July 20, 1954 G. A. BERGMAN 2,684,055

ROCK-DRILL HAVING AN ENGINE ASSEMBLED THEREWITH

Filed Feb. 25, 1952

FIG. 1

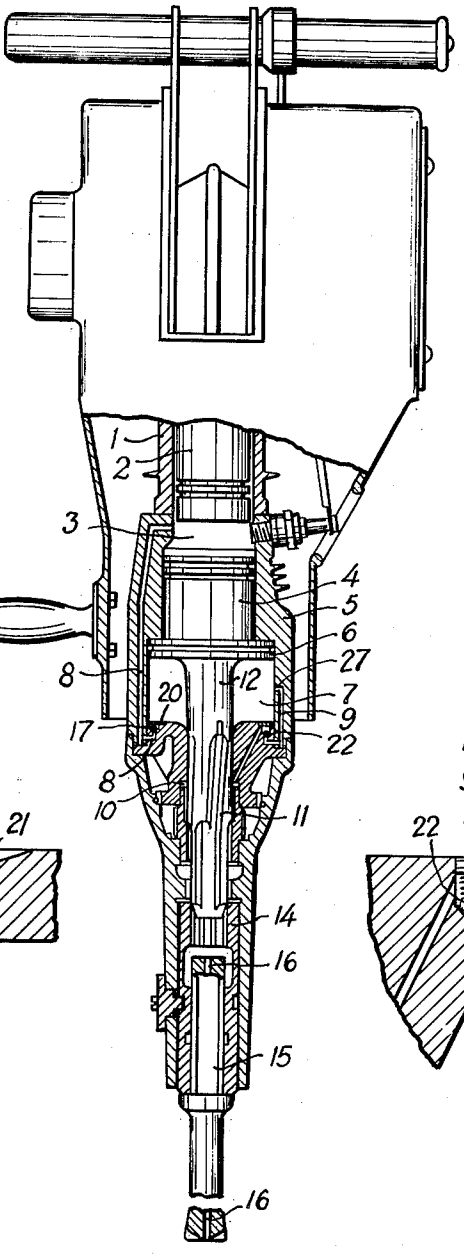


FIG. 2

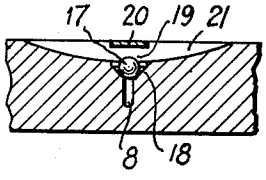
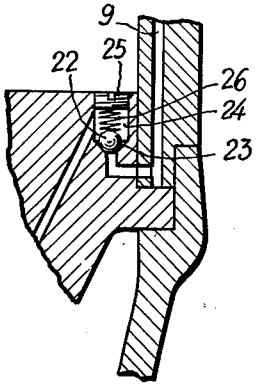


FIG. 3



Inventor:-
Gustav Albert Bergman,
By
Pierce, Scheffler & Parker,
Attorneys.

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ROCK-DRILL HAVING AN ENGINE ASSEMBLED THEREWITH

Gustav Albert Bergman, Danderyd, Sweden

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4 Claims. (Cl. 123—7)

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In rock-drills and similar motor-driven tools provided with an impact piston operated by means of an internal combustion engine assembled with the rock-drill, the impact piston forms a movable wall in the engine cylinder or, in other words, a movable cylinder head at one end of the engine cylinder. The impact piston receives its reciprocating motion by the fact that the pressure from the gases of combustion drives it, upon every ignition in the engine cylinder, outwardly in a working stroke, compressed gases on the outside of the impact piston then driving it back in a return stroke. The compressed gases are inclosed within a cylinder space on the outside of the impact piston, and this device is designated in the following as a "gas cushion." In a known construction, the inlet of the gas cushion is in open communication with a source of compressed gas, and is provided with an outlet which is open toward a channel leading through the boring tool down into the bore-hole, wherein the tool operates, the escaping gases being utilized for the scavenging of the bore-hole. In this connection, certain losses come about by the fact that gas is pressed from the cylinder of the impact piston back through the inlet passage during the working stroke of the impact piston, while gas escapes at the same time through the outlet from this cylinder. In certain cases, the losses become so large that a sufficient pressure will not be attained on the outside of the impact piston for the return movement of the piston. This manifests itself by the impact piston operating too slowly and by the impact effect becoming low. The rate at which the boring tool works itself down into the bore-hole will be small in a corresponding degree.

The object of the present invention is primarily to obviate these disadvantages and to attain a rapid movement of the impact piston and a correspondingly high boring rate. The substantially distinguishing feature of the invention resides above all in that the inlet to the gas cushion has provided therein a non-return valve closing at a discharge from the gas cushion. A power-loaded, preferably spring-loaded valve may also be arranged in the outlet from the gas cushion, said valve being adapted to be opened for the discharge of gas from the gas cushion only at the attainment of a certain pressure in the latter. If the inlet opens into the cylinder of the impact piston at the bottom of the cylinder, the non-return valve prevents a return flow from the gas cushion to the source of compressed gas during the whole of the working stroke of the

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impact piston, and at the same time the power-loaded valve in the outlet ensures that the pressure of the gas cushion falls below a certain suitable value. Hereby the return movement of the impact piston becomes safer and quicker. Generally, the engine cylinder proper is used as a source of gas pressure, the inlet channel of the cylinder of the impact piston then communicating with this cylinder of the engine. It is also possible, however, to make use of a special compressor operating with air, for example, said compressor delivering the requisite pressure medium to the gas cushion, while the non-return valve is arranged in the communicating passage between the compressor and the gas cushion.

An example of the application of the invention is illustrated in the accompanying drawing. Fig. 1 shows the rock-drill, partly in axial section. Fig. 2 shows, to a larger scale, the non-return valve in the inlet of the cylinder of the impact piston, and Fig. 3 shows, likewise to a larger scale, the power-loaded valve in the outlet.

In the drawing, 1 designates the cylinder of the internal combustion engine, 2 the operating piston thereof, and 3 the combustion chamber. 4 denotes the impact piston and 5 the cylinder of the impact piston. The impact piston is provided with an auxiliary piston 6 of a larger diameter, and this auxiliary piston moves in an enlarged end portion of the impact piston cylinder. The cylinder space 7 on the outside of the auxiliary piston 6 encloses the gas cushion. This gas cushion communicates through a passage 8 with the combustion space 3. Furthermore, the gas cushion communicates through an outlet passage 9 with an annular space 10, which is connected, through the intermediary of grooves 11 in the impact piston rod 12, with the interior of a sleeve 14 serving as an attachment for the boring tool 15. Leading through the boring tool is an axial passage 16 reaching down to the operating end of the tool, so that gases entering the sleeve 14 through said passage may be conveyed down into the bore-hole.

According to the invention, a non-return valve is arranged in the inlet passage, said non-return valve closing at an escape of fluid from the gas cushion 7. According to the drawing, the non-return valve takes the form of a ball 17 cooperating with a seat 18 in a recess 19 in the bottom of the impact piston cylinder. The channel 8 opens from below into the bottom of the recess 19, and immediately above the valve ball 17, a plate 20 or the like is secured in the bottom

of the cylinder, said plate partly preventing the ball 17 from being thrown up from the recess, and partly guiding the hot gases rushing out of the inlet 8 toward the sides, so that they are prevented from meeting the auxiliary piston 6. The recess 19 extends laterally approximately on a chord of the cylinder bottom, and the bottom 21 of the recess slopes obliquely upwardly toward the cylinder bottom to merge by degrees into the latter, as shown in Fig. 2.

According to the invention, the outlet passage 9 also has a power-loaded valve arranged therein, said valve opening only at the attainment of a certain pressure in the gas cushion. This valve may consist of a valve ball 22 cooperating with a seat 23 formed by the bottom of a recess 24 in the cylinder chamber 27 of the impact piston. The recess 24 is closed at the top by means of a screw stopper 25, which keeps a spring 26 in the recess against the valve ball. The latter is thus loaded by a certain definite force, which may be controlled, if desired, by the screw stopper being screwed in more or less.

The passage 9 commences with an opening 27 in the cylinder wall at a distance above the bottom of the impact piston cylinder, by reason of which it will be cut off by the auxiliary piston 6 during the outward movement of the latter (downwardly in the figure).

The mode of operation of the machine described is broadly as follows. At the ignition and the immediately following combustion in the engine cylinder 3, the impact piston 4 will be thrown with its auxiliary piston 6 in a direction out from the combustion chamber 3 by the pressure then produced. Gas will thus be compressed on the lower side of the auxiliary piston 6 in the cylinder space 7. When a certain pressure has been produced in the latter, before the auxiliary piston has reached the opening 27 of the outlet passage 9, the force of the spring 26 acting upon the valve ball 22 may be overcome, so that the valve ball will be raised from the seat 23 so as to admit the gases into the passage 9. These gases continue to the annular space 10 through the slots 11 to the sleeve 14 and through the axial channel 16 in the boring tool 15 down into the bore-hole to scavenge the latter clean from boring-dust and the like produced during the boring work. However, before the impact piston has had time to move appreciably, the gases of combustion, which are under a high pressure, have been permitted partly to flow through the channel 8 past the non-return valve 17 into the cylinder space 7. After the impact piston has moved for a distance, it covers the opening 27 of the outer passage 9, whereupon the pressure in the cylinder space 7 rises rapidly. When it exceeds the pressure of the inlet passage 8, the non-return valve 17 closes, whereupon the gas cushion

in the space 7 is cut off both on the inlet side and on the outlet side. For this reason the auxiliary piston cannot reach the bottom but will rebound against the gas cushion into the inner end position shown. The procedure is then repeated anew at the next combustion in the engine cylinder.

Although the invention has been described as applied to rock-drills with boring tools, it obviously also comprises similar machines with other tools, such as breaking tools, chisels, hammers and the like. Nor is the invention otherwise limited to the construction shown, which only aims at illustrating an example of embodiment.

What I claim is:

1. In a rock drill driven by an internal combustion engine by impact, a cylinder, a conduit connecting the combustion chamber of said combustion engine with said cylinder, an impact piston movable in the cylinder and defining a gas chamber to form a gas cushion in the cylinder for returning the impact piston, a non-return valve in said conduit opening toward said cylinder chamber to permit introduction of combustion gases from the combustion chamber of the engine into said gas chamber but preventing return of the gases.

2. In a rock drill driven by an internal combustion engine, a cylinder, an impact piston movable in said cylinder and defining a gas chamber to form a gas cushion at the impact side of the piston for the return stroke of the impact piston, said cylinder having an inlet for gas under pressure and an outlet for gases, and a spring-loaded valve in said outlet opening outward from the cylinder.

3. In a rock drill driven by an internal combustion engine, a cylinder having an outlet, a passage for gas forming a communication between the combustion chamber of the combustion engine and said cylinder, an impact piston movable in the cylinder and defining a gas chamber in the cylinder to form a gas cushion for the return of the impact piston, a non-return valve in said passage opening toward the cylinder chamber, and a spring-loaded valve in the outlet adapted to open outward from the cylinder chamber at a predetermined gas pressure therein.

4. In the rock drill claimed in claim 3, a through passage in the tool of the rock drill, the spring loaded valve being mounted in said passage.

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