Jan. 2, 1923. 1,440,731.

E. G. GARTIN.

FLUID MOTOR.

ORIGINAL FILED JAN. 14, 1916.

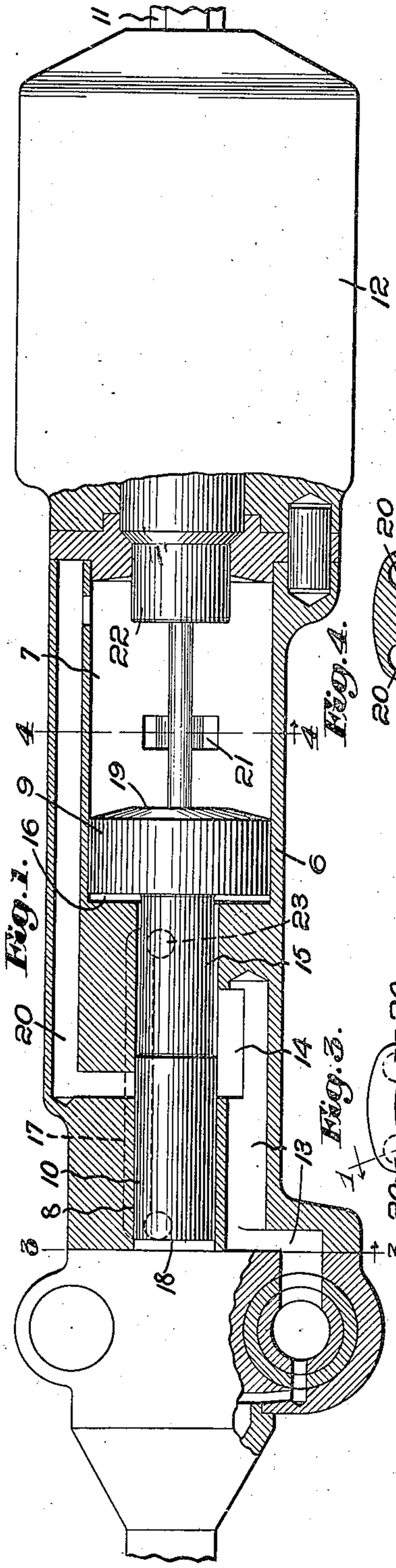

Fig. 1.

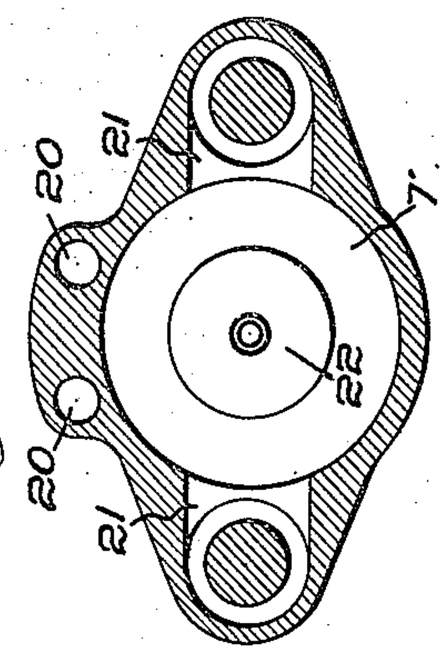

Fig. 4.

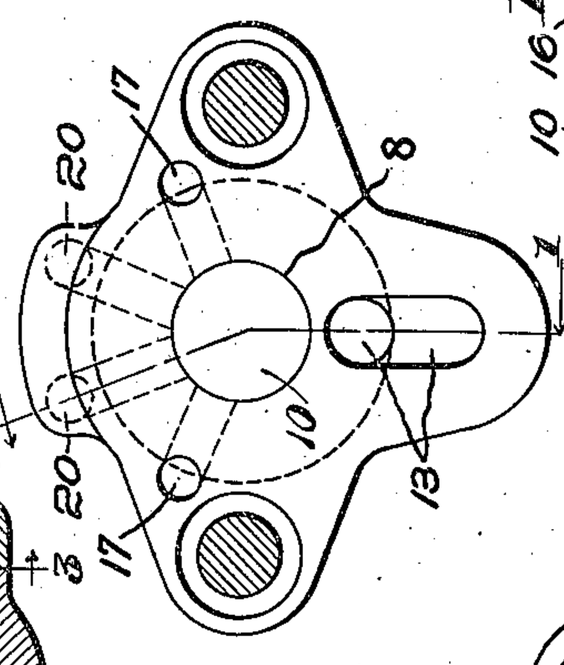

Fig. 3.

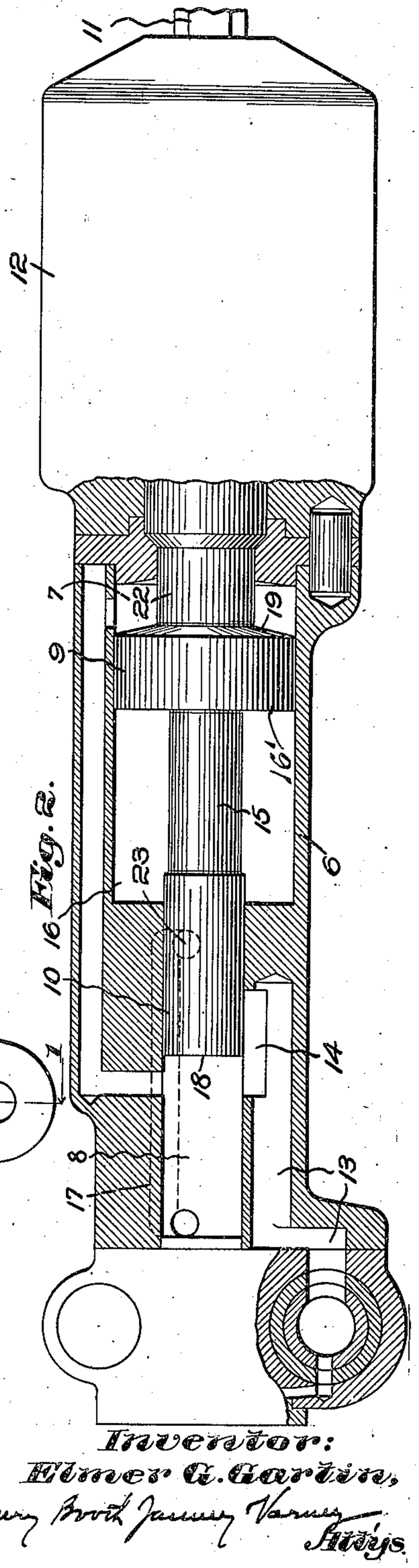

Fig. 2.

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UNITED STATES PATENT OFFICE.

ELMER G. GARTIN, OF CLAREMONT, NEW HAMPSHIRE, ASSIGNOR TO SULLIVAN MACHINERY COMPANY, OF CLAREMONT, NEW HAMPSHIRE, A CORPORATION OF MASSACHUSETTS.

FLUID MOTOR.

Application filed January 14, 1916, Serial No. 72,165. Renewed September 19, 1922. Serial No. 589,234.

To all whom it may concern:

Be it known that I, ELMER G. GARTIN, a citizen of the United States, and a resident of Claremont, county of Sullivan, State of New Hampshire (whose post-office address is Claremont, New Hampshire), have invented an Improvement in Fluid Motors, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention pertains to improvements in direct acting fluid motors for use in rock drills or other percussive tools and particularly though not exclusively, to valveless percussive fluid motors for use in hammer drills and the like.

A preferred construction of one embodiment of my invention is shown in the drawings and herein described for illustrative purpose, while the scope of my invention is more particularly pointed out in the appended claims.

In the drawings:

Figures 1 and 2 are partial longitudinal sections on the lines 1—1—1 of Fig. 3 of a preferred construction of the fluid motor of a hammer drill illustrative of one embodiment of my invention;

Figures 3 and 4 are sections thereof on the lines 3—3 and 4—4 respectively of Fig. 1.

Referring to the drawings I prefer to provide a motor cylinder 6 having a large piston chamber 7 and a small piston chamber 8 in which may reciprocate a piston having an enlarged head 9 and a smaller head 10. I preferably use the fluid motor herein described in connection with a drill steel 11, drill steel rotating means 12, pressure fluid feeding means and coordinated controlling mechanism, all substantially as invented by one George H. Gilman.

Pressure fluid is supplied to the fluid motor from any suitable source through a supply conduit 13 preferably opening into the smaller piston chamber 8 through a preferably elongated port 14 which is preferably so located as to connect at one extremity of the piston stroke with a grooved portion 15 of the piston and adapted to admit pressure fluid to the intermediate pressure receiving chamber 16, the pressure fluid acting on the area 16′ of the piston head 9 and tending to move the piston to the right. (See Figs. 1 and 2.) I preferably provide a by-pass port 17 to conduct pressure fluid to the small piston chamber 8 preferably at the rear end thereof as shown to act on the pressure receiving area 18 to assist in impelling the piston forward on its forward stroke. I prefer to return the piston by live air preferably acting expansively on the return pressure receiving area 19 and to this end I may provide a return passage 20 connecting with the rear piston chamber 8 and with the enlarged piston chamber 7. I preferably provide pressure fluid inlet means adapted to admit pressure fluid to the rear of the piston 10 when approaching the forward limit of its stroke, so that live pressure fluid can be supplied to the return pressure receiving area through the return port 20. This pressure fluid inlet means may, if desired, be combined with the inlet 14 by an elongation thereof and I have so shown it herein. I may supply a single exhaust port 21 to exhaust fluid from both pressure receiving areas of the piston head 9.

When my invention is used in connection with a hammer drill I prefer to interpose a striking plug 22 of a well-known type between the percussive piston and the drill steel 11. As shown in Figures 3 and 4, I prefer to use plural by-pass ports 17, return ports 20, and exhaust ports 21.

The embodiment of my invention illustrated, operates as follows: Assuming the piston to be in the position shown in Fig. 1, pressure fluid admitted through the supply port 14 passes around the reduced portion 15 of the piston into the intermediate pressure chamber 16, and acts on the piston, upon the area 16′ thereof, to impel the piston forward. Pressure fluid also passes through the port 23 into the by-pass port 17 and thence into the smaller piston chamber 8 to act upon the pressure area 18 to assist in driving the piston forward. After the piston has advanced a portion of its stroke, the supply port 14 is closed by the piston head 10 and the piston completes its working stroke by the expansive action of the pressure fluid. When the piston has nearly completed its forward stroke live pressure fluid is admitted to the front of the piston to act on the pressure area 19 to return the piston. I prefer to admit such fluid into the rear piston chamber 8 preferably through the port 14 and to conduct it

to the piston chamber 7 through the return port 20, all as shown in Fig. 2. The object of conducting the fluid supply for chamber 7 through the rear piston chamber 8 is to secure a delayed action of this pressure in chamber 7. If the ports 14 and 20 open into the cylinder chamber 8 sufficiently far toward the rear to insure a cut off late enough in the return stroke to provide sufficient fluid for chamber 7 to make a proper return stroke, some means must be provided to prevent excessive cushioning of the forward stroke by pressure entering chamber 7 during the latter part of the forward stroke after ports 14 and 20 are uncovered. I use the expansion of the pressure fluid for chamber 7 into the chamber 8, wherein the pressure has been much reduced by expansion, to accomplish the required delay in fluid transmission to chamber 7 after ports 14 and 20 are opened by the piston. After the return stroke has been started the ports 14 and 20 are closed by the piston head 10 and the return stroke is completed by the expansive force of the pressure fluid in the piston chamber 7, until the position shown in Fig. 1 is attained, after which the whole operation is repeated as described. At or about the time the port 14 is closed, the port 23 is opened so that the air which would otherwise be highly compressed in the smaller piston chamber 8 is permitted to flow through the passage 17 and around the recessed piston portion 15 to the intermediate chamber 16, so that the cushioning action of the compressed air is more evenly divided between the piston heads 18 and 9.

The very important feature of expansion into chamber 8, mentioned above, must now be noted in greater detail. The manner in which provision is made in a valveless tool for the supply of sufficient fluid for an effective return stroke while yet enabling the striking of a clean sharp blow uncushioned by pre-admission, and still taking advantage of a relatively great degree of expansion of the fluid which acts on the pressure surfaces of the piston in causing a forward stroke, is a feature of great importance. Considering the tool as with the parts in the position shown in Fig. 1, it will be seen that as the piston moves forward, the inlet port 14 will be closed after the piston has moved through about forty per cent of its stroke. From this instant to slightly after eighty per cent stroke, there will be expansion in chambers 7 and 8. There is thus a considerable reduction of pressure in chamber 8 of the cylinder, the pressure dropping, in doubling the volume due to expansion, to perhaps less than forty per cent of the initial pressure. It will thus be evident that the cushioning pressure on the opposite end of the piston must be kept at a minimum in order to avoid serious checking of the blow. After the head 9 of the piston closes the port 21, there will be a gradual building up of cushioning pressure by the compression of the trapped air in the forward end of the cylinder, but this pressure does not reach a height sufficient to seriously impede efficient striking, the pressure acting to cause the stroke exceeding, by a safe margin, the maximum cushioning pressure so caused. Now as the pressure in chamber 8 is very much below initial pressure, it will be obvious that on the opening of the rear end of the port 14 by the end of section 10 of the piston, chamber 8 acts as an expansion chamber located between the port 14 and the chamber 7. Owing to the expansion of the air from port 14 into this chamber, the cushioning action of the air passing through port 20 will be much delayed in the forward end of the cylinder, and the building up of pressure sufficient to cause material checking of the piston will not occur until after impact has taken place. On the return stroke, the ports 14 and 20 are closed simultaneously and the expansion of the air in the forward end of the cylinder is not reduced by an excessive clearance volume since the chamber 8 is out of communication with the port 20 during expansion. It is thus possible to locate the rear end of port 20 in such position as to provide an ample supply of fluid to accomplish an effective return stroke without unduly impeding the forward or striking movement of the piston.

The pressure area 16′ is preferably greater than the pressure area 18 and the return pressure area 19 is preferably equal to the combined area of the two opposed pressure areas. Thus the expansion of the pressure fluid is availed of on both forward and return strokes with resultant economy of pressure fluid. The construction illustrated permits the use of a relatively light piston with relatively large pressure areas and large ports, all of which contribute to the rapid, efficient and economical operation of the tool.

While I have shown and described one embodiment of my invention, it will be understood that changes involving omission, substitution, alteration, rearrangement or reversal of elements, may be made without departing from the scope of my invention.

My invention and what I desire by Letters Patent to procure is defined in the following claims:

1. In a motor, a cylinder, a piston reciprocable therein, an inlet port, fluid distributing means comprising means for conducting fluid therefrom to the opposite ends of said cylinder, means alternately connecting and interrupting a connection of said conducting means to said inlet port, a chamber intermediate the inlet port and one end

of said cylinder into which the fluid pressure supply expands in passing to said last mentioned end but communicable therewith only during admission thereto, and exhaust means for said motor.

2. In a percussive motor, a cylinder, a piston reciprocable therein, an inlet port, fluid distributing means comprising means for conducting fluid from said inlet port to one end of the cylinder to cause said piston to strike a blow, means for conducting fluid from said inlet port to the opposite end of said cylinder to produce a return stroke, a chamber between said inlet port and said last mentioned end of the cylinder into which the fluid expands in passing to the latter, and exhaust means for said motor communicable with said second mentioned conducting means but not with said chamber.

3. In a motor, a cylinder, a piston reciprocable therein, an inlet port, fluid distributing means comprising means for conducting fluid therefrom to one end of the cylinder during a portion of one pass of the piston, means for conducting fluid to the opposite end of said cylinder from said inlet port during a portion of the alternate pass of the piston, a chamber between said inlet port and said last mentioned end of the cylinder into which the fluid expands in passing to the latter, means for closing communication between said expansion chamber and said last mentioned end of the cylinder during expansive action of the fluid simultaneously with the interruption of the supply of fluid thereto, and exhaust means for said motor.

4. In a fluid pressure percussive rock drill, a cylinder, a piston therein, and fluid distributing means comprising means for causing expansive action of fluid pressure on the forward movement of the piston, and means for admitting pressure to the forward end of said cylinder prior to the completion of the forward movement of the piston, said first mentioned means being operative to minimize cushioning in the forward end of said cylinder.

5. In a fluid pressure percussive rock drill, a cylinder, a piston therein, and fluid distributing means comprising means for causing expansive action of fluid pressure on the forward movement of the piston whereby a reduced pressure is produced in the rear end of said cylinder, and means opened prior to the completion of the forward movement of the piston for conducting fluid pressure for the other end of said cylinder through said reduced pressure space whereby cushioning on the forward stroke is minimized.

6. In a fluid pressure percussive rock drill, a cylinder, a piston therein, and fluid distributing means comprising means for causing expansive action of fluid pressure on the forward movement of the piston whereby a reduced pressure is produced in the rear end of said cylinder, means opened prior to the completion of the forward movement of the piston for conducting fluid pressure for the other end of said cylinder through said reduced pressure space whereby cushioning on the forward stroke is minimized, and means for closing communication between said reduced pressure space and the front end of said cylinder simultaneously with the termination of fluid supply thereto whereby the clearance volume of the latter is not increased.

7. In a fluid pressure percussive rock drill, a cylinder, a piston therein, and fluid distributing means comprising means for causing expansive action of fluid pressure on the forward movement of the piston whereby a reduced pressure is produced in the rear end of said cylinder, means opened prior to the completion of the forward movement of the piston for conducting fluid pressure for the other end of said cylinder through said reduced pressure space whereby cushioning on the forward stroke is minimized, and means for closing communication between said reduced pressure space and the front end of said cylinder simultaneously with the termination of fluid supply thereto whereby the ratio of expansion is not decreased by excess clearance volume.

8. A percussive fluid motor comprising, in combination, a cylinder having coaxial bores of different diameters, a piston having heads fitting said bores, said heads cooperating with said bores to form a small chamber, a large chamber and an intermediate chamber, and fluid distributing means for said motor comprising conduit means communicating with said small chamber and adapted for connection to said intermediate chamber, an inlet communicable with said small chamber, and means for placing said conduit in communication with said intermediate chamber when communication between said inlet and said small chamber is closed.

9. A fluid motor comprising a cylinder, a piston therein, said cylinder and piston providing opposite relatively large and small pressure chambers and an intermediate pressure chamber, and pressure fluid supplying and distributing means associated with said cylinder and controlled by said piston, said means comprising a fluid inlet, a passage connecting said opposite pressure chambers, a passage opening into one end of the smaller chamber, and means adapted to connect said small and intermediate pressure chambers by way of said last mentioned passage, said piston being movable into opposite positions to place either of said passages in communication with said inlet while closing the other of said passages.

10. A fluid motor comprising a cylinder, a piston therein, said cylinder and piston providing opposite relatively large and small pressure chambers and an intermediate pressure chamber, and pressure fluid supplying and distributing means associated with said cylinder and controlled by said piston, said means comprising a fluid inlet, a passage connecting said opposite pressure chambers, a passage opening into the smaller chamber, and means adapted to connect said small and intermediate pressure chambers by way of said last mentioned passage, said piston being movable into opposite positions to place one end of either of said passages in communication with said inlet while covering one end of the other of said passages.

11. A fluid motor comprising a cylinder having opposite portions of relatively large and small cross sectional area, a piston having relatively large and small heads fitting said cylinder portions respectively and an intermediate reduced portion, and pressure fluid supplying and distributing means associated with said cylinder and controlled by said piston, said means comprising a fluid inlet communicating with said small cylinder portion, a passage connecting the opposite ends of said small cylinder portion, and a passage connecting said large and small cylinder portions, said piston when in opposite positions alternatively placing one or the other of said passages in communication with said inlet while closing the remaining passage.

12. A fluid motor comprising a cylinder having opposite portions of relatively large and small cross sectional area, a piston having relatively large and small heads fitting said cylinder portions respectively and an intermediate reduced portion, and pressure fluid supplying and distributing means associated with said cylinder and controlled by said piston, said means comprising a fluid inlet communicating with said small cylinder portion, a passage connecting the opposite ends of said small cylinder portion, and a passage connecting said large and small cylinder portions, the small head of said piston when in one position covering one end of one of said passages while placing the adjacent end of the other of said passages in communication with said inlet, and in another position covering the end of said last named passage while placing the end of said first named passage in communication with said inlet.

13. A percussive fluid motor comprising, in combination, a cylinder having coaxial bores of different diameters, a piston having portions fitting said bores, said portions cooperating with said bores to form a pair of chambers of different diameters in which fluid may act to effect a forward stroke and a single chamber in which fluid may act to effect a return stroke, and fluid distributing means for said motor comprising conduit means controlled by said piston through which said pair of chambers are intermittently connected, an inlet communicable with said smaller cylinder bore, and a groove in said piston operative to bring said inlet into communication with said pair of chambers, said parts being constructed and arranged to permit communication between said pair of chambers at a time when neither communicates with said inlet.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

ELMER G. GARTIN.

Witnesses:

THEODORE B. JOHANNIS,

ROBERT E. CROSS.