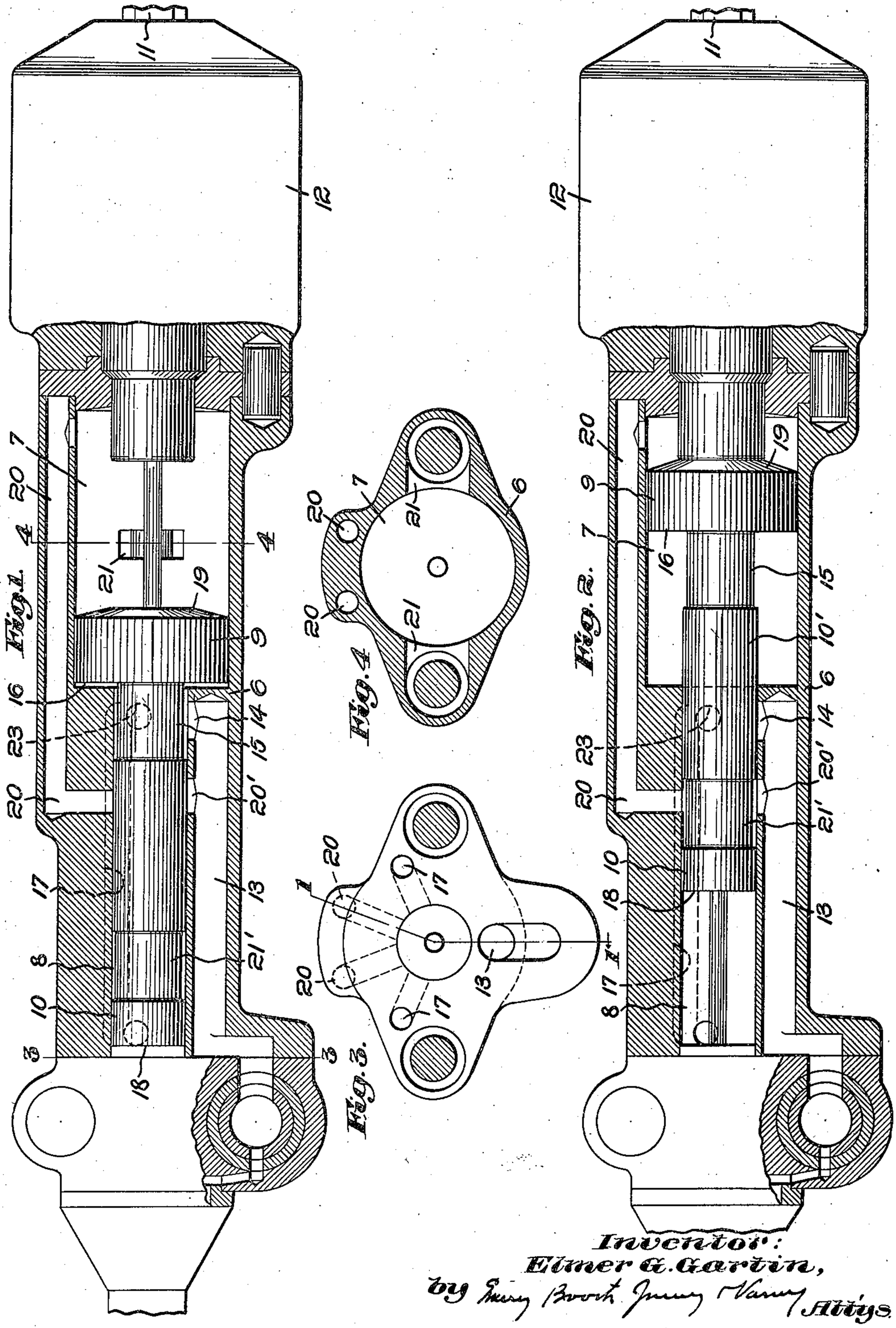
Jan. 2, 1923. 1,440,730.

E. G. GARTIN.

FLUID MOTOR.

ORIGINAL FILED JAN. 14, 1916.



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by Emery Booth Jenney & Vaney Attys.

Patented Jan. 2, 1923. 1,440,730

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. 72,164. Renewed July 18, 1921. Serial No. 485,790.

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 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, which parts may be of any suitable construction and arrangement and, specifically, constitute no part of the present invention.

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 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 area 16 of the piston head 9. I preferably provide a by-pass port 17 to conduct pressure fluid to and from 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. The forward point of communication of this by-pass port with the bore 8 is so disposed relative to the inlet port 14 that the latter is connected with the chamber 7 before, and remains connected therewith after, the port 23. There is thus communication between the fluid supply and the two forwardly acting pressure areas for different proper fractional portions of the 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 adapted to conduct fluid from the rear pressure fluid supply port 13 to the enlarged piston chamber 7. I preferably provide pressure fluid inlet means 20′ adapted to admit pressure fluid to a groove 21′ when the piston is 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. 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 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 and acts upon the intermediate pressure receiving area 16 to impel the piston forward. A small quantity of pressure fluid also passes through the port 23 into the by-pass port 17 and thence, after the initial forward movement of the piston, into the smaller piston chamber 8 to prevent the formation of a vacuum in said piston chamber, and also, to some extent, 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 ports 14 and 23 are 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 piston groove 21′, preferably through the port 20′, and to conduct it to the piston chamber 7 through the return port 20, all as shown in Fig. 2. At this time the air trapped in the piston chamber 8 by the covering of the port 23 by the piston portion 10′ is so fully expanded as to exert only a negligible pressure on the piston surface 18, which pressure is much more than overcome by the live pressure acting on the greater piston area 19. After the return stroke has been started, the ports 20′ 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. As the piston approaches the limit of its rearward stroke, the trapped air in the piston chamber 8 is again compressed, thereby cushioning said stroke, and when the port 23 is again uncovered by the piston portion 10′, said air will have been compressed to substantially its original extent, balancing the inlet pressure so that no additional air will be admitted to the chamber 8 except sufficient to compensate for leakage.

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. In the construction illustrated the pressure fluid admitted to the chamber 7 does not act upon the pressure area 18 of the piston head 10 as in my copending application filed Jan. 14, 1916, Serial No. 72165. This effects a saving in pressure fluid and permits me to return the piston without the resistance of live air pressure on any opposing pressure surface until the limit of the return stroke is nearly reached.

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. A valveless percussive fluid motor comprising in combination, a cylinder of two inside diameters; a piston of two outside diameters therefor; said piston presenting a plurality of pressure areas effective to receive pressure to move said piston in one direction and a single pressure area effective to receive pressure to move said piston in the opposite direction; live pressure fluid supply means; and piston controlled pressure fluid distributing means effective to supply live pressure fluid to said single pressure area while withholding live pressure fluid from said plurality of pressure areas and closing communication between said last named areas.

2. A valveless percussive fluid motor comprising, in combination, a cylinder of two diameters; a piston of two diameters therefor; said cylinder and piston presenting a plurality of pressure chambers effective to receive pressure fluid to move said piston in one direction and a single pressure chamber effective to receive pressure to move said piston in the opposite direction; pressure fluid supply means; pressure fluid distributing means comprising separate conduit means leading to each of said piston chambers, each of said conduit means being individually controlled by said piston; and a plurality of reduced portions in the smaller diameter part of said piston intermittently effective to connect said pressure fluid supply means with said distributing means.

3. A valveless percussive fluid motor comprising, in combination, a cylinder providing a large piston chamber and a smaller piston chamber; a piston therefor, having a large piston head reciprocable in said large piston chamber, and a smaller piston head reciprocable in said smaller piston chamber; said cylinder and piston providing three pressure receiving chambers, two of which receive pressure to actuate said piston in one direction, and the third of which receives pressure to actuate said piston in the opposite direction; and piston controlled conduit means providing for the admission of live pressure fluid to the last named pressure receiving chamber, while withholding live pressure fluid from the other two pressure receiving chambers and closing communication between said last named chambers.

4. A percussive fluid motor comprising, in combination, a cylinder of two diameters, a piston of two diameters therefor, said cylinder and piston providing three pressure chambers large, small and intermediate; and piston controlled pressure fluid distributing conduit means providing initial admission of live pressure fluid to said small and intermediate pressure chambers, thereafter the

admission of live pressure fluid to said intermediate pressure chamber alone, and the subsequent admission of live pressure fluid to said large pressure chamber while withholding live pressure fluid from said small and intermediate pressure chambers.

5. A valveless percussive fluid motor comprising, in combination, a cylinder providing a large piston chamber and a smaller piston chamber; a piston therefor, having a large piston head reciprocable in said large piston chamber, and a smaller piston head reciprocable in said smaller piston chamber; said cylinder and piston providing three pressure receiving chambers, two of which receive pressure to actuate said piston in one direction, and the third of which receives pressure to actuate said piston in the opposite direction; separate piston controlled conduit means for admitting fluid to each of said two first named pressure receiving chambers; and piston controlled conduit means providing for the admission of live pressure fluid to the last named pressure receiving chamber, said last named piston controlled conduit means being independent of said first named piston controlled conduit means.

6. A valveless percussive fluid motor comprising, in combination, a cylinder providing a large piston chamber and a smaller piston chamber; a piston therefor having a large piston head reciprocable in said large piston chamber and a smaller piston head reciprocable in said smaller piston chamber, an intermediate piston portion intermediate said large head and said smaller head and fitting said smaller piston chamber; a pressure conducting reduced piston portion between said intermediate piston portion and said larger head; a pressure conducting reduced piston portion between said intermediate portion and said smaller piston head; fluid inlet means; port means alternately opened to said fluid inlet means by said pressure conducting reduced piston portions respectively and closed to live pressure fluid by said intermediate piston portion, whereby pressure fluid is alternately admitted to oppositely effective pressure surfaces of said larger piston head to produce reciprocating movement of said piston; and separate port means to conduct pressure to said smaller piston head during admission to the adjacent side of said larger head, said last mentioned port means being closed at all other times by said intermediate piston portion.

7. A percussive fluid motor comprising, in combination, a cylinder of two diameters, a piston of two diameters therefor, said piston presenting a plurality of pressure areas effective to receive pressure to move said piston in one direction and a single pressure area effective to receive pressure to move said piston in the opposite direction, live pressure fluid supply means, and pressure fluid distributing means effective to supply live pressure fluid to said plurality of pressure areas and to close communication between them.

8. A valveless percussive fluid motor comprising, in combination, a cylinder of two diameters; a piston of two diameters therefor; said cylinder and piston presenting a plurality of piston chambers effective to receive pressure fluid to move said piston in one direction and a single pressure chamber effective to receive pressure to move said piston in the opposite direction; pressure fluid supply means including separate piston controlled conduit means for admitting fluid to said piston chambers; pressure fluid distributing means; and a plurality of reduced portions in a smaller diameter part of said piston intermittently effective to connect said pressure fluid supply means with said distributing means, said reduced portions controlling separate fluid inlets, respectively.

9. A valveless percussive fluid motor comprising, in combination, a cylinder of two diameters, a piston of two diameters therefor, said cylinder and piston presenting a plurality of piston chambers effective to receive fluid pressure to move said piston in one direction and a single pressure chamber effective to receive pressure to move said piston in the opposite direction, pressure fluid inlet means, separate conduit means leading to each of said piston chambers, the connection of each of said conduit means with said inlet means being individually controlled by the piston to effect expansive action of the pressure fluid in each of said pressure chambers and to close communication between all of said chambers except during their connection with the inlet means.

10. A valveless percussive fluid motor comprising, in combination, a cylinder providing a large piston chamber and a smaller piston chamber, a piston therefor having a large piston head reciprocable in said large piston chamber and a smaller piston head reciprocable in said smaller piston chamber, an intermediate piston portion intermediate said large head and said smaller head and fitting said smaller piston chamber, a pressure conducting reduced piston portion between said intermediate piston portion and said larger head, a pressure conducting reduced piston portion between said intermediate portion and said smaller piston head, fluid inlet means, port means alternately opened to communication with said fluid inlet means by said pressure conducting reduced piston portions and closed to live pressure fluid by said intermediate piston portion whereby pressure fluid is alternately admitted to oppositely effective surfaces of

said larger piston head to produce reciprocating movement of said piston, and a separate port leading to said smaller piston head and opened by said first named reduced piston portion to communicate with said inlet means and with the adjacent side of said larger head during admission to the latter and closed at all other times by said intermediate piston portion.

11. A valveless fluid operated motor comprising a cylinder, a piston therein having a pair of pressure receiving areas adapted to receive pressure to effect the strokes in one direction and a single pressure receiving area to receive pressure to effect the opposite strokes, fluid distribution means operative to supply live pressure continuously from the beginning of said first mentioned strokes for different proper fractional portions of such strokes to said pair of pressure receiving areas respectively, and means for admitting pressure to the third mentioned pressure receiving area to effect said second mentioned strokes.

12. A valveless fluid operated motor comprising a cylinder, a piston therein having a pair of pressure receiving areas adapted to receive pressure to effect a stroke in one direction and a single pressure receiving area to effect the opposite stroke, means for admitting live pressure to said pair of pressure receiving areas from the beginning of and for respectively different fractional portions of said first mentioned stroke, means for directly exhausting the pressure acting upon but one of the pressure areas, and means for admitting live pressure to the third mentioned pressure receiving area to effect a return stroke.

13. A fluid operated motor comprising, in combination, a cylinder, a piston therein having a pair of pressure receiving areas adapted to receive pressure to effect the stroke in one direction, one of said areas being materially larger than the other, and a single pressure receiving area to receive pressure to effect the opposite stroke, means operative to connect said pair of pressure receiving areas with inlet pressure from the beginning of and for different proper fractional portions respectively of the strokes in one direction, means for exhausting the fluid which is acting upon the larger of said areas adjacent the end of the stroke in that direction, and means for supplying and exhausting pressure fluid to act upon the third mentioned pressure receiving area.

14. A fluid operated motor comprising, in combination, a cylinder, a piston therein having a pair of pressure receiving areas adapted to receive pressure to effect the strokes in one direction, one of said areas being materially larger than the other, and a single pressure receiving area to receive pressure to effect the opposite stroke, said area being equal to the sum of said first mentioned areas, means for connecting said pair of pressure receiving areas with a source of fluid pressure from the beginning of and respectively for different fractional portions of the stroke in one direction, means for exhausting the fluid which acts upon the larger of said areas adjacent the end of the stroke, and means for supplying and exhausting pressure fluid to act upon the third mentioned pressure receiving area.

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

ELMER G. GARTIN.

Witnesses:
D. A. CABOT,
THEODORE B. JOHANNIS.