are two ports 80, one communicating with each of the two longitudinal passages 58.

In operation, assuming the parts to be in the position shown in Fig. 1, air is conducted from the passage 42 to the valve 14 and thence through the port 54, passages 58 and ports 60 to the forward end of the sleeve 12. This fluid acting on the pressure surface 78 of the piston 16 actuates the piston rearwardly. When the piston 16 has moved a sufficiently great distance rearwardly to uncover the rearward ends of the grooves 66, as shown in Fig. 2, pressure fluid is exhausted from the forward end of the sleeve 12 and the exhaust from the rearward end is cut off. The compressive action of the piston increases the pressure in the rearward portion of the sleeve sufficiently to throw the flapper valve 48 into its other limiting position cutting off the supply of pressure fluid to the forward end of the piston and supplying pressure fluid to the rearward end portion thereof. This reversal in supply actuates the piston forwardly until the piston 16 moves clear of the stem 50 and cuts off the exhaust through the grooves 66. Accordingly, the pressure behind the piston drops and the pressure in front of the piston increases, causing the valve to be thrown into the position shown in the drawing. In the normal operation of the drill, the piston covers the port 80 at all times.

When the valve is in the opposite position to that shown in Fig. 1, air is conducted from the passage 42 to the valve 14 and thence through the port 52 to the rearward end of the piston 16 tending to move the piston forward. If the piston happens to be already in its forward limiting position, the current of air past the flapper valve is sufficient to throw the flapper valve into the other position shown in Fig. 1. The drill then operates as described above.

Whenever drilling progress is being impeded by accumulated cuttings in the drill hole and it is desired to cleanse the hole by introducing an uninterrupted flow of pressure fluid, the supply of pressure fluid is temporarily cut off by the operator, and the piston by force of gravity and because of the leakage of air from the air cushion, moves forward beyond the normal forward limiting position to the stop, or rearward end, 82 of the tubular guide piece 70, as shown in Fig. 3. In consequence, the piston uncovers the port 80 to communicate the passage 58 with the rearward end of the sleeve 12 and covers the port 60 to prevent admission of pressure fluid to the forward end of the sleeve 12 and to prevent re-starting of the piston. It is to be noted that the distance between the stop 82 and the port 60 is less than the distance between the pressure surface 78 and the rear end of the sliding-contact surface of the greater-diametered portion 17 of the piston 16.

When the supply of pressure fluid is re-opened by the operator, assuming the valve to be in the position shown in Fig. 1, the pressure fluid flows through the port 54, the passage 58, the port 80, and bores 62 and 64 to openings in the working implement from which it issues to cleanse the drill hole.

The current of the air past the flapper valve 48 closes the port 54 partially and consequently opens the port 52 partially and allows pressure fluid to flow also through the port 52 to the bores 62 and 64.

When the valve is in the opposite position to that

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shown in Fig. 1, and the supply of pressure fluid is re-opened by the operator, the pressure fluid flows through the port 52. Again, the air current partially closes the port 52 and partially opens the port 54, so that the pressure fluid flows through both ports.

To re-start the reciprocation of the piston and resume normal drilling, the drill is lowered on the working implement, which moves rearwardly causing the piston to move rearwardly and cover the port 80 and uncover the port 60 to re-admit pressure fluid to operate on the pressure surface 78 of the piston 16 and to actuate the piston rearwardly.

I claim:

1. A drill comprising a casing having a chamber therein, a piston reciprocable in said chamber within normal limits when the drill is operating, a working implement arranged to be actuated by said piston to drill a hole in the earth, said drill having one passage leading to the forward end of said casing for supplying fluid thereto to cleanse the hole of earth cuttings and a second passage for supplying fluid to the first said passage, such supply of fluid to said first passage being controlled by the position of the piston such that the supply is completely cut off when the piston reciprocates within normal limits and established when said piston is outside of said normal limits.

2. A down-the-hole drill comprising a casing having a chamber therein, a piston reciprocable in said chamber within normal limits, a working implement arranged to be actuated by said piston to drill a hole in a material, said drill having a first passage leading from the chamber to the forward end of said casing for supplying fluid thereto to cleanse the hole, and a second passage opening into the chamber for supplying fluid through the chamber to the first said passage, the passages opening into the chamber at relative position such that communication of the passages through the chamber is established only when said piston is outside said normal limits, and such communication is cut off by said piston when the piston is within said normal limits.

3. A pneumatic drill comprising a casing having a chamber therein, a piston reciprocable in said chamber within normal limits when the drill is operating, a working implement arranged to be actuated by said piston to drill a hole in a material, means for supplying air to the opposite end portions of said chamber to reciprocate said piston including a first passage in said casing for conducting compressed air to the forward end of the chamber to actuate the piston rearwardly and communicating with said chamber at a location such that such communication is cut off by said piston when said piston is moved forwardly of its normal forward limiting position by cutting off the supply of air to the first said passage and moving said drill rearwardly from the material being drilled such that the operation of said piston is prevented although air is again supplied to said first passage, conduit means in said casing communicating with the forward end of the casing, and a second passage in said casing communicating with said first passage and said conduit means at a location such that communication between said second passage and said conduit means is cut off by said piston when the piston is within said normal limits and in communication with said conduit means when said piston is moved forwardly of its normal forward limiting position by cutting off the supply of air to the first said passage and moving said drill rearwardly from the material being drilled so that when air is again supplied to the first said passage it is supplied to the conduit means by said second passage.

4. The pneumatic drill claimed in claim 3 in which the operation of the piston is resumed by moving the drill forwardly toward the material being drilled to cut off communication between the second said passage and the conduit means, and to establish communication be-

tween the first passage and the forward end of the chamber.

5. A pneumatic drill comprising a casing having a chamber therein, a piston reciprocable in said chamber within normal limits when the drill is operating, a working implement arranged to be actuated by said piston to drill earth, a valve in said casing for valving compressed air to the forward end portion of said chamber for actuating said piston in the rearward direction, a first passage in said casing for conducting compressed air from said valve to the forward end portion of said chamber and communicating therewith at a location such that such communication is cut off by said piston when said piston is moved forwardly of its normal forward limiting position by cutting off the supply of air to the drill and moving said drill rearwardly from the earth being drilled, conduit means in said casing communicating with the forward end of the casing, and a second passage in said casing communicating with said first passage and said conduit means at a location such that communication between said second passage and said conduit means is cut off by said piston when the piston is within said normal limits and in communication with said conduit means when said piston is moved forwardly of its normal forward limiting position by cutting off the supply of air to the valve and moving the said drill rearwardly from the earth being drilled.

6. A down-the-hole pneumatic drill comprising a casing having a chamber therein, a hammer piston movable in both the forward and rearward directions in said chamber within normal limits when the drill is operating and having a portion thereof slidably fitted in said chamber, a working implement having an end in said casing arranged to be actuated by said piston and an end adapted to drill earth, a valve in said casing for valving compressed air to the forward end portion of said chamber for actuating said piston in the rearward direction, a passage in said casing for conducting compressed air from said valve to the forward end portion of said chamber and including a port formed in said casing and communicating with the forward end portion of said chamber at a location such that said port is covered by the sliding contact portion of said piston when said piston is moved forwardly of its normal forward limiting position by cutting off the air supply and moving said drill away from the work, a conduit through said piston and through said working implement, a stop mounted at the forward end of said chamber for limiting the forward motion of said piston, and a second port formed in said casing and communicating with said conduit and said chamber at a location rearwardly of said stop a distance greater than the length of the sliding-contact portion of said piston, such that said second port is uncovered when said piston is against said stop.

7. A down-the-hole pneumatic drill comprising a casing having a chamber therein, a piston reciprocable in said chamber within normal limits and having a longitudinal conduit therethrough, a working implement having a longitudinal conduit therethrough open to the piston conduit and having an end in said casing arranged to be actuated by said piston and an end adapted to drill earth, a valve in said casing for valving compressed air to the opposite end portions of said chamber for actuating said piston within normal limits, a first passage in said casing for conducting compressed air to the rearward end of said chamber for actuating the piston in the forward direction, a second passage in said casing for conducting

compressed air from said valve and opening at the downstream end thereof into the forward end portion of said chamber for actuating the piston rearwardly, valve means at opposite end portions of said chamber cooperating with the piston for alternately exhausting opposite ends of said chamber, said down-stream end of the second passage being positioned at a location such that it is covered by said piston when said piston is moved forwardly of its normal forward limiting position by cutting off the air supply and moving said drill away from the work, and a port in said casing communicating with said second passage and the rear end portion of said chamber at a location such that communication between said port and said rear end chamber portion is cut off by said piston when the piston is within said normal limits and in communication with said rear end chamber portion when said piston is moved forwardly of its normal forward limiting position by cutting off the supply of air to the valve and moving said drill rearwardly from the earth being drilled.

8. A down-the-hole pneumatic drill comprising a casing having a chamber therein, a hammer piston having a longitudinal passage therethrough movable in both the forward and rearward directions in said chamber within normal limits when the drill is operating and having a portion thereof slidably fitted in said chamber, a working implement having a longitudinal passage therethrough and open to the piston passage and having an end in said casing arranged to be actuated by said piston and an end adapted to drill earth and the like, a valve in said casing for valving compressed air to opposite end portions of said chamber for actuating said piston, a passage in said casing for conducting compressed air from said valve to the rearward end of said chamber for actuating the piston in the forward direction, a stem longitudinally mounted against movement relative to the casing in the rearward end of said chamber adapted to extend forwardly into said piston passage with a slidable fit to limit rearward movement of said piston, the portion of said stem engageable with said piston having a length less than the length of the piston stroke, a second passage in said casing for conducting compressed air from said valve to the forward end portion of said chamber for actuating the piston rearwardly and including a port in said casing and communicating with the forward end portion of said chamber at a location such that said port is covered by the sliding contact portion of said piston when said piston is moved forwardly of its normal forward limiting position by cutting off the air supply and moving said drill away from the work, a stop mounting at the forward end of said chamber for limiting the forward motion of said piston, and a second port formed in said casing and communicating with said passage and said chamber at a location such that the distance of said second port from said stop is greater than the length of the sliding contact portion of said piston.

References Cited in the file of this patent

UNITED STATES PATENTS

816,090	Hellman et al. -----	Mar. 27, 1906
1,518,124	Mercer -----	Dec. 2, 1924
1,637,792	Jimerson -----	July 26, 1927
2,810,549	Morrison -----	Oct. 22, 1957
2,837,317	Hulshizer -----	June 3, 1958

FOREIGN PATENTS

24,109	Great Britain -----	Dec. 15, 1914
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