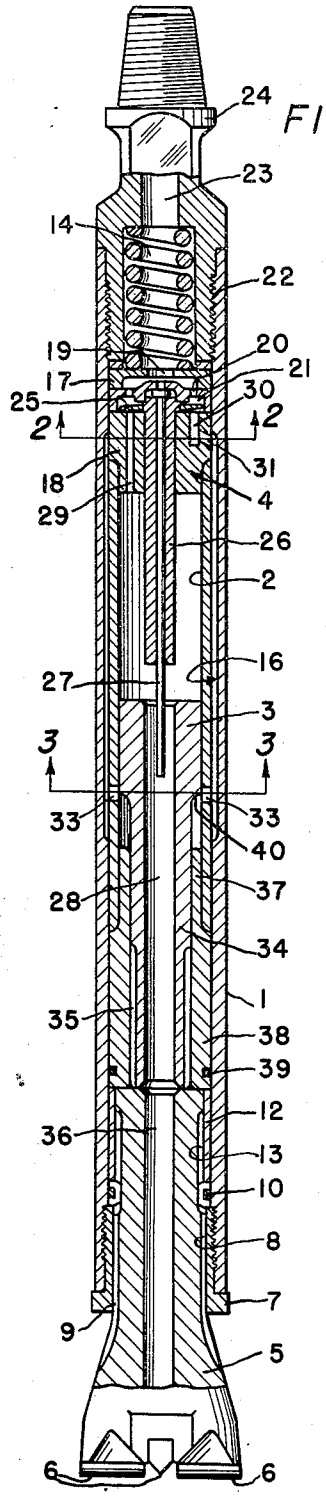
Sept. 6, 1960 W. A. MORRISON 2,951,467

ROCK DRILL

Filed Nov. 6, 1958

FIG. 1



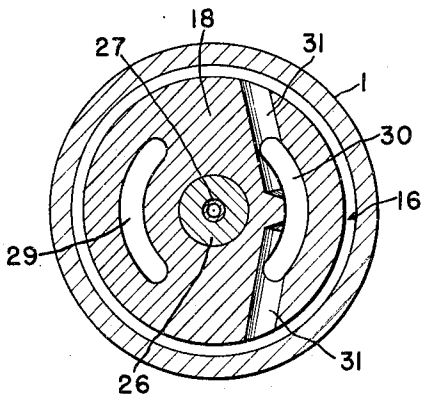


FIG. 2

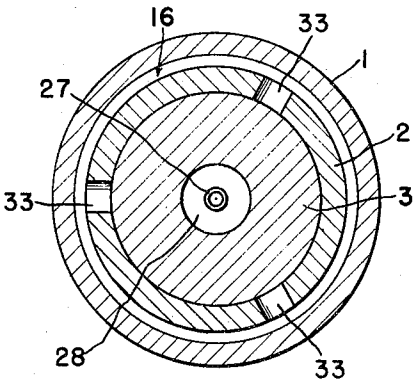


FIG. 3

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ROCK DRILL

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2 Claims. (Cl. 121—16)

This invention relates to rock drills and particularly to pneumatically operated percussive drills which are adapted to be inserted into the hole being drilled and are therefore commonly called "down-the-hole" drills.

An object of the invention is to construct a drill of the above type with the outer casing, piston sleeve and valve parts constructed and integrated in such a way as to distribute operating shocks and stresses over a wide area instead of concentrating them in a limited area having a tendency to early breakage.

Another object, in accomplishing the foregoing, is to provide an annular chamber for pressure fluid between the outer cylindrical casing and the inner concentric piston sleeve, which permits the fluid control valve to rotate relative to the piston sleeve and thus avoids the necessity for locking it against rotation.

Still another object of the invention is to provide an annular chamber for pressure fluid between the outer cylindrical casing and the inner piston sleeve to simplify the assembly of the fluid control valve with the associated outer casing and piston sleeve.

Various other objects and advantages will be apparent as the nature of the invention is more fully disclosed.

The drill disclosed herein for the purpose of illustrating the invention comprises a tubular outer casing containing a piston sleeve in which a piston is reciprocated by fluid under pressure valved alternately to opposite ends of the piston by a valve located between the rear end of the piston sleeve and a backhead which is threaded to the rear end of the casing and is connected to a fluid supply line.

In accordance with a feature of the invention, an elongated annular chamber between the tubular outer casing and the piston sleeve, for the passage of pressure fluid from the valve to the forward pressure surface of the piston, is formed by undercutting the inner tubular wall of said casing while the diameter of the piston sleeve remains uniform throughout. As a result of this construction the fluid control valve, having ports communicating with said annular chamber, can rotate relative to the piston sleeve without disturbing such communication.

Other advantages of thus forming the annular chamber between the outer casing and the piston sleeve are that a larger internal bore may be obtained for a given size outer casing; and that the elongated undercut section of the outer casing serves as a shock absorber for vibrations of the drill and distributes shocks and stresses over its relative large area instead of permitting them to be concentrated, as heretofore, in the threaded upper end of the casing which has always been subject to early breakage.

The invention is described in connection with a preferred embodiment illustrated in the accompanying drawing, in which:

Fig. 1 is a longitudinal sectional view of a pneumatically operated percussive rock drill embodying the invention;

Fig. 2 is an enlarged transverse section taken on line 2—2 of Fig. 1; and

Fig. 3 is an enlarged transverse section taken on line 3—3 of Fig. 1.

The drill shown in the drawing comprises a tubular outer casing 1 containing a tubular piston sleeve 2 in which a piston 3 is reciprocated by fluid under pressure valved alternately to opposite ends of the piston by valve 4.

A working implement 5, shown in the form of a drill bit, is mounted in the forward end of casing 1 with its inner end positioned to be struck by the piston. The drill bit includes a head having cutters 6 arranged to cut a hole of slightly greater diameter than the diameter of casing 1 so that the drill casing may be lowered into the hole being drilled.

The bit 5 is retained in casing 1 and engaged for rotation therewith by a chuck which includes an end member 7 threaded in the forward end of casing 1 and having internal longitudinal splines 8 slidably engaging complementary grooves 9 in the shank of bit 5. The chuck also includes a ring 10 clamped between the end member 7 and a sleeve 12, and extending into the groove 13 in the shank of drill bit 5 for limiting the longitudinal movement of the drill bit relative to casing 1.

The sleeve 12 of the chuck is split longitudinally (not shown) and has a tight spring fit in the casing 1. This is so that the sleeve 12 will hold the parts, such as valve 4 and sleeve 2, in the casing when the chuck parts 7 and 10 are disconnected to remove the drill bit 5 for repair or replacement. Actually, the spring 14 in the inner end of the casing will move such parts somewhat, but said spring will not extend sufficiently to eject them from the casing.

An important feature of the invention resides in the formation and positioning of the annular chamber 16 between the tubular casing 1 and the piston sleeve 2. The said annular chamber 16, which completely encircles piston sleeve 2, is formed by undercutting the outer casing 1. In other words, the inner diameter of casing 1 is increased by machining to form the elongated annular chamber 16, while the outer diameter of piston sleeve 2 remains uniform throughout. The advantages of forming said annular chamber 16 by undercutting the outer casing 1, rather than the piston sleeve 2, will be apparent from the ensuing description.

The body valve 4, shown herein by way of illustration, includes a two-piece cage 17 and 18 slidably fitted in casing 1. The upper portion 17 of the cage is roughly tubular in shape and is provided with ports 19 and 20 for the passage of pressure fluid to the valve chamber 21 from the fluid supply passage 23 in the cylindrically shaped backhead 24 which is threaded at 22 in the upper end of casing 1. The flow of pressure fluid from the valve chamber 21 for actuating the piston 3 is controlled by means of a conventional flapper type valve 25 mounted for rocking movement about a central tube 26 mounted on the upper or rearward end of the roughly tubular shaped valve cage piece 18. The cage piece 18 has a reduced portion slidably fitted in the sleeve 2 and a flange abutting the end of said sleeve 2. A pipe 27 extends through the tube 26 into the central bore 28 of piston 3 for the purpose of conducting air continuously from supply passage 23 into the piston for cleansing purposes.

A port 29 is formed in the cage piece 18 of valve 4 leading from valve chamber 21 to the rearward end portion of the piston 3 and is positioned to be covered by the flapper valve 25 when rocked to the position shown in Fig. 1 of the drawing. Positioned on the opposite side of cage piece 18 is a port 30 arranged to be covered by the flapper valve 25 when rocked into its opposite po-

sition. This port **30** communicates with ports **31** therein which communicate with the annular chamber **16** between tubular casing **1** and piston sleeve **2**. It is particularly to be noted that since ports **31** are above the piston sleeve **2**, and since annular chamber **16** extends forwardly and rearwardly beyond the rear end of the piston sleeve **2** and completely encircles said sleeve **2**, any rotation of valve cage piece **18** will not in any way disturb the communication between ports **31** and annular chamber **16**. It is also to be noted that, on assembly of the rock drill, positioning of the fluid control valve **4** is very simple because there is no necessity of inserting the fluid control valve into the rear end of the casing **1** and piston sleeve **2** in a predetermined position since ports **31** are above the piston sleeve **2** and since annular chamber **16** extends rearwardly beyond the piston sleeve **2** and completely encircles said sleeve **2**. As shown in Figs. 1 and 3, ducts **33** in piston sleeve **2** connect the annular chamber **16** with the interior of sleeve **2** when said ducts **33** are uncovered by the piston **3**.

The reduced extension **34** of piston **3** contains longitudinal grooves **35** through which air is exhausted to the bore **36** of drill bit **5**, as hereinafter described. In this type of piston construction a tubular guide piece **37** is mounted at the forward end of piston sleeve **2** and includes a flange **38** clamped between the sleeve **12** and the forward end of piston sleeve **2**. A sealing ring **39** is mounted in said flange **38** to limit the escape of pressure fluid leaking from the annular chamber **16** between sleeve **2** and casing **1**.

In operation, assuming the parts to be in the position shown in Fig. 1, air is conducted from supply passage **23** to the valve **4** and thence through port **30**, ports **31**, annular chamber **16** and ducts **33** to the interior of piston sleeve **2** beneath the forward pressure surface **40** of piston **3**. This fluid, acting on said pressure surface **40**, actuates the piston rearwardly. When piston **3** has moved a sufficiently great distance rearwardly to uncover the rearward ends of grooves **35**, pressure fluid from ducts **33** is exhausted through said grooves **35** and thence through bore **36** of drill bit **5**. The compressive action of the piston increases the pressure in the rearward portion of piston sleeve **2** and valve port **29** sufficiently to throw the flapper valve **25** into its other limiting position in which it closes port **30** and thus cuts off the supply of pressure fluid to the forward end of the piston, whereupon pressure fluid is supplied to the rear pressure surface of the piston.

This reversal in supply of the pressure fluid actuates the piston **3** forwardly until the piston moves clear of the tube **26** and cuts off the exhaust through grooves **35**. Accordingly, the pressure behind the piston drops and the pressure in front of the piston increases, causing the flapper valve **25** to be thrown to the position shown in Fig. 1.

A primary purpose of the drill construction herein shown and described is: to simplify assembly of the rock drill, to permit the valve **4** to rotate relative to the piston sleeve **2**, and to eliminate the likelihood of breakage at the threaded section **22** of the drill.

An important advantage gained by undercutting the outer casing **1** to form the annular chamber **16**, instead

of cutting the piston sleeve **2** for this purpose, is that a larger internal bore may be obtained for a given size outer casing **1** than is otherwise possible. If the piston sleeve **2** were cut and its outer diameter thereby reduced for the above purpose, as in previous rock drills of the type disclosed herein, said piston sleeve would be entirely too thin especially if the cutting extended all the way around the sleeve as it would have to do in order to form the annular chamber **16**.

Another advantage is that the cross-sectional area of the outer casing **1**, throughout the length of its undercut portion, is equal to or less than the cross-sectional area of the threaded portion **22** of said casing. Thus the casing **1** has a relatively long undercut section which serves as a shock absorber for the vibrations of the drill, and because of the said relatively great length of said undercut section the shock or stress is distributed over a greater area than heretofore and no limited area is over-stressed. In previous rock drills of the type referred to, the thinnest part of the outer casing has been the relatively short threaded end section (where the threads **22** are in Fig. 1), resulting in a concentration of shock stresses at this point which lead to early failure due to breakage at said threaded part.

Although a specific embodiment has been shown and described herein for purposes of illustration, it will be evident to those skilled in the art that the invention is capable of various modifications and adaptations within the scope of the appended claims.

The invention claimed is:

1. A rock drill comprising a tubular outer casing, a cylindrical piston sleeve in said casing, a piston having forward and rear pressure surfaces reciprocably mounted in said sleeve, a backhead having a pressure fluid supply passage threaded in the rear end of said casing, the inner tubular surface of said casing being undercut and forming an annular chamber between said casing and said sleeve, said undercut extending forwardly and rearwardly beyond the rear end of said sleeve, a duct in said sleeve communicating with said annular chamber and adapted to be uncovered by said piston to supply pressure fluid to the forward pressure surface thereof, a valve body mounted on the rear end of said sleeve within said casing and being free to rotate with respect to said sleeve, valve ports in said valve body communicating respectively with the interior of said sleeve and with said annular chamber, and means carried by said valve body for controlling the flow of pressure fluid from said supply passage to said respective valve ports.

2. A rock drill according to claim 1, in which the cross-sectional area of the threaded rear end portion of said casing is at least as great as the cross-sectional area of the undercut portion of said casing.

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