Aug. 25, 1936. E. G. GARTIN 2,051,839

PRESSURE FLUID MOTOR

Filed Aug. 17, 1934

Fig. 1

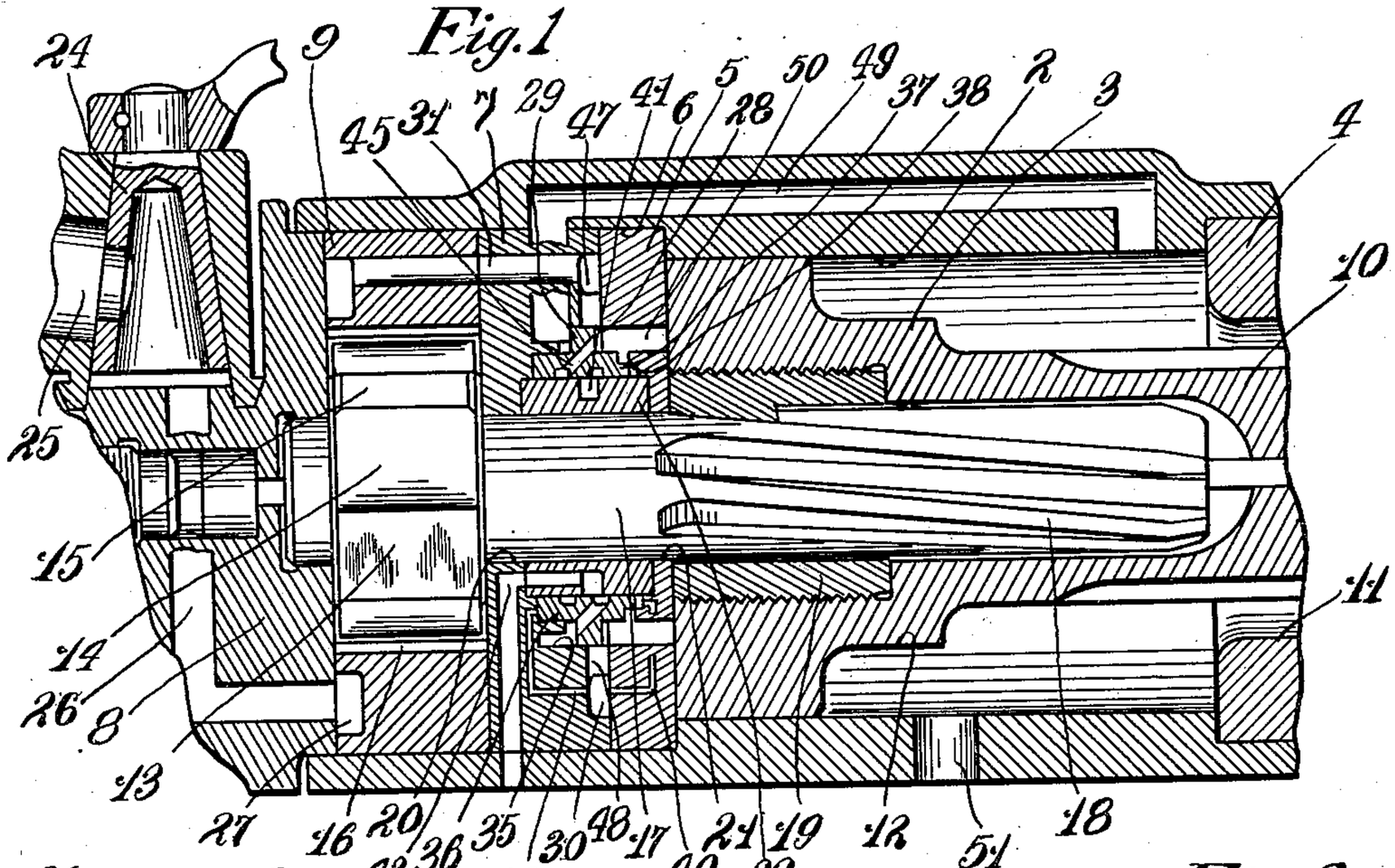


Fig. 2

Fig. 3

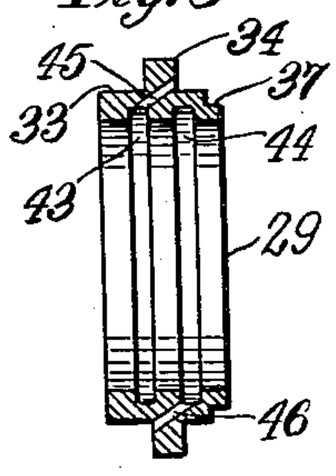


Fig. 4

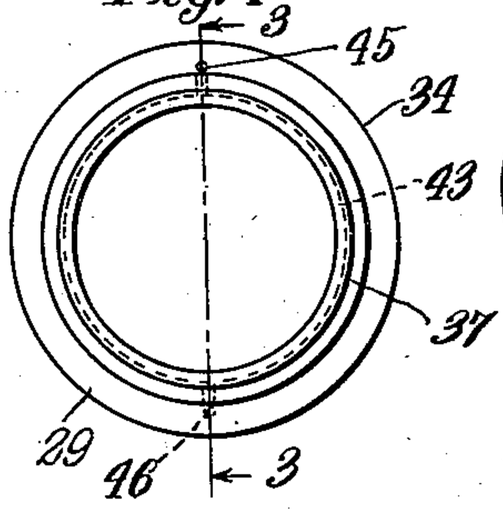


Fig. 5

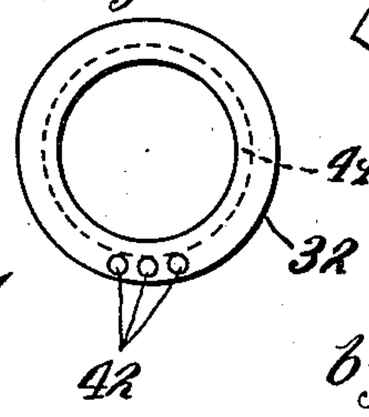
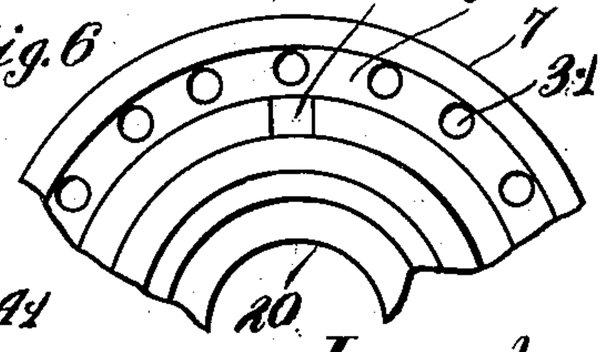


Fig. 6



Inventor
Elmer G. Gartin
by Louis A. Mixsan,
Att'y.

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PRESSURE FLUID MOTOR

Elmer G. Gartin, Claremont, N. H., assignor to Sullivan Machinery Company, a corporation of Massachusetts

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20 Claims. (Cl. 121—19)

This invention relates to pressure fluid motors, and more particularly to improvements in pressure fluid motors of the percussive type.

An object of this invention is to provide an improved pressure fluid motor having improved fluid distribution means. Another object is to provide an improved fluid distribution means for a pressure fluid motor of the reciprocating motor piston, percussive type. A further object is to provide an improved fluid distributing valve mechanism for such a motor. Yet another object of this invention is to provide an improved pressure fluid percussive motor particularly designed to use in rock drills of the hammer type. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawing there is shown for purposes of illustration one form which the invention may assume in practice.

In this drawing,—

Fig. 1 is a central, longitudinally extending view showing the illustrative embodiment of the improved pressure fluid motor.

Fig. 2 is a view similar to Fig. 1 showing the motor parts in a different position.

Fig. 3 is a detail axial sectional view through the distributing valve.

Fig. 4 is an end elevational view of the fluid distributing valve.

Fig. 5 is an end elevational view of the valve guide sleeve.

Fig. 6 is a fragmentary end elevational view of one of the valve chest plates.

In this illustrative embodiment of the invention, there is shown a pressure fluid motor of the reciprocating motor piston, percussive type especially designed to use in hammer rock drills and comprising a cylinder 1 having a bore 2 containing a reciprocatory motor piston 3. The motor cylinder is provided with a front head 4 and a rear head plate 5, the latter herein arranged in an enlarged bore 6 alined with the cylinder bore 2. Also arranged in the bore 6 and abutting the rear surface of the plate 5 is a valve chest plate 7, while arranged between the rear surface of the plate 7 and a rear head block 8 is an annulus 9. The parts, 4, 5, 7, 8 and 9 are held in assembled relation with respect to the motor cylinder in any suitable manner. As is usual in rock drill hammer motors, the piston 3 is provided with a forwardly projecting striking bar 10 adapted to deliver impact blows to a suitable working instrument such as a rock drill steel, this striking bar extending through a bore 11 formed in the front head 4 and having an enlarged portion 12 adapted slidingly to fit within the bore 11 when the piston is in its forward position in the manner shown in Fig. 2. As is also usual in rock drill hammer motors, rotative movement is imparted to the hammer piston to effect rotation of the working instrument by means of a ratchet and pawl mechanism 13 of a well known design, comprising an oscillatory pawl carrier 14 carrying pawls 15 adapted to engage ratchet teeth 16 formed on the inner periphery of the annulus 9. Integral with the pawl carrier 14 is a forwardly projecting rotation bar 17 having spiral grooves 18 cooperating with a spiral rifle nut 19 fixed within the hammer piston, this rotation bar extending axially through bores 20 and 21 formed in the plates 7 and 5, respectively. As the particular piston striking bar and rotation mechanism structure does not per se enter into this invention other than the particular association of the valve mechanism with respect thereto, further detailed description thereof is deemed unnecessary.

Now referring to the fluid distribution means for effecting reciprocation of the motor piston, it will be noted that carried by the rear head block 8 is a throttle valve 24 for controlling the supply of pressure fluid from a passage 25 communicating with a suitable pressure fluid source, to a passage 26 communicating with an annular groove or recess 27 formed in the rear face of the annulus 9. The abutting plate elements 5 and 7 cooperate to form a valve chest and are suitably axially bored or recessed to provide a valve chamber 28 in which is reciprocably mounted a fluid distributing valve, generally designated 29, of an improved design. Formed in the forward face of the plate 7 is an annular groove or recess 30 communicating through passages 31 with the fluid supply groove 27. Surrounding the rotation bar 17 and forming a guide for the distributing valve 29 is a sleeve or bushing 32 suitably seated at its ends within annular recesses formed in the adjacent faces of the cooperating valve chest plates 5 and 7. The improved fluid distributing valve is herein of the reciprocating sleeve type having a sleeve-like body portion 33 and an external annular flange 34 formed on the valve body intermediate the ends of the latter, the external periphery of this flange having a sliding fit with the larger bore 35 of the valve chamber. The rear end portion of the valve body has a sliding fit in a bore 36 formed in the plate 7, while the forward end of the valve body has a reduced annular flange 37 having a sliding fit in a reduced bore 38 formed in the rear face of the plate 5.

The reduced flange 37 forms a reduced pressure area at the forward end of the valve body substantially smaller than the pressure area on the rear end of the valve body, thereby providing for differential throwing action as hereinafter described. Leading from the recess 30 to the rear end of the valve chamber is a constant pressure passage 39, while a similar passage 40 connects the recess 30 with the forward end of the valve chamber at the reduced end of the valve body, these passages supplying pressure fluid to act constantly on the differential pressure areas of the valve body. The bushing or sleeve 32 is externally grooved at 41 midway between its ends, and this groove is connected by passages 42 to exhaust. The valve body is internally grooved at 43 and 44, the groove 43 being connected by a diagonal passage 45 in the valve with the valve chamber at the forward side of the flange 34 and the groove 44 being connected by a diagonal passage 46 with the valve chamber at the rear side of the flange 34. The annular groove or recess 30 communicates with the valve chamber through radial passages 47 and 48 in the front face of the plate 7, one of which is clearly shown in Fig. 6, and these passages are controlled by the central valve flange 34. Communicating with the valve chamber at the rear side of the valve flange 34 is a passage 49 leading to the forward end of the cylinder bore, while communicating with the valve chamber at the forward side of the valve flange 34 are longitudinal passages 50, 50 leading directly through the plate 5 to the rear end of the cylinder bore. The motor cylinder is provided with a central, piston controlled, free exhaust port 51.

In the operation of the improved pressure fluid motor, when the parts are in the position shown in Fig. 1, pressure fluid flows through passages 25, 26 groove 27, passage 31, groove 30, passages 47, 48 through the valve chamber past the forward surface of the central flange 34 and thence through passages 50 to the rear end of the cylinder bore to act on the rear pressure area of the motor piston to drive the latter forwardly. At this time the forward end of the cylinder bore is connected to exhaust through the central exhaust port 51 and through passage 49, through the valve chamber, diagonal passage 46, annular groove 41 and passages 42 leading to exhaust. The pressure fluid acting on the forward pressure area of the central valve flange 34 and the reduced differential pressure area at the forward end of the flange 37 holds the valve in the position shown. As the hammer piston moves forwardly the head of the motor piston overruns the exhaust port 51, closing communication of this port with the forward end of the cylinder bore and as forward movement of the piston continues, opening communication between the rear end of the cylinder bore with the atmosphere. The connecting of the rear end of the cylinder bore to exhaust causes a sudden drop in pressure at the rear side of the hammer piston and at the forward side of the valve flange 34, and as a result the constant pressure flowing through passage 39 to the rear pressure area of the valve body throws the valve forwardly from the position shown in Fig. 1 to the position shown in Fig. 2. When the parts are in the position shown in Fig. 2, pressure fluid flows through passages 25, 26, groove 27, passage 31, groove 30, passages 47 and 48, through the valve chamber past the rear surface of the valve flange 34, and thence through passage 49 to the forward end of the cylinder bore to act on the forward pressure area of the motor piston to drive the latter rearwardly. The valve is held in this position by the pressure fluid acting on the rear surface of the central flange 34 and the constant pressure acting on the rear pressure area of the valve body. At this time the rear end of the cylinder bore is connected to exhaust through port 49 and through passages 50, diagonal port 45 in the valve, groove 41 and exhaust passages 42. As the motor piston moves rearwardly the piston head overruns the exhaust port 49 cutting off communication of the rear end of the cylinder bore to atmosphere, and upon continued movement of the piston opening the forward end of the cylinder bore to atmosphere. This causes a sudden drop in pressure in the rear end of the cylinder bore and in passage 49 and the valve chamber at the rear side of the central flange 34, and as the motor piston continues to move rearwardly a relatively high pressure is built up within the rear end of the cylinder bore, which, together with the constant pressure acting on the forward pressure area of the reduced flange 37, acts on the valve to throw the latter rearwardly from the position shown in Fig. 2 to the position shown in Fig. 1. The above operations are rapidly repeated during normal operation of the motor.

As a result of this invention, it will be noted that an improved pressure fluid motor is provided having improved fluid distribution means whereby the action of the motor piston is materially improved. It will further be noted that the improved valve mechanism is of an extremely simple design, requiring a relatively small number of component parts, and due to its simplicity may be manufactured at a minimum of expense and readily kept in repair. These and other uses and advantages of the improved pressure fluid motor will be clearly apparent to those skilled in the art.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber and having an axial bore extending therethrough, a member concentric with said valve within the bore of the latter and relative to which said valve is reciprocable, said member extending through the valve chamber, passage means comprising passages controlled by said valve for supplying pressure fluid to the opposite ends of said cylinder, and vent passage means including passages formed internally within said valve and cooperating passages in said concentric member for alternatively connecting said first mentioned passages to the exhaust.

2. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber and having an axial bore extending therethrough, a member concentric with said valve within the bore of the latter and relative to which said valve is

reciprocable, said member extending through the valve chamber, passage means comprising passages controlled by said valve for supplying pressure fluid to the opposite ends of said cylinder, and vent passage means including passages formed internally within said valve and cooperating passages in said concentric member for alternatively connecting said supply passages to the exhaust, one of said vent passages formed in the valve venting one of said supply passages when said valve is in one position and the other vent passage venting the other of said supply passages when the valve is in its opposite position.

3. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber and having an axial bore extending therethrough, a bushing coaxial with and arranged within the bore in said valve and forming a guide for the latter, said bushing extending through the valve chamber, passage means including passages controlled by said valve for supplying pressure fluid to the opposite ends of said cylinder, and passage means formed in said valve and bushing for alternatively connecting said passages to the exhaust to vent the opposite ends of said cylinder alternatively through said passages.

4. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber, a bushing coaxial with said valve and forming a guide for the latter, passage means including passages controlled by said valve for supplying pressure fluid to the opposite ends of said cylinder, and passage means formed in said valve and bushing for alternatively connecting said passages to the exhaust and including vent ports formed in said valve and a vent groove formed in said bushing, one of said vent ports being communicable with said vent groove to vent one of said supply passages when said valve is in one position and another vent port communicable with said vent groove for venting the other of said supply passages when the valve is in its opposite position.

5. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber comprising a sleeve-like body and a central external flange, passage means including passages controlled by said valve flange for supplying pressure fluid to the opposite ends of said cylinder, and means formed in said valve for alternatively connecting said supply passages to the exhaust.

6. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber comprising a sleeve-like body and a central external flange, passage means including passages controlled by said valve flange for supplying pressure fluid to the opposite ends of said cylinder, and means formed in said valve for alternatively connecting said supply passages to the exhaust and including vent ports extending through the valve flange and communicating respectively with the pressure areas at the opposite sides of said flange, one of said vent ports connecting one of said supply passages to exhaust when the valve is in one position and the other of said vent ports connecting the other of said supply passages to exhaust when the valve is in its opposite position.

7. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber and having a sleeve-like body, a central external flange, passage means including passages communicating with the valve chamber at the opposite sides of said valve flange and leading respectively to the opposite ends of the cylinder bore, said flange controlling communication of said supply passages with a source of fluid supply, and vent means controlled by said valve for alternatively connecting said supply passages to atmosphere.

8. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber, passage means including passages controlled by said valve for supplying pressure fluid to the opposite ends of said cylinder, and means controlled by said valve for alternatively connecting said supply passages to the exhaust, said vent means including internal grooves in said valve, passages connecting said grooves respectively with the opposite ends of said valve chamber, and vent means with which said grooves are alternatively communicable.

9. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber, a coaxial bushing in which said sleeve valve is guided, passage means including passages controlled by said valve for supplying pressure fluid to the opposite ends of said cylinder, and means controlled by said valve for alternatively connecting said supply passages to the exhaust including annular grooves formed internally within said valve, passages connecting said grooves respectively with the opposite ends of the valve chamber, and a passage in said bushing with which said grooves are alternatively communicable.

10. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber, a coaxial bushing on which said sleeve valve is guided, passage means including passages controlled by said valve for supplying pressure fluid to the opposite ends of said cylinder, and means controlled by said valve for alternatively connecting said supply passages to the exhaust including annular vent grooves formed internally within said valve, passages connecting said grooves, respectively, with the opposite ends of the valve chamber, an annular groove formed externally on said guide bushing and with which said first mentioned annular grooves are alternatively communicable, and a passage for connecting said last mentioned groove to the atmosphere.

11. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber and having a sleeve-like body and a central external flange, passage means comprising

passages controlled by said valve flange for supplying pressure fluid to the opposite ends of said cylinder, and means controlled by said valve for alternatively connecting said supply passages to the exhaust and including annular grooves formed internally within said valve body, passages connecting said grooves respectively with the valve chamber at the opposite sides of said central flange, and vent means with which said grooves are alternatively communicable.

12. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber and having a sleeve-like body portion and a central external flange, said valve body having formed thereon at its opposite ends differential pressure areas, means for supplying constant pressure to said pressure areas, passage means, one for each end of the cylinder, controlled by said valve for conducting pressure fluid to the opposite ends of said cylinder, and vent means controlled by said valve for alternatively connecting said passage means to the exhaust.

13. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, the latter having an enlarged centrol bore and reduced end bores, a valve reciprocable in said valve chamber and having an enlarged central portion fitting said enlarged bore and reduced end portions fitting said reduced bores, passage means comprising passages controlled by said valve for supplying pressure fluid to the opposite ends of said cylinder, and means formed in said valve for alternatively connecting said passages to the exhaust.

14. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber and traversed by a bore, means extending within the bore of said valve and forming a guide for the latter, passages means including passages controlled by said valve for supplying pressure fluid to the opposite ends of said cylinder, and passage means associated with said valve and said valve guiding means for alternatively connecting said passages to exhaust to vent the opposite ends of said cylinder alternatively through said passages.

15. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber and comprising a sleeve-like body and a central external flange, passage means including passages controlled by said valve flange for supplying pressure fluid to the opposite ends of said cylinder, and means controlled by said valve for alternatively connecting said supply passages to the exhaust.

16. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber and comprising a sleeve-like body and a central external flange, passage means including passages controlled by said valve flange for supplying pressure fluid to the opposite ends of said cylinder, means controlled by said valve for alternatively connecting said supply passages to the exhaust comprising internal passage means in the valve, a passage for connecting the valve at one side of said flange with said internal passage means, and a passage connecting the valve at the opposite side of said flange with said internal passage means.

17. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber and comprising a sleeve-like body and a central external flange, passage means including passages controlled by said valve flange for supplying pressure fluid to the opposite ends of said cylinder, means controlled by said valve for alternatively connecting said supply passages to the exhaust comprising annular front and rear grooves formed internally in said valve, and passages connecting the rear groove with the forward side of said valve flange and the front groove with the rear side of said valve flange.

18. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber, means coaxial with said valve and extending therewithin and forming a guide for said valve, passage means including passages controlled by said valve for supplying pressure fluid to the opposite ends of said cylinder, and passage means formed in said valve and said guiding means for alternatively connecting said supply passages to the exhaust and including vent ports formed in said valve, a vent passage formed in said guiding means, one of said vent ports being communicable with said vent passage to vent one of said supply passages when said valve is in one position and another vent port communicable with said vent passage for venting the other of said supply passages when the valve is in its opposite position.

19. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve chamber, a sleeve valve reciprocable in said valve chamber comprising a sleeve-like body and a central external flange, internal guiding means extending within said valve body and on which the valve is slidably guided, passage means including passages controlled by said valve flange for supplying pressure fluid to the opposite ends of said cylinder, and means formed in said valve and said guiding means for alternatively connecting said supply passages to the exhaust and including vent ports extending through the valve flange and communicating respectively with the pressure areas on the opposite sides of said flange, and vent passage means in said guiding means with which said vent ports are communicable, one of said vent ports connecting one of said supply passages to said vent passage means when the valve is in one position and the other of said vent ports connecting the other of said supply passages to said vent passage means when the valve is in its opposite position.

20. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distribution means for effecting reciprocation of said piston including a valve chest having a valve

chamber, a sleeve valve reciprocable in said valve chamber and traversed by a bore, coaxial guiding means extending within the valve bore and on which the valve is slidably guided, passage means including passages controlled by said valve for supplying pressure fluid to the opposite ends of said cylinder, passage means including passages controlled by said valve for alternatively connecting said supply passages to the exhaust including annular grooves formed internally within said valve, passages connecting said grooves respectively with the opposite ends of the valve chamber, and a vent passage in said guiding means with which said grooves are alternatively communicable.

ELMER G. GARTIN.