

March 8, 1938.

E. G. GARTIN

2,110,331

PRESSURE FLUID MOTOR

Filed July 17, 1933

2 Sheets-Sheet 1

Fig. 1.

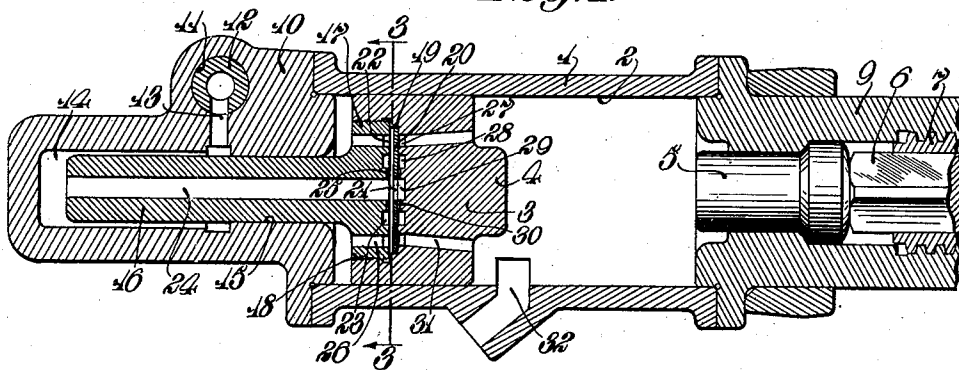


Fig. 2.

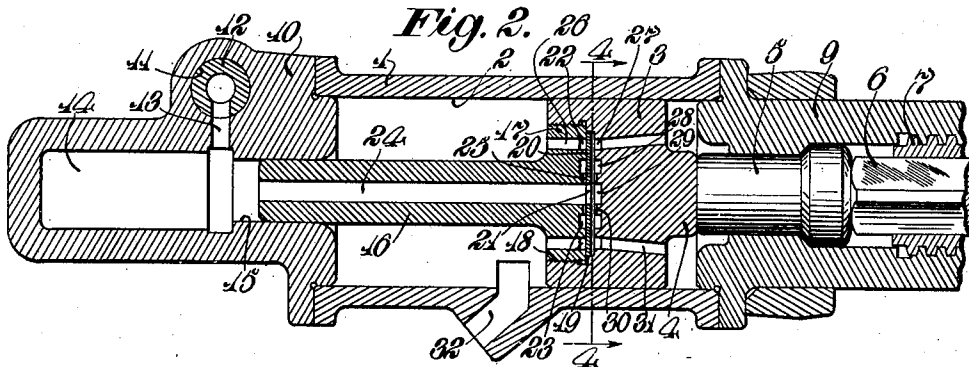


Fig. 3.

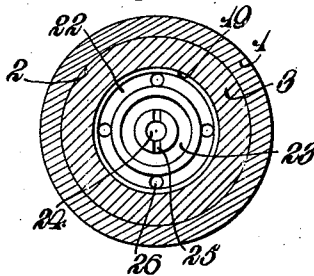


Fig. 4.

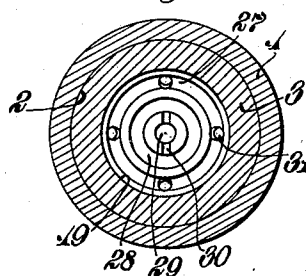
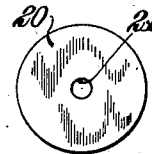


Fig. 5.



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2 Sheets-Sheet 2

Fig. 6.

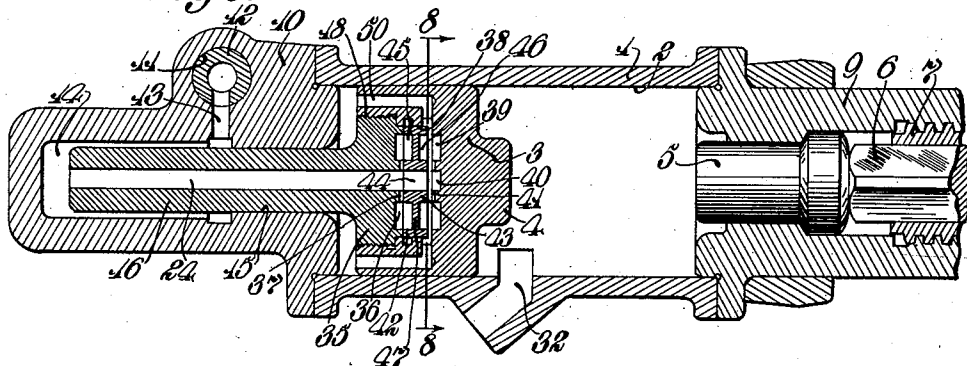


Fig. 7.

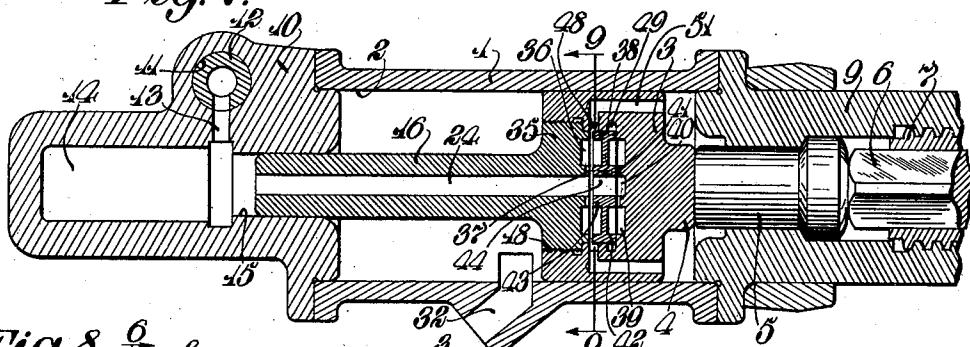


Fig. 8.

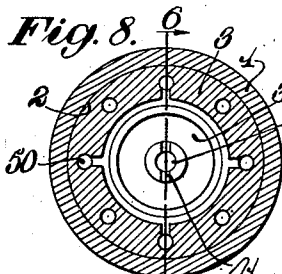


Fig. 9.

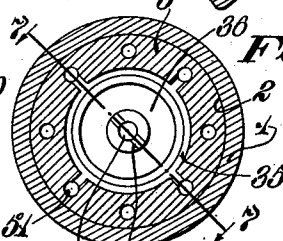


Fig. 10.

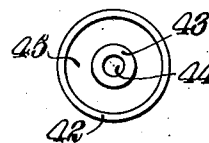


Fig. 11.

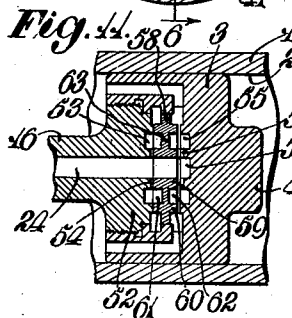
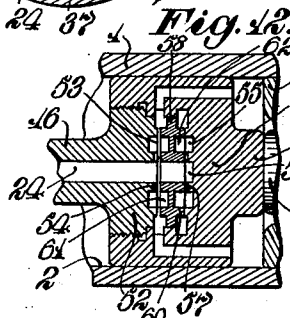


Fig. 12.



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UNITED STATES PATENT OFFICE

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PRESSURE FLUID MOTOR

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Application July 17, 1933, Serial No. 680,798

16 Claims. (Cl. 121—19)

My invention relates to pressure fluid motors, and more particularly to improvements in the fluid distribution means of such motors.

An object of this invention is to provide an improved pressure fluid motor. Another object is to provide an improved fluid distributing means for such a motor. Still another object is to provide an improved valve mechanism for a pressure fluid motor, the valve mechanism and distribution passages controlled thereby being arranged within the motor piston in an improved manner whereby the speed and efficiency of the motor may be materially increased. A still further object is to provide an improved valve mechanism arranged within the motor piston of a pressure fluid motor of the reciprocating piston impact type. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawings there are shown for purposes of illustration three forms which the invention may assume in practice.

In these drawings,—

Fig. 1 is a longitudinal section through one illustrative embodiment of the improved pressure fluid motor.

Fig. 2 is a view similar to Fig. 1, showing the motor piston and fluid distributing valve in a different position.

Fig. 3 is a cross sectional view taken on line 3—3 of Fig. 1.

Fig. 4 is a cross sectional view taken on line 4—4 of Fig. 2.

Fig. 5 is an elevational view showing the distributing valve.

Fig. 6 is a view similar to Fig. 1, showing a modified form of construction, with the section on line 6—6 of Fig. 8.

Fig. 7 is a view similar to Fig. 6, showing the motor piston and fluid distributing valve in a different position, and with piston rotated to the angle of line 7—7.

Fig. 8 is a cross sectional view taken on line 8—8 of Fig. 6.

Fig. 9 is a cross sectional view taken on line 9—9 of Fig. 7.

Fig. 10 is an elevational view of the modified form of fluid distributing valve.

Figs. 11 and 12 are fragmentary sectional views, similar to Figs. 6 and 7, showing a still further modified form of valve construction.

In the illustrative embodiment of the invention shown in Figs. 1 to 5, inclusive, there is shown a pressure fluid motor of the fluid actuated, reciprocating piston type, comprising a cyl-

inder 1 having a bore 2 containing a reciprocable motor piston 3, herein in the form of a hammer having a front striking projection 4 adapted to transmit a series of impact blows through a striking block 5 to the shank 6 of a working implement. The shank 6 is arranged in a chuck 7 carried within a chuck housing 9 arranged at the forward end of the cylinder and forming the front cylinder head. Secured to the rear end of the cylinder is a rear cylinder head block 10, and the elements 9, 1 and 10 are secured in assembled relation in any suitable manner. Arranged transversely in the head block 10 is a bore 11 containing a rotary throttle valve 12, and this throttle valve controls the flow of pressure fluid through a passage 13 to a constant pressure chamber 14 in the form of a bore formed in axial alinement with the cylinder axis. Alined with the bore 14 is a reduced bore 15 for guiding a tubular projection 16, herein formed integral with a valve chest element 17, herein threadedly connected at 18 within the rear end of the hammer piston. Formed in the hammer piston is a valve chamber 19 containing a reciprocable fluid distributing valve 20. The valve 20 is herein in the form of a flat disc having a central opening 21. Formed in the forward face of the valve chest member 17 are concentric annular grooves 22 and 23, and the inner groove 23 communicates with an axial bore 24, formed in the tubular projection 16, through slots 25 while the outer groove 22 communicates with the rear end of the cylinder bore through a series of passages 26 formed in the member 17. Also formed in the front wall of the valve chamber are concentric annular grooves 27 and 28, of the same diameter as the grooves 22 and 23; while formed centrally therein is a recess or chamber 29 communicable through the opening 21 in the valve with the fluid supply passage 24. The inner groove 28 communicates with the chamber 29 through slots 30, while the outer groove 27 communicates with the forward end of the cylinder bore through a series of passages 31 formed in the piston head. The cylinder has formed therein a central, piston-controlled, free exhaust port 32.

In this form of the invention, when the parts are in the position shown in Fig. 1, pressure fluid flows through supply passage 13, constant pressure chamber 14, the axial supply passage 24 formed in the tubular projection 16, to the valve chamber at the rear side of the valve, and thence through the outer groove 22, and the passages 26, to the rear end of the cylinder bore; the pressure fluid acting on the rear face of the piston head

to drive the piston in a forward direction to effect its working stroke. When the motor piston is in the position shown in Fig. 1, the forward end of the cylinder bore is connected to exhaust through the exhaust port 32, and as the motor piston moves forwardly this port is covered by the piston head, and when the rear edge of the piston head uncovers this exhaust port 32, the space at the rear side of the motor piston is connected to atmosphere. As a result, line pressure, which is communicated through the passage 24 and through the opening 21 in the valve, to chamber 29, and thence through the slots 30 to the inner annular groove 28, and then acts on the forward face of the valve being opposed by a reduced pressure, thereupon throws the valve rearwardly 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 the axial supply passage 24, through the passage 21, through the valve chamber at the forward side of the valve, and thence through the outer annular groove 27 and passages 31 to the front end of the cylinder bore; the pressure fluid acting on the forward face of the piston head to move the piston rearwardly to effect the retraction stroke. When the parts are in the position shown in Fig. 2, the rear end of the cylinder bore is connected to exhaust through the exhaust port 32. As the piston moves rearwardly, the forward edge of the piston head overruns the exhaust port 32, thereby connecting the forward end of the cylinder bore to exhaust, and thereafter the pressure in the annular groove 23 acting on the rear face of the valve throws the valve against the opposing reduced pressure, from the position shown in Fig. 2 to the initial position shown in Fig. 1. These events are repeated in rapid succession during normal operation of the motor.

In the modified form as shown in Figs. 6 to 10, inclusive, the motor cylinder and head structure are identical to those in the form described above. In this form of the invention, however, the fluid distribution passages are so arranged that when the motor piston strikes the striking block 5 there is no tendency for the valve to be thrown off its seat by the inertia action. In this form of the invention, the rear face of the valve chest member 35 with which the projection 16 is integrally formed, is provided with an annular groove 36 communicating with the supply passage 24 by slots 37. Formed in the piston, in front of the member 35, is a valve chamber 38, and the front wall of this valve chamber is provided with an annular groove 39 communicating with an axial chamber 40 through slots 41. In this form of the invention, the valve is of the spool type, having a peripheral guide sleeve portion 42 and a central sleeve portion 43 having an axial opening 44 aligned with the axial supply passage 24 and forming a passage for conducting pressure fluid from the passage 24 to the chamber 40 at the forward side of the valve chamber. Formed in the opposite faces of the valve are annular recesses 45 and 46, separated by a central transverse partition 47. Formed at the opposite ends of the valve chamber are annular grooves 48 and 49, the groove 49 being connected by a series of passages 50 with the rear end of the cylinder bore, and the groove 48 being connected to the front end of the cylinder bore through a series of passages 51.

When the parts are in the position shown in Fig. 6, pressure fluid flows from the supply pas-

sage 13 through the constant pressure chamber 14, axial supply passage 24, passage 44 in the valve, and through the valve chamber at the forward face of the valve, and thence through groove 49 and passage 50 to the rear end of the cylinder bore; the pressure fluid acting on the rear face of the piston head to drive the piston forwardly to effect its working stroke. As the rear edge of the piston head overruns the exhaust port 32, the pressure fluid in the rear end of the cylinder bore is conducted to exhaust, while the pressure fluid conducted by the axial passage 24 through slots 37 to the annular groove 36 acts on the rear face of the valve to throw the valve against the opposing reduced pressure from the position shown in Fig. 6 to the position shown in Fig. 7. When the striking portion of the motor piston engages the striking block, there is no tendency, in this form of the invention, for the valve to be thrown from its seat by the inertia action, since when the motor piston strikes its blow the valve is held firmly against the front wall of the valve chamber. However, if the valve should, for any reason, not be thrown forwardly by the pressure fluid, it is thrown by the inertia action when the piston strikes the striking block. When the parts are in the position shown in Fig. 7, pressure fluid flows through axial supply passage 24, through the valve chamber, past the rear face of the valve, thence through groove 48 and the passages 51, to the front end of the cylinder bore, the pressure fluid acting on the front face of the piston head to drive the piston rearwardly to effect its retraction stroke. As the forward edge of the piston head overruns the exhaust port 32, the front end of the cylinder bore is connected to exhaust, and as a result, the valve is thrown from the position shown in Fig. 7 to the initial position shown in Fig. 6 by the line pressure in the groove 39 acting against the opposing reduced pressure. Otherwise this form of the invention is identical to that described above.

In the modification shown in Figs. 11 and 12, the cylinder and piston structure and the fluid distributing passages and valve chamber structure are similar to those shown in Fig. 6. In this form of the invention, the rear face of the valve chest member 52, with which the tubular member 16 is integrally formed, is provided with an annular groove 53 communicating with the axial supply passage 24 through slots 54. Formed in the forward wall of the valve chamber is an annular groove 55 communicating with an axial chamber 56 through slots 57. The fluid distributing valve is of the spool type, as in the form of the invention shown in Fig. 6, but in this instance the outer sleeve portion of the valve is provided with a radial flange 58 projecting outwardly from the outer of inner and outer sleeve-like, concentric flanges 59 and 60. The opposite faces of the valve are provided with annular recesses 61 and 62 formed between the concentric flanges, and these recesses are separated by a central transverse partition 63. In this form of the invention the line pressure acting in the groove 53 tending to throw the valve from the position shown in Fig. 11 to the position shown in Fig. 12, is supplemented by compression pressure built up in the forward end of the cylinder bore by the motor piston and acting on the rear pressure area of the radial flange 58. During rearward movement of the piston the valve is thrown from the position shown in Fig. 12 to the position shown in Fig. 11 by the line pressure in groove 55 and compression pressure built up in the rear end of the cylinder

bore by the motor piston and acting on the front pressure area of the flange 58. It will thus be seen that this form of valve is thrown by line pressure and compression pressure acting against an opposing reduced pressure. Otherwise this form of the invention is identical to that described above in the modification shown in Fig. 6.

As a result of this invention, it will be noted that an improved pressure fluid motor is provided, having an improved valve mechanism arranged within the motor piston and improved fluid distributing passages controlled thereby, whereby the speed and efficiency of the motor may be materially increased due to the extremely short distances the motive fluid must flow between the valve and the working spaces. It will further be noted that the improved pressure fluid motor is of an extremely simple design, the arrangement of the valve within the motor piston enabling the use of relatively short supply passages in providing for a substantially direct flow from the valve chamber to the ends of the cylinder. These and other uses and advantages of the invention will be clearly apparent to those skilled in the art.

While I have in this application specifically described three forms which my invention may assume in practice, it will be understood that these forms are shown for purposes of illustration only, and that the invention may be further 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 chamber formed in said piston, a fluid actuated fluid controlling valve arranged in said chamber, and passage means controlled by said valve for supplying pressure fluid to said cylinder, said passage means arranged with respect to said valve and said valve being arranged in said chamber so that said valve seats in a forward position when the piston strikes its blow, thereby to prevent unseating of the valve by inertia action.

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 chamber formed in said piston, a valve mounted in said valve chamber for controlling fluid flow to the opposite ends of said cylinder, and passage means for supplying pressure fluid from the valve chamber at the forward side of the valve to the rear end of the cylinder and from the valve chamber at the rear side of the valve to the forward end of the cylinder.

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 chamber formed in said piston, a valve mounted in said valve chamber for controlling fluid flow to the opposite ends of said cylinder, passage means for supplying pressure fluid from the valve chamber at the forward side of the valve to the rear end of the cylinder and from the valve chamber at the rear side of the valve to the forward end of the cylinder, and fluid means for throwing said valve into its opposite operating positions.

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 chamber formed in said pis-

ton, a fluid actuated fluid distributing valve arranged in said valve chamber for controlling fluid flow to the opposite ends of said cylinder, passage means for supplying pressure fluid from the valve chamber at the forward side of the valve to the rear end of the cylinder and from the valve chamber at the rear side of the valve to the forward end of the cylinder, and fluid means for throwing said valve into its opposite operating positions.

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 chamber formed in said piston, a fluid actuated fluid distributing valve arranged in said valve chamber for controlling fluid flow to the opposite ends of said cylinder, passage means for supplying pressure fluid from the valve chamber at the forward side of the valve to the rear end of the cylinder and from the valve chamber at the rear side of the valve to the forward end of the cylinder, and fluid means for throwing said valve into its opposite operating positions, said valve being thrown by line pressure acting on one side of the valve against an opposing reduced pressure.

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 chamber formed in said piston, a fluid actuated fluid distributing valve arranged in said valve chamber for controlling fluid flow to the opposite ends of said cylinder, passage means for supplying pressure fluid from the valve chamber at the forward side of the valve to the rear end of the cylinder and from the valve chamber at the rear side of the valve to the forward end of the cylinder, and fluid means for throwing said valve into its opposite operating positions, said valve being thrown by line pressure and compression pressure acting on one side of the valve against an opposing reduced pressure.

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 chamber formed in said piston, passages connecting the opposite ends of said chamber to the ends of the cylinder which are respectively more remote from said chamber ends, a fluid actuated sleeve valve arranged in said valve chamber for controlling fluid flow through said passages to the opposite ends of said cylinder and having inner and outer sleeve-like body portions providing between them annular grooves, one in each of the opposite faces of the valve, and providing seat areas of relatively large extent whereby differential pressures are exerted on the opposite ends of the valve in either end position of the latter, and means for supplying pressure fluid constantly to said grooves, said valve having an axial passage through which fluid flows for passage to one end of said cylinder, said constant pressure supply means for one of said grooves receiving pressure fluid flowing through said axial valve passage.

8. In a pressure fluid motor, a cylinder, a piston reciprocable therein, said piston having a rearwardly projecting tubular portion, and fluid distribution means for effecting reciprocation of said piston including a valve chamber formed in said piston, a fluid controlling valve arranged in said chamber for controlling fluid flow to the opposite ends of said cylinder, passage means for supplying pressure fluid from the valve chamber

at the forward side of the valve to the rear end of the cylinder and from the valve chamber at the rear side of the valve to the forward end of the cylinder, and fluid supply means for said valve chamber including an axial passage formed in said tubular portion.

9. In a pressure fluid motor, a cylinder having a rear head, said head having formed therein a constant pressure chamber, a hammer piston reciprocable in said cylinder and having a rearwardly projecting tubular portion projecting within said pressure chamber, and fluid distribution means for effecting reciprocation of said piston including a valve chamber formed in said piston, a fluid controlling valve arranged in said valve chamber for controlling fluid flow to the opposite ends of said cylinder, and passage means for supplying pressure fluid from the valve chamber at the forward side of the valve to the rear end of the cylinder and from the valve chamber at the rear side of the valve to the forward end of the cylinder, pressure fluid being supplied to said valve chamber from said constant pressure chamber through said tubular portion.

10. In a pressure fluid motor, a cylinder having a rear head, said head having formed therein a constant pressure chamber, a hammer piston reciprocable in said cylinder and having a rearwardly projecting tubular portion projecting within said pressure chamber, and fluid distribution means for effecting reciprocation of said piston including a valve chamber formed in said piston, a fluid controlling valve arranged in said valve chamber for controlling fluid flow to the opposite ends of said cylinder, and passage means for supplying pressure fluid from the valve chamber at the forward side of the valve to the rear end of the cylinder and from the valve chamber at the rear side of the valve to the forward end of the cylinder, pressure fluid being supplied to said valve chamber from said constant pressure chamber through said tubular portion, said valve having an axial passage through which fluid flows to one end of said cylinder.

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 chamber formed in said piston, a fluid actuated fluid distributing valve movably guided in said chamber, and passage means controlled by said valve for supplying pressure fluid to the opposite ends of said cylinder including passages formed in said piston and leading from the forward end of said valve chamber to the rear end of the cylinder and passages formed in said piston and leading from the rear end of the valve chamber to the forward end of said cylinder.

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 chamber formed in said piston, a fluid actuated fluid distributing valve reciprocable in said chamber, concentric annular grooves formed in the opposite faces of the valve chamber, axial fluid supply passage means in said piston, passages formed in the opposite faces of the valve chamber for connecting said axial passage

means with the inner ones of said concentric grooves for supplying pressure fluid constantly to said inner grooves, said valve sealing the outer boundary of one or the other of said inner grooves when in its opposite positions, and passages connecting the outer grooves with the opposite ends of the cylinder, said passages each connecting its respective groove with the cylinder end which is the more remote from said groove.

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 chamber formed in said piston, a fluid actuated fluid distributing valve reciprocable in said chamber, said valve having end seating surfaces and annular pressure areas surrounding said seating surfaces, passage means controlled by said valve for supplying pressure fluid from said valve chamber to the opposite ends of said cylinder, and means for throwing said valve into its different operating positions including means for supplying pressure fluid to said annular pressure areas on said valve.

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 chamber formed in said piston, a fluid distributing valve arranged in said valve chamber to reciprocate in the direction of reciprocation of said motor piston, and passage means controlled by said valve for supplying pressure fluid to said cylinder, said passage means arranged with respect to said valve and said valve being arranged in said chamber so that said valve seats in a forward position when the piston strikes its blow thereby to prevent unseating of the valve by inertia action.

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 chamber formed in said piston, a fluid distributing valve arranged in said valve chamber for controlling fluid flow through said piston to the opposite ends of the cylinder, and passage means controlled by said valve for supplying pressure fluid to said cylinder, said passage means arranged with respect to said valve and said valve movable in said valve chamber in such direction relative to the path of piston travel that the interruption of the movement of the piston upon the striking of its blow presses said valve toward reverse-flow effecting position.

16. In a pressure fluid motor, a cylinder, a piston reciprocable therein, and fluid distributing means for effecting reciprocation of said piston including a valve chamber formed in said piston, a fluid distributing valve arranged in said valve chamber for movement therein, and passage means controlled by said valve for supplying pressure fluid to said cylinder, said valve chamber providing abutments against which said valve strikes at its extremes of movement, said passage means arranged with respect to said valve and said abutments arranged and said valve guided so that reversals of piston travel tend only to maintain said valve in its positions peculiar to such reversals of travel.

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