United States Patent [19]

Montabert

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[54] **PERCUSSION APPARATUS**

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[52] **U.S. Cl.** ..... **91/2 C,** 91/300, 91/321, 92/108

[51] **Int. Cl.** **F15b 15/22,** F01b 7/18, F01l 25/04

[58] **Field of Search** 91/300, 321, 25, 91/26, 31; 92/108

[56] **References Cited**

UNITED STATES PATENTS

2,664,859	1/1954	Green	92/108
3,322,038	5/1967	Dobson	91/300
3,399,602	9/1968	Klessig et al.	91/300
3,411,592	11/1968	Montabert	91/321

FOREIGN PATENTS OR APPLICATIONS

533,367	11/1956	Canada	91/300

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[57] **ABSTRACT**

The piston (**2**) of a hydraulically operated percussion implement moves jointly with a juxtaposed distributor (**3**) in a cylinder bore to strike a tool (**16**) seated in the lower end of that bore. The admission of high-pressure oil to a space (**11**) adjacent a rear face of the piston is jointly controlled by the distributor and by a valve (**20**) inserted between that space and an inlet port. The distributor has an enlarged head (**3***a*) which overlies a fluid cushion in an annular recess (**10**) communicating with an expansion chamber (**9**) in the piston, this chamber being defined by an axial bore (**6**) and a stationary plunger (**7**) entering same. One or more pushers (**12**) under oil pressure bear upon the distributor to depress it, in the wake of the piston, after the latter has begun its descent and causes the application of high pressure to a space (**11***a*) above the distributor. The descent of the piston enlarges the expansion chamber (**9**) which thereby draws part of the oil from the annular recess (**10**) to reduce the resistance to the downward movement of the distributor.

3 Claims, 3 Drawing Figures

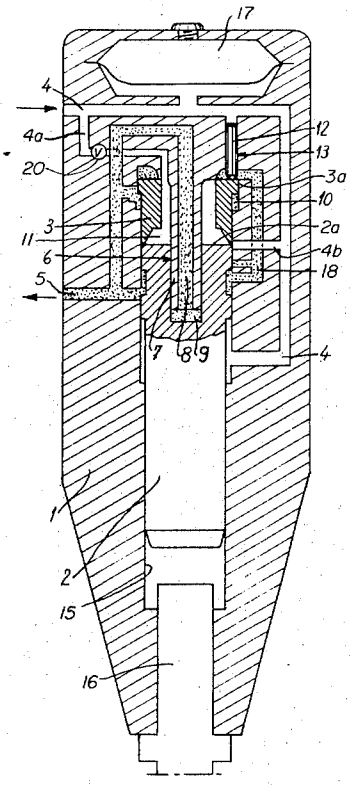


FIG.1

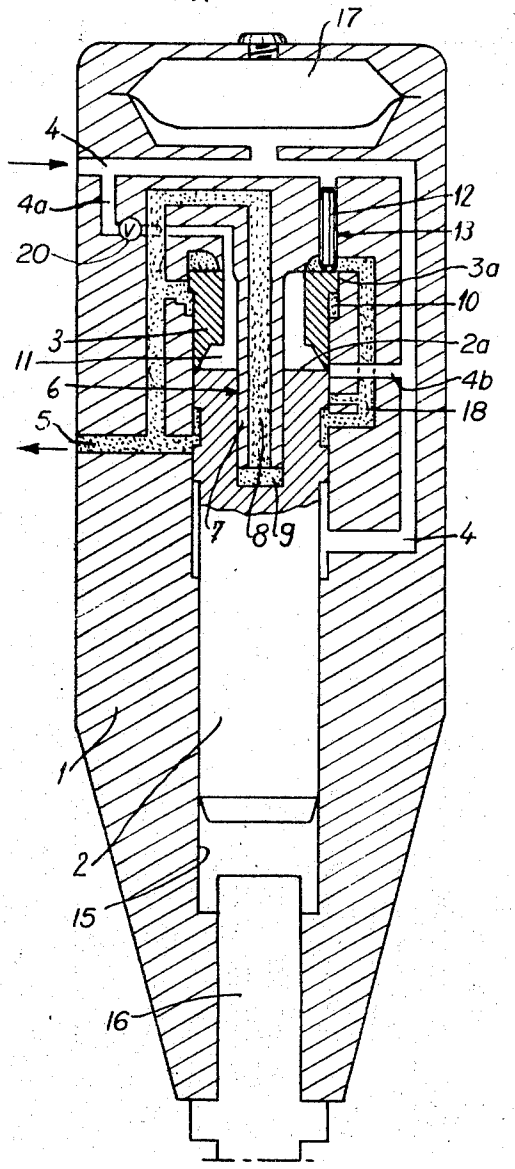


FIG.2

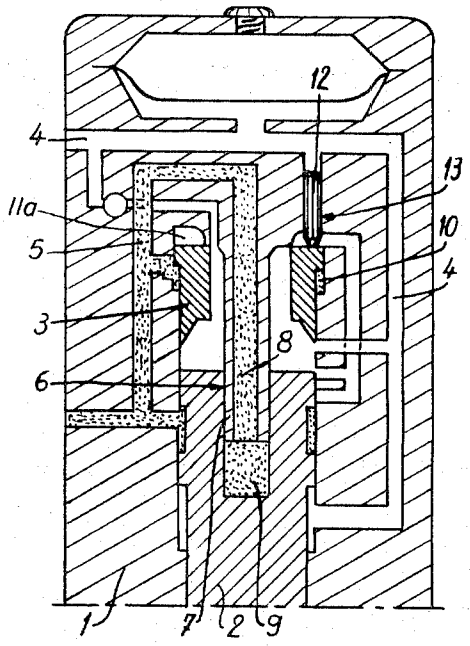
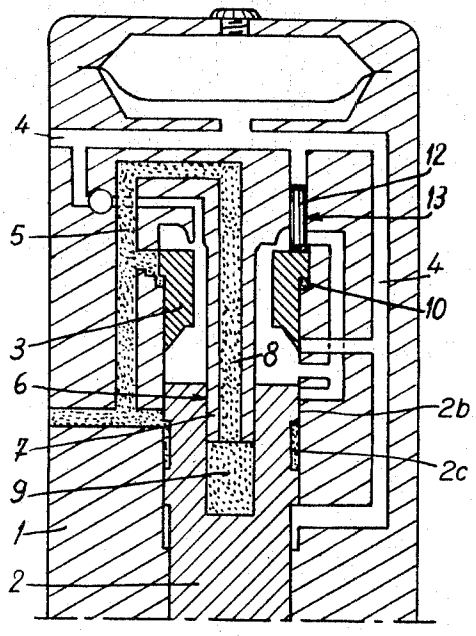


FIG.3



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PERCUSSION APPARATUS

FIELD OF THE INVENTION

The present invention relates in general to percussion apparatus, notably of the type disclosed and illustrated in my prior U.S. Pat. No. 3,411,592.

Such implements serve to deliver successive blows to a tool such as a spindle, pick, drill bit or the like, in order to disintegrate concrete, rock or other ores, or for performing work requiring shocks, such as riveting, hammering, pounding, etc.

DESCRIPTION OF THE PRIOR ART

The essential feature in a system of this general type, utilizing an incompressible liquid as a working fluid, is that the shock or impact is produced by a movable piston slidably fitted in an elongated cylindrical body which has ports interconnected by suitable ducts and a slide valve or like distributing member adapted to connect the chamber overlying the piston alternately with a high-pressure circuit for producing the rapid downward or operative stroke of the piston and with a low-pressure circuit to permit the upward or withdrawal stroke of the piston.

Of course, to perform this function the distributor or slide valve must be able to be reciprocated along a rectilinear path at a rate corresponding to the working rate of the apparatus.

Whereas the return movement of the distributor is controlled positively and mechanically by the piston, its forward movement in the system of my prior patent, is effected by the expansion of a restoring spring acting directly upon the distributor.

Under these conditions, experience teaches that two causes are liable to limit the rate of travel of this distributor and therefore of the apparatus itself. These causes are :

- the reaction force exerted by the oil in the low-pressure circuit upon the distributor,
- the presence of the restoring spring which prevents the distributor from attaining sufficiently high speeds and which is liable to break.

In other words, the distributor is not capable of performing an operative stroke at a speed high enough to cut off the high-pressure fluid supply when the signal therefor is delivered to this distributor from the control circuits. This constitutes an obvious impairment of the efficiency and performances of the apparatus.

SUMMARY OF THE INVENTION

Accordingly, the present invention aims at providing means for avoiding the afore-described drawbacks of the apparatus disclosed in my prior patent and to enable an increase in the rate of operation of the distributor and therefore of the apparatus itself.

I realize this object by a combination of the following features:

- forming in the piston a chamber communicating permanently with an annular recess, located beneath an enlarged head of the distributor, which is connected to the low-pressure circuit whose fluid is drawn into the expanding chamber as the piston is lowered, so as to reduce the upward force exerted by this fluid on the distributor;
- providing at least one pusher member slidably mounted in a bore opening into the high-pressure fluid circuit and adapted to engage the upper face of this distributor, thereby positively controlling the operative strokes of the distributor as a function of the very fluid pressure prevailing in this high-pressure circuit.

BRIEF DESCRIPTION OF THE DRAWING

A typical embodiment of the present invention will now be described by way of example with reference to the accompanying diagrammatic drawing in which:

FIGS. **1**, **2** and **3** are longitudinal sections showing the positions obtaining at the end of the return strokes of the piston and distributor, during the operative stroke of the piston and, approximatively, at the end of the operative strokes of the piston and the distributor, respectively.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawing, the reference numeral **1** designates the elongated and substantially cylindrical body of a percussion implement provided with an axial bore **15** for the guidance of a tool **16**. Slidably fitted in this bore is a piston **2** and a slide valve or distributor **3**. The various ducts constituting the high-pressure fluid circuit are denoted **4**; the low-pressure circuit (stippled), is designated **5**.

According to the present invention, the piston **2** has formed in its upper portion a coaxial blind hole **6** constituting a bore in which a plunger **7** rigid with the body **1** of the apparatus is slidably fitted. This plunger **7** comprises a central or axial passage **8** permanently connected to the low-pressure fluid circuit **5**. The length of plunger **7** is such that when the piston **2** is completing its return stroke or has nearly attained its uppermost portion, as shown in FIG. **1**, the piston bore **6** provides a lower chamber **9** containing liquid under low pressure.

In fact, this chamber constantly communicates with the low-pressure circuit **5**, specifically with an annular recess **10** surrounding the distributor **3** to form a fluid cushion underneath the enlarged distributor head.

On the other hand, according to the present invention, the upper face of distributor **3** is constantly in direct mechanical engagement with one or more pusher members **12**. Each pusher member is slidably mounted in a bore **13** of body **1** that opens at its upper end into one of the ducts **4** of the high-pressure fluid circuit; on the other hand, this pusher member **12** constantly bears with its lower end upon the distributor **3**.

A fluid space **11** adjacent a rear face **2*a*** of piston **2** communicates with the high-pressure branch **4** of the hydraulic circuit (which includes a gas cushion **17**) through a channel **4*a***, containing a control valve **20**, and through a channel **4*b*** which is cut off by the distributor **3** and the piston **2** in the retracted position of FIG. **1**. An enlarged head **3*a*** of distributor **3** separates the space **11** from an annular extension **11*a*** thereof, overlying the distributor head **3*a***, in the top position of the distributor in which the ring space **11*a*** communicates via a conduit **18** either with low-pressure branch **5** (piston **2** raised, in FIG. **1**) or with high-pressure branch **4** (piston **2** lowered, FIGS. **2** and **3**); a land **2*b*** of the piston adjacent an annular groove **2*c*** serves as a switching means for reversing this connection. Pusher member **12** is seen to pass through the ring space **11*a***.

The movements constituting the rectilinear reciprocations of piston **2** and distributor **3** in cylinder **1** are

produced and take place under the same conditions as described in my prior U.S. Pat. No. 3,411,592.

Thus, the piston **2** moves first alone from the restracted position of FIG. **1** to the advanced position of FIG. **2**, without any concomittant movement of distributor **3**; it is only when the resultant of the forces acting upon distributor **3** is no longer directed upwards, because of the switchover of space **11***a* from the low-pressure branch **5** to the high-pressure branch **4**, that the pusher member or members **12**, responsive to the high-pressure fluid, cause the distributor **3** to move downwards.

This movement is facilitated to a substantial degree by the fact that as the piston **2** moves downwards the volume of its upper chamber **9** increases, thus producing suction in the low-pressure circuit **5** and therefore a reduction in the reactor force exerted by the fluid in recess **10** upon the head of distributor **3**.

Under these conditions the acceleration of the downward movement of distributor **3** becomes a maximum, since :

- the resistance to the descent of distributor **3** decreases as the piston **2** moves downwards,
- the pusher member or members **12** driven by the high-pressure fluid exert on the distributor **3** a thrust which is reliable, constant in time, maximum throughout the stroke and proportional to the supply pressure, in contrast to the force exerted by one or more springs which is likely to vary during actual service, decreases with the stroke and is not dependent on the fluid pressure in the high-pressure circuit.

As in the case described in my prior U.S. patent, the distributor **3** is returned positively to its upper position by its mechanical engagement with piston **2**.

What I claim is :

1. A percussion implement comprising an elongated body provided with a bore having an open front end for receiving a tool, a piston slidable in said bore, a distributor slidable in said bore adjacent a rear face of said piston remote from said front end, a hydraulic circuit in said body including a high-pressure branch and a low-pressure branch, control means including said distributor for connecting a fluid space adjacent said rear face alternately to said high-pressure and low-pressure branches, said low-pressure branch forming an annular recess around said distributor occupied by an incompressible fluid and forwardly of an enlarged head thereof for cushioning a forward movement of said distributor, pusher means in said body bearing in a forward direction upon said distributor under pressure from said high-pressure branch, and suction means on said piston operative upon incipient forward movement thereof for drawing fluid from said recess to accelerate a corresponding movement by said distributor, said suction means including a stationary plunger in said body projecting axially into a blind bore of said piston and defining therewith a chamber expanding upon forward movement of the piston.

2. A percussion implement as defined in claim **1** wherein said hydraulic circuit includes an annular extension of said fluid space adjacent a rear surface of said head, said pusher means passing through said extension.

3. A percussion implement as defined in claim **2** wherein said extension is cut off from said fluid space in a retracted position of said distributor and wherein said hydraulic circuit includes piston-controlled switching means for alternately connecting said extension with said low-pressure branch and said high-pressure branch in a withdrawn piston position and an advanced piston position, respectively.

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