C. H. HAESELER.

POWER OPERATED PERCUSSIVE TOOL.

APPLICATION FILED AUG. 20, 1910.

994,743.

Patented June 13, 1911.

3 SHEETS—SHEET 1.

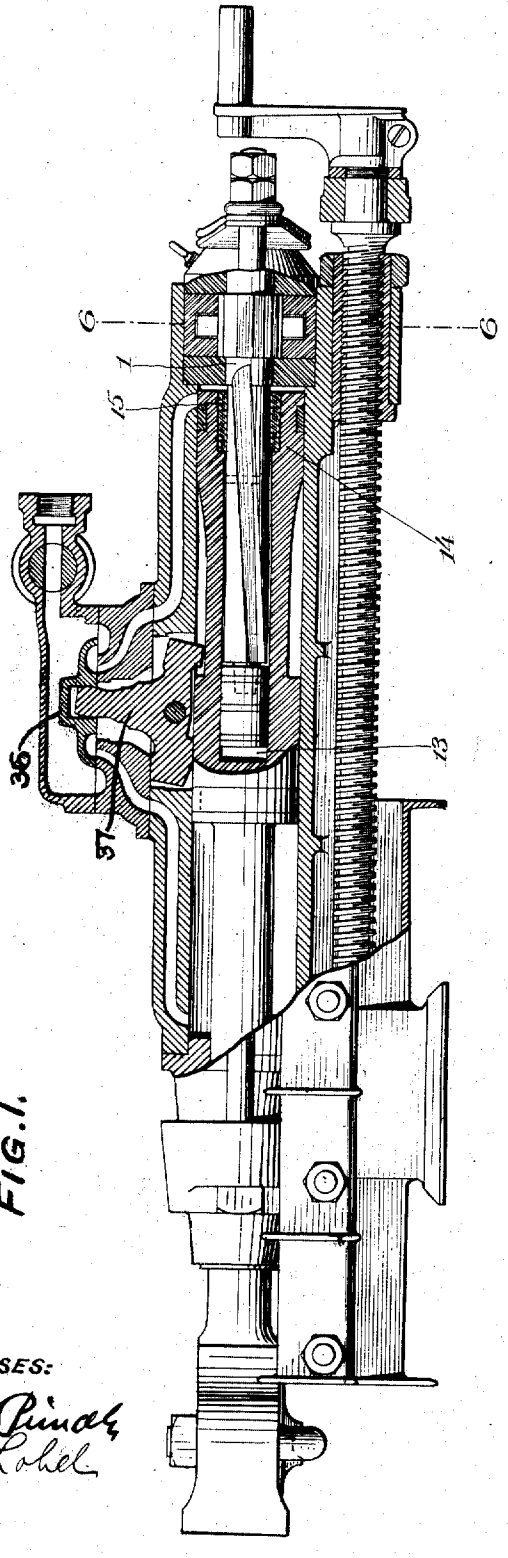

FIG. 1.

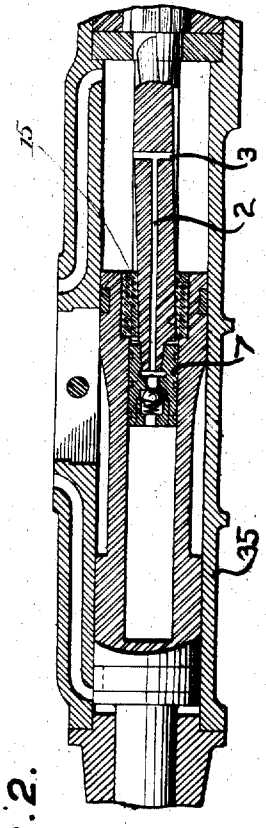

FIG. 2.

WITNESSES:

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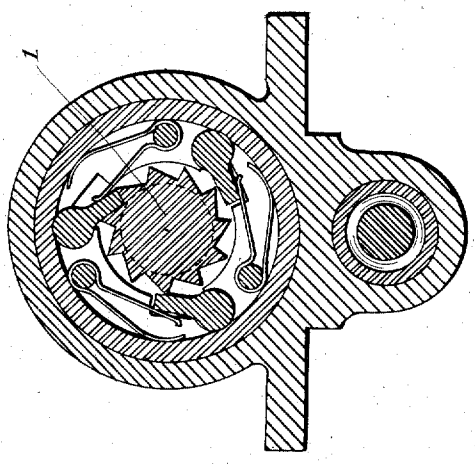

FIG. 6.

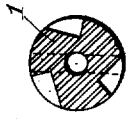

FIG. 4.

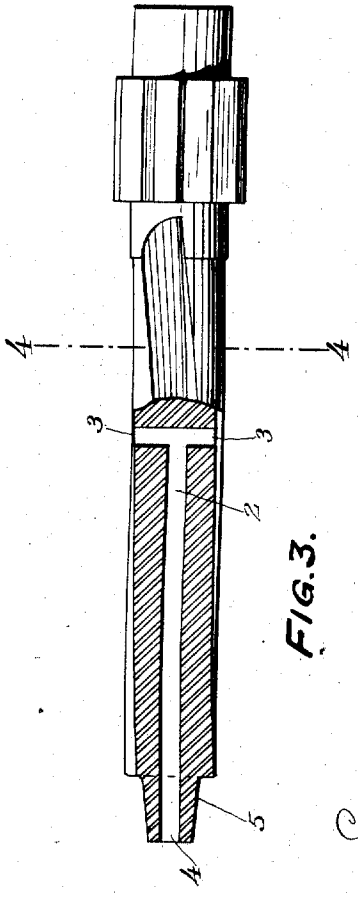

FIG. 3.

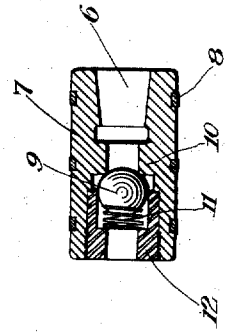

FIG. 5.

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3 SHEETS—SHEET 3.

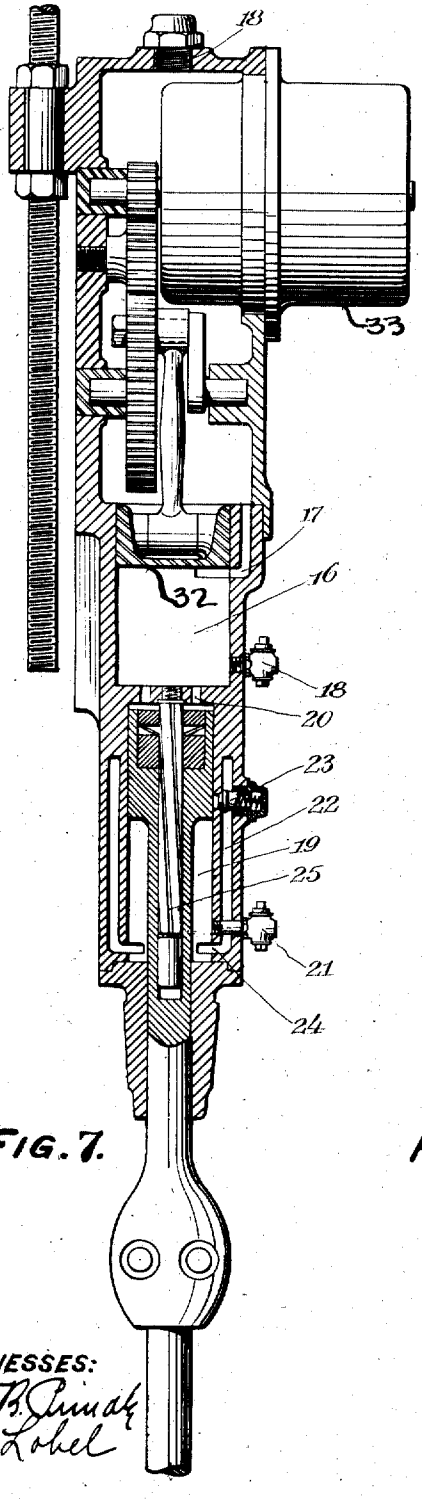

FIG. 7.

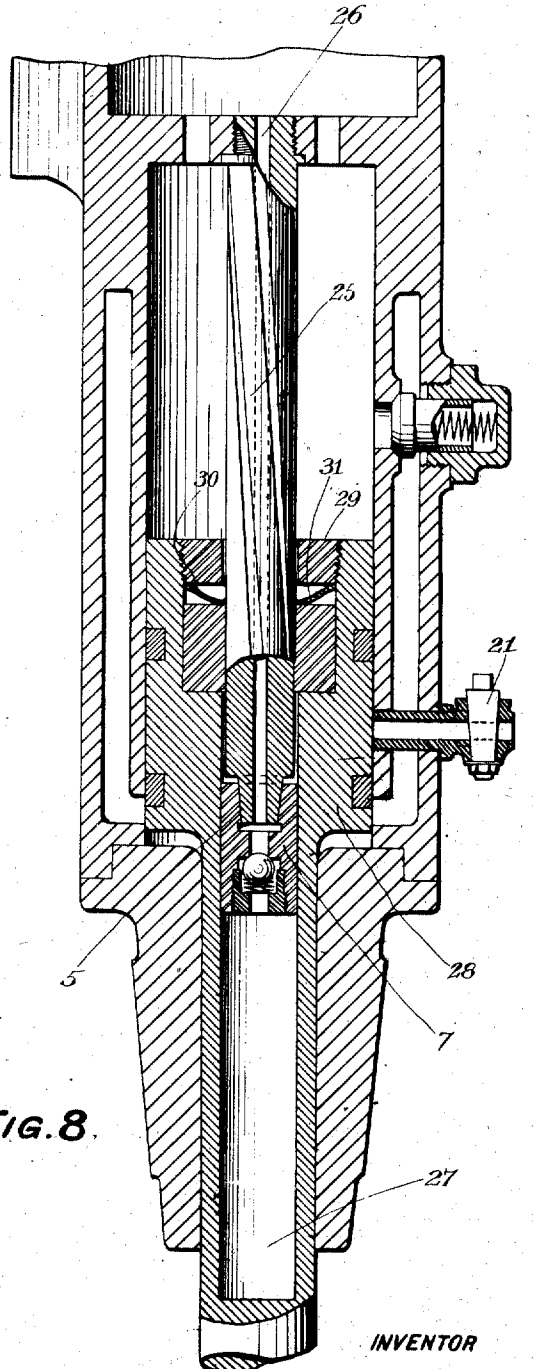

FIG. 8.

WITNESSES:

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UNITED STATES PATENT OFFICE.

CHARLES HERMAN HAESELER, OF PHILADELPHIA, PENNSYLVANIA.

POWER-OPERATED PERCUSSIVE TOOL.

994,743. Specification of Letters Patent. Patented June 13, 1911.

Application filed August 20, 1910. Serial No. 578,149.

To all whom it may concern:

Be it known that I, CHARLES H. HAESELER, a citizen of the United States of America, and a resident of Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented certain new and useful Improvements in Power-Operated Percussive Tools, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

This invention relates to power operated percussive tools such as rock drills, mining machines, power hammers, pile drivers and the like, the operation of which is effected by elastic motive fluid under pressure alternately admitted into a cylinder upon opposite sides of a piston freely mounted therein. Because of the fact that in this class of tool the percussion piston is freely mounted in the cylinder, in the sense that there is no mechanical means to limit the extent of the stroke thereof, it follows that some means must be provided to prevent the piston from striking the upper head of the cylinder upon the upward or return movement of the piston. For this purpose it is common to admit the motive fluid behind the percussion piston at some period during its rearward movement, prior to the completions thereof, so that this motive fluid is further compressed during the completion of such return movement and as so further compressed will act as a cushion, but in practice this method has usually been found inefficient for several reasons: First, it is quite difficult to maintain a tight enough joint for the purpose between the percussion piston and the cylinder in which it is mounted, this being chiefly owing to the severe wear to which the parts are subjected in use; second, it is manifestly impracticable to admit the motive fluid behind the piston at too early a period, because the effect would be to undesirably shorten the stroke of the piston, yet the rebound of the piston, following a blow, varies considerably and a point of admission sufficient under some conditions is wholly inadequate under others; third, because of the comparatively small portion of the stroke that can be used for cushioning purposes there is too short a period for the pressure to accumulate sufficiently. Again in the case of rock drills, to which this invention is particularly adapted, the presence of the rotator bar employed therein at the upper end of the cylinder, and which commonly enters a cavity in the percussion piston, reduces the available area not only for cushioning purposes, but also for power purposes; moreover its presence results in further joints through which further leakage readily occurs.

The main objects of the present invention are first to efficiently cushion the piston of this class of tools upon the return stroke thereof, and second to increase the efficiency of the tool by increasing the speed of operation thereof, whereby the force of the blows are augmented, and the number of the blows imparted in a given period of time is increased. These objects are attained by the employment of a special cushioning piston of smaller effective area than that of the percussion piston, secured to a longitudinally fixed bar or rod, such bar or rod in the case of a rock drill or similar tool being conveniently the rotator or rifle bar thereof, the said cushioning piston being mounted in a cylinder provided in or carried by the percussion piston, and the provision of means by which the motive fluid is admitted to the said cylinder in front of the cushioning piston during the forward movement of the percussion piston, and is held entrapped therein during the entire return movement of the percussion piston so that it will be compressed in such return movement to a high degree. The fluid thus compressed forms an efficient cushioning means, the high degree of compression attained by reason of the length of stroke being found sufficient for all purposes, yet the fact that the pressure therein rises slowly until near the end of the stroke, causing the percussion piston to make substantially a full and complete stroke under all conditions. The motive fluid thus compressed reacts upon the next-forward stroke to augment the motive fluid admitted for power purposes, so as to increase the speed and force of the forward or power stroke, thereby increasing the efficiency of the drill to a considerable extent. A further advantage of the high degree of compression thus attained is the heating of the motive fluid. Not only is its tension increased, but where steam is employed as such motive fluid, the super-heating immediately obviates any tendency toward condensation thereof, and prevents water from collecting in the drill. This is particularly beneficial when it is considered that these drills are commonly used in the open and often during cold weather, with almost no attempt at heat insulation of the connecting pipes.

The cushioning means just described may

be used either supplementary to the common expedient of admitting motive fluid at the rear of the percussion piston during its return movement as first above described, or instead thereof. Preferably the motive fluid will still be admitted behind the percussion piston before the completion of the return movement thereof, but at a somewhat later period, this being for the double purpose of increasing the cushioning action at the extreme end of the stroke, and the building up of pressure for the next forward stroke.

My invention also consists in certain novel details of construction and combinations of parts, including a detachable connection for the cushioning piston, whereby the parts may be readily taken apart and reassembled, all as will be well understood in the light of the following specification; and in order that my invention may be thoroughly understood I will now proceed to describe in detail certain embodiments thereof, having reference to the accompanying drawings illustrating the same, and will then point out the novel features in claims.

In the drawings: Figure 1 is a view in partly side elevation and partly central longitudinal section, of a power rock drill constructed in accordance with my invention. Fig. 2 is a view in central longitudinal section of the central portion of the drill, showing the main piston in its forward position. Fig. 3 is a detail view partly in side elevation and partly in central longitudinal section of the rifle bar employed in the construction of tool illustrated in Figs. 1 and 2. Fig. 4 is a view in transverse section therethrough upon the line 4—4 in Fig. 3. Fig. 5 is a detail view in central longitudinal section through the cushioning piston. Fig. 6 is a view in transverse section through the drill upon the line 6—6 in Fig. 1. Fig. 7 is a view in central longitudinal section through a pulsator type of drill equipped with my invention. Fig. 8 is an enlarged view in central longitudinal section through the main cylinder and correlated parts, the main piston being shown in its forward position.

The rock drill illustrated in Figs. 1 to 6 inclusive comprises in general a main cylinder 35, a reciprocating percussion piston 14 therein, a distributing valve 36 for admitting and exhausting motive fluid to and from the cylinder below and above the piston, and a rocker 37, actuated by the piston in its reciprocating movements, for operating the valve. The upper end of the piston 14 is provided with a nut 15 which is fitted to a rifled rotator bar 1, the said bar being carried by the upper head of the drill and extending downward through the said nut into a cylindrical cavity 13 in the piston. At its upper end the rifle bar is provided with a ratchet wheel, the teeth of which are arranged to engage pawls in the said upper head, and by which rotational movements of the rifle bar are permitted in one direction only. As so far described the drill is of ordinary well known construction and operates in the usual manner, elastic motive fluid such as steam or air under pressure being alternately admitted by the valve above and below the piston 14 to successively drive the piston downward in a power stroke and lift it in a return stroke. The rifle bar and its connections constitute a rotating means by which the piston will be given a partial movement of rotation when moving in one direction, the rifle bar itself being permitted to rotate by reason of the ratchet and pawl mechanism when the piston is moving in the other direction. By this means an intermittent step by step movement in the same direction is constantly imparted to the piston in its operation. The lower end of the rifle bar 1 is provided with a conical extremity 5 to which is fitted the correspondingly conical portion 6 of a cushioning piston 7, the periphery of which is provided with packing rings 8 arranged to accurately fit the cylindrical cavity 13. The piston 7 is hollow and is provided interiorly with a check valve 9, fitted to a valve seat 10, the said check valve being conveniently closed by means of a spring 11, a plug 12 constituting an abutment for the spring and serving as means to retain the valve against accidental displacement. The rifle bar 1 has a longitudinal passage which opens into the hollow piston 7 at its lower end 4 and connects at its upper end, through a cross passage 3, with the interior of the cylinder 13 above the percussion piston 14. Motive fluid admitted above the percussion piston 14 to drive the same downward in a power stroke, will, during such downward movement of the piston, enter the cross passage 3 in the rifle bar 1, and will pass down through the longitudinal passage 2 therein through the cushioning piston 7, past the check valve 9, into the cylindrical cavity 13, beneath the said cushioning piston 7. Upon the upward movement of the percussion piston 14 in a return stroke the check valve 9 will automatically close, and the motive fluid in the cylindrical cavity 13 will be entrapped. This fluid, which it will be realized is initially under the normal degree of compression at which the motive fluid is employed, will be compressed further to a very high degree in the said return movement of the percussion piston, the effect of which will be first, to prevent the piston 14 from striking the upper head, second, to produce a powerful initial impulse to start the piston downward upon a new power stroke, and third, to augment the power of the tool in such power stroke. The net result is a remark-

able increase of efficiency of the tool, and the avoidance of injury such as so commonly occurs from the piston striking the upper head.

In Figs. 7 and 8 the cushioning device is shown as applied to a form of pulsator drill, in which the motive fluid is compressed by means of a compressor piston 32 fitted to a cylinder 16, and operated by a motor 33, all included as a part of the drilling tool structure as a whole. Air is admitted to the cylinder 16 through an admission port 18 and a passage 17, and the extent to which the air is compressed may be regulated by means of a hand operated regulator valve 18ª in the lower end of the cylinder 16 beneath the piston 32. The percussion piston 28 is located in a cylinder 19 which in this instance is formed as a continuation of the cylinder 16, being divided therefrom by a horizontal wall having passages 22 therethrough which connect the two said cylinders. The rifle bar 25 in this construction is permanently fixed to the said wall, the nut 30 therefor being rotatably mounted in the percussion piston 28 and having the usual or any desired form of ratchet and pawl connection with the piston as will be well understood, the said nut being mounted in a counter-bore in the percussion piston 28 and retained in position by the usual form of slip release spring and head 29, as will be well understood, these parts being common in the art and requiring no detailed description or illustration herein. Under normal conditions the nut is held against relative rotation with respect to the piston when the piston is moving in one direction so that the piston will be given a partial movement of rotation during such movement, but upon the movement of the piston in the other direction the ratchet and pawl connection will release the nut and permit it to rotate freely in the piston. The lower end of the rifle bar enters a cylindrical cavity 27 in the piston 28, and a cushioning piston 20 is accurately fitted to the said cylindrical cavity 27 exactly as in the construction of Figs. 1 to 6 inclusive, the said piston being similarly secured to the lower extremity of the rifle bar by means of the coacting conical surfaces 5 and 6 and provided with a check valve controlled passage therethrough. The longitudinal channel 26 in the rifle bar 25 may conveniently extend, however, clear through the rifle bar from one end to the other so that its upper end opens into the compression cylinder 16. The upper and lower ends of the cylinder 19 are arranged to be connected by a suitable passage 22, such as is conveniently in the form of an annular chamber, so that it will likewise constitute a receiver space, the upper end of the passage being controlled by a check valve 23, while the lower end enters the cylinder 19 at the bottom thereof through the freely open port or passage 24. The cylinder at its lower end is provided with a valve 21 similar to the hand operated regulator valve 18ª in the cylinder 16. The drill, as a whole, operates as follows: Air being compressed by the compression piston 32, passes through the passages 20 into the cylinder 19 above the percussion piston 28. This drives the piston downward and as the piston in its downward movement uncovers the upper opening of the passage 22, the compressed air will pass the check valve 23 down through the passage 22 to the lower end of the cylinder 19 beneath the percussion piston 28. Then as the compression piston 32 rises the air which has passed the check valve 13 will be trapped thereby and will operate to lift the percussion piston in a return stroke, the upward movement of the compression piston relieving the upper side of the percussion piston at this time. In the downward movement of the percussion piston, motive fluid under pressure will be admitted through the longitudinal channel 26 in the rifle bar 25 and through the hollow cushioning piston 7 into the lower end of the cylindrical cavity 27 in the percussion piston 28, and upon the return movement of the piston the air will be trapped therein as in the construction of Figs. 1 to 6 inclusive, to thereby act as an effective cushion to prevent the piston from striking the upper wall or head and to otherwise act upon the piston in its next succeeding downward movement as stated above.

In either of the structures described it will of course be understood that the effective area of the percussion piston upon which the motive fluid acts to move it in a return stroke is greater than that of the cushioning piston which opposes it. In the structure shown in Figs. 1 to 6 inclusive in which the motive fluid operated to actuate the percussion piston in its return movement is employed at full motive fluid pressure, the relative areas are about three to one, while in the structure shown in Figs. 7 and 8, in which the motive fluid is used expansively when actuating the percussion piston in its return movement, the proportional difference is much greater. These proportions may of course be very varied to suit different conditions and requirements.

It will be noted that in both of the constructions herein described the piston 20 at the end of the rifle bar acts as an outboard bearing for the rifle bar, supporting the rifle bar in the movement of the piston, and thereby preventing undue wear upon the rifle bar or upon the nut engaged thereby, and also tending to steady the parts so as to insure their proper operation. The conical connection between the piston and the

rifle bar is also a desirable feature of construction because it provides for the ready disconnection of the parts when the drill is taken apart for repair or other purposes. In reassembling the parts it is only necessary to mount the piston in the cylindrical cavity because in the first stroke of the percussion piston the motive fluid trapped in the cylindrical cavity beneath the cushioning piston will immediately act to lift the cushioning piston into position wherein it will intimately engage the conical end 5 of the rifle bar and thereafter the frictional engagement between the complementary conical parts 5 and 6, coupled with the air pressure, will tend to keep the parts in their proper engaged positions.

It will of course be understood that the two constructions shown and described are merely illustrative of types of tools to which my invention may be advantageously employed, and it will also be clear that my invention is equally adapted for employment with other forms and types of power operated percussive tools. It will also be understood that many of the details of construction and arrangement of parts of the cushioning means may be varied without departing from the spirit and scope of my invention in its broad aspect.

What I claim is:

1. In an elastic fluid operated percussive tool, the combination with a cylinder and a percussion piston freely mounted therein, of means for applying elastic motive fluid against a given area of the piston to move it in one direction, and means for entrapping motive fluid, and for compressing it against a relatively smaller area of the piston, during substantially the entire movement of the said piston in such direction.

2. In an elastic fluid operated percussive tool, the combination with a cylinder and a percussion piston freely mounted therein, the said piston presenting a relatively greater area upon one side for actuation by elastic motive fluid, and a relatively smaller area in opposition thereto for resisting such actuation, of means for admitting elastic motive fluid in the cylinder to operate against the relatively large area of the piston to move it in one direction, and means for entrapping motive fluid, and for compressing it by the said piston, throughout the said relatively smaller area, during substantially its entire movement in such direction.

3. An elastic fluid operated percussive tool comprising a main cylinder, a percussion piston mounted to reciprocate freely therein, a compression cylinder, and a cushioning piston having a smaller effective area than the percussion piston, mounted in the said compression cylinder, means for admitting elastic motive fluid in the main cylinder against the percussion piston to move it in one direction, and means for entrapping motive fluid in the compression cylinder, and for compressing it therein against the cushioning piston during substantially the entire movement of the said percussion piston in such direction.

4. In an elastic fluid operated percussive tool, the combination with a cylinder and a percussion piston freely mounted therein, of means for admitting elastic motive fluid into the cylinder, against one side of the said piston to actuate it in one direction, and cushioning means of smaller effective area, operating to compress entrapped motive fluid during substantially the entire movement of the said piston in such direction.

5. In a power operated percussive tool, the combination with a cylinder and a percussion piston mounted to reciprocate freely therein, and means for admitting elastic motive fluid under pressure to the cylinder alternately upon opposite sides of the piston, to alternately actuate the same in opposite directions, of means for compressing a portion of the motive fluid employed in moving the piston in one direction, during substantially the entire movement of the said piston in the opposite direction.

6. In a power operated percussive tool, the combination with a cylinder and a percussion piston mounted to reciprocate freely therein, and means for admitting elastic motive fluid under pressure to the cylinder alternately upon opposite sides of the piston, to alternately actuate the same in opposite directions, of means for completely entrapping a portion of the motive fluid employed in moving the piston in one direction, and for continuously compressing it while so completely entrapped during substantially the entire movement of the said piston in the opposite direction.

7. In a power operated percussive tool, the combination with a cylinder and a percussion piston mounted to reciprocate freely therein, and means for admitting elastic motive fluid under pressure to the cylinder alternately upon opposite sides of the piston, to alternately actuate the same in opposite directions, of means for exhausting motive fluid from a portion only of that part of the piston against which it operates when moving the said piston in one direction, whereby when the piston is moved in the other direction, the said piston will operate throughout the remaining portion thereof to continuously compress such residual motive fluid, the compression of which will progressively oppose the entire movement of the piston in the latter said direction.

8. In an elastic fluid operated percussive tool, the combination with a cylinder and a percussion piston freely mounted therein, and having a compression cylinder in axial

alinement therewith, of a cushioning piston in the last said cylinder, a longitudinally stationary rod for carrying the said cushioning piston, means for admitting elastic motive fluid under pressure into the first said cylinder upon opposite sides of the percussion piston, and into the said compression chamber in front of the said cushioning piston, and means for completely entrapping the motive fluid in the said compression chamber, whereby it will be compressed during substantially the entire movement of the percussion piston in one direction, and will expend its energy to assist in the actuation of the said percussion piston when the latter is moving in the opposite direction.

9. In mechanism of the class described, the combination with a main cylinder and a percussion piston freely mounted therein and having a co-axial cylindrical cavity, of a cushioning piston mounted in the said cylindrical cavity, a longitudinally fixed rod to which the said cushioning piston is attached, means for admitting elastic motive fluid under pressure into the main cylinder alternately upon opposite sides of the percussion piston, and into the said cylindrical cavity, and non-return means for preventing the escape of motive fluid from the said cylindrical cavity.

10. In a rock drill the combination with a main cylinder and a percussion piston freely mounted therein, and having a co-axial cylindrical cavity, of a longitudinally stationary rotator bar carried at one end by the said main cylinder and at the other end projecting into the said cylindrical cavity, a cushioning piston carried by the latter end of the said rotator bar, and means for admitting an elastic fluid into, and entrapping it within, the said cylindrical cavity.

11. In a rock drill, the combination with a main cylinder and a percussion piston freely mounted therein and having a co-axial cylindrical cavity, of a longitudinally fixed rotator bar received within the said cavity, a piston thereon fitted to the said cavity, means for admitting motive fluid to the said main cylinder, and check valve controlled passages for admitting motive fluid to the said cylindrical cavity.

12. In a rock drill, the combination with a main cylinder, and a percussion piston freely mounted therein, and having a cylindrical cavity, of a longitudinally fixed rotator bar received within the said cavity, and a piston fitted to the said cavity and detachably connected to the end of the said rotator bar.

13. In a device of the character described, a percussion cylinder, a percussion piston, a rotator bar, a cylinder in said piston and in which the said rotator bar works, a piston for the latter said cylinder, and a friction joint for connecting the rotator bar and the latter said piston.

14. In a device of the character described, a percussion cylinder, a percussion piston, a rotator bar, a cylinder in said piston and in which the said rotator bar works, a piston for the latter said cylinder, and a conical friction joint for connecting the rotator bar and the latter said piston.

15. In a device of the character described, a percussion cylinder, a percussion piston, a rotator bar, a cylinder in the said piston, and in which the rotator bar works, an element fitted to the rotator bar in sliding relation therewith, and carried by the piston, a piston in the cylinder in the said percussion piston, and self-engaging detachable connecting means between the second said piston and the said rotator bar.

16. In a device of the character described, a percussion cylinder, a percussion piston, a rotator bar, a cylinder in the said piston, and in which the rotator bar works, an element fitted to the rotator bar in sliding relation therewith, and carried by the piston, a piston in the cylinder in the said percussion piston, and a friction joint for detachably connecting the second said piston with the said rotator bar.

17. In a device of the character described, a percussion cylinder, a percussion piston, a rotator bar, a cylinder in the said piston, and in which the rotator bar works, an element fitted to the rotator bar in sliding relation therewith, and carried by the piston, a piston in the cylinder in the said percussion piston, and a conical friction joint for detachably connecting the second said piston with the said rotator bar.

18. In a rock drill, the combination with a main cylinder, a percussion piston freely mounted therein and having a longitudinal cylindrical cavity, and means for admitting elastic fluid into the cylinder alternately upon opposite sides of the said piston, of a rotator bar which enters the said cylindrical cavity, a hollow piston upon the end of the said rotator bar and fitted to the said cylindrical cavity, and a check valve in the said hollow piston, the said rotator bar having a channel therethrough which affords connection between the rear end of the main cylinder and the said hollow piston.

In testimony that I claim the foregoing I have hereunto set my hand.

CHARLES HERMAN HAESELER.

Witnesses:
G. B. PRINDLE,
M. LOBEL.