P. T. COFFIELD.

HYDRAULIC MOTOR.

APPLICATION FILED JAN. 13, 1909.

962,623.

Patented June 28, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

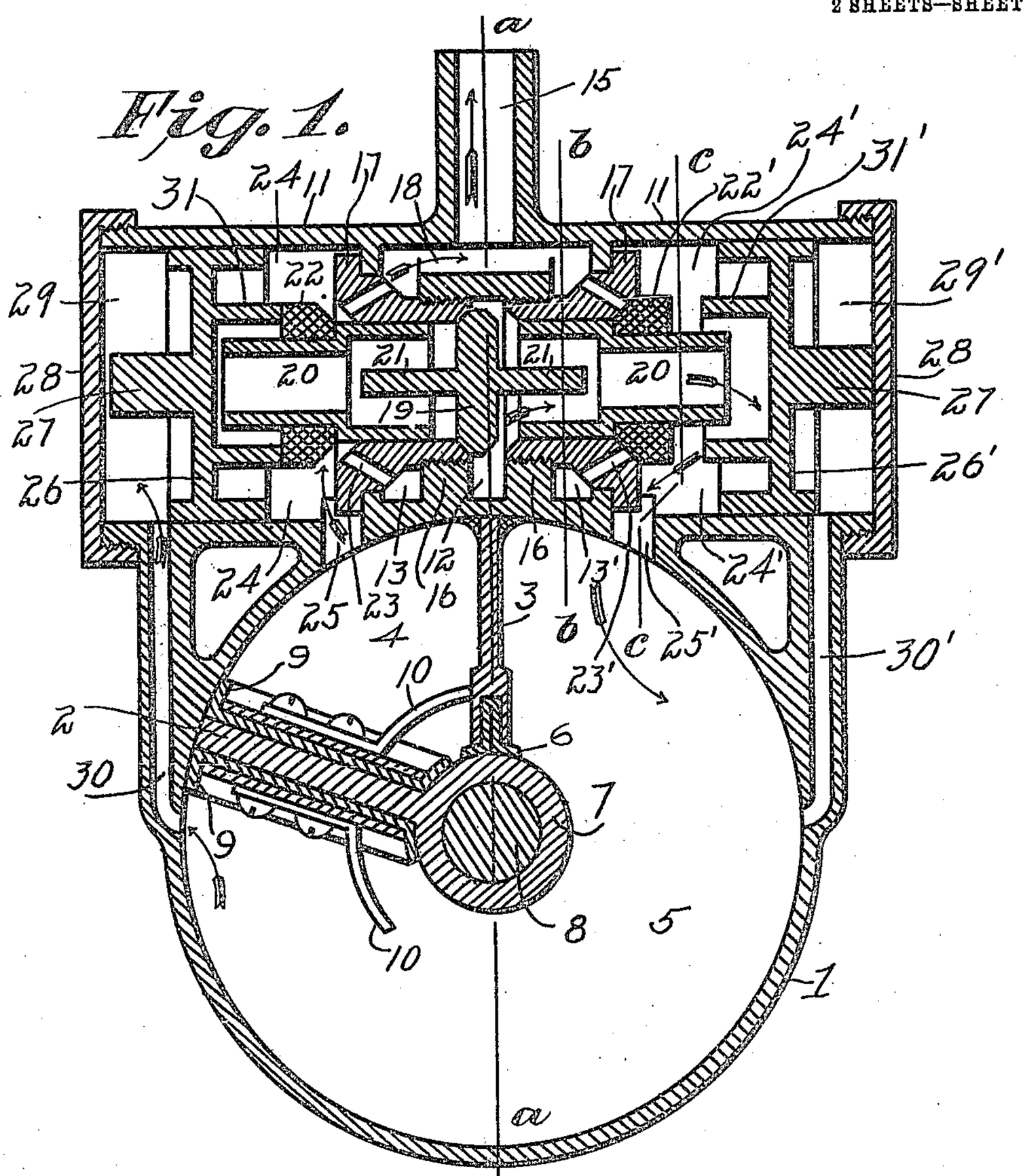
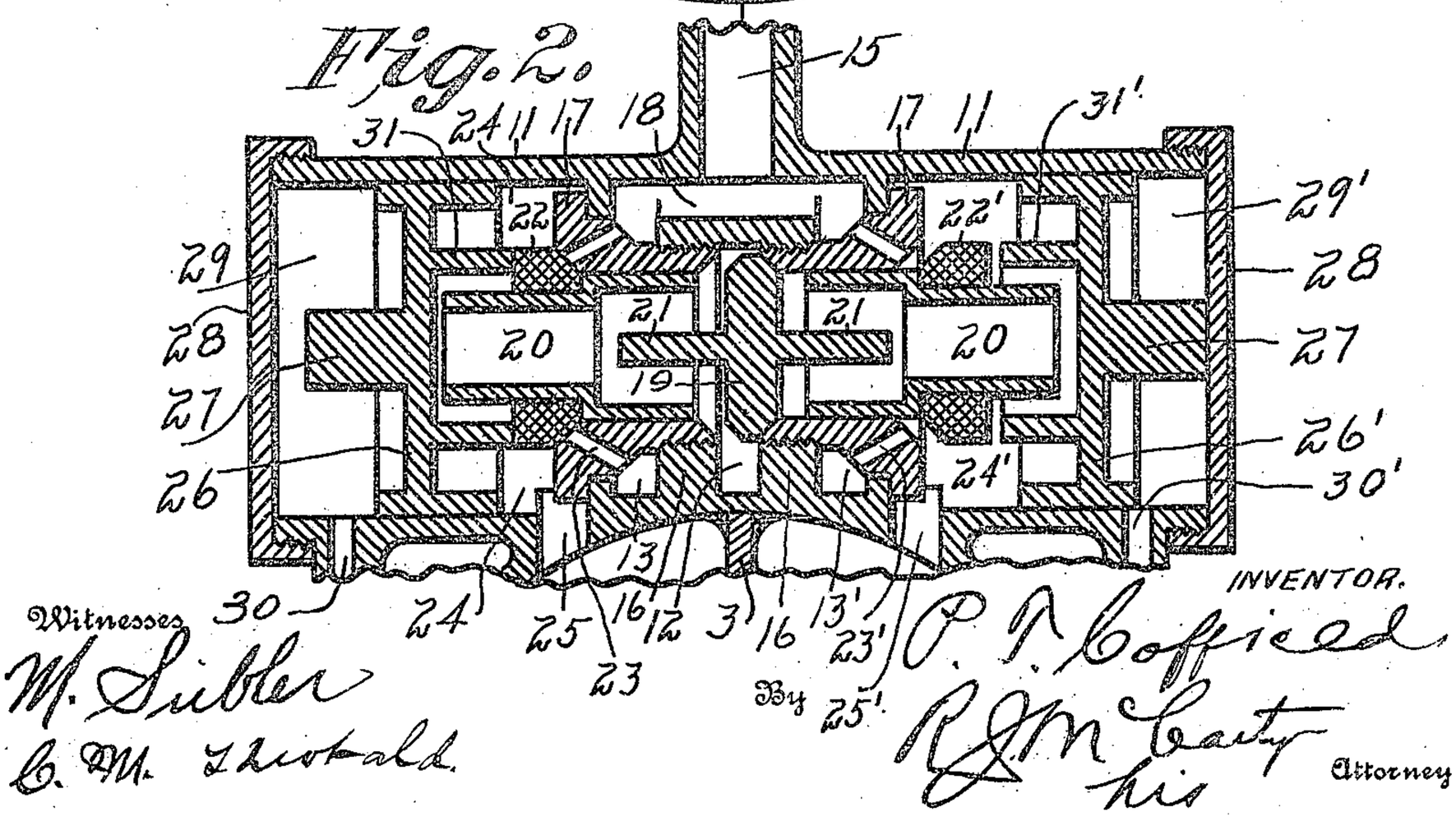



Fig. 2.



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2 SHEETS—SHEET 2.

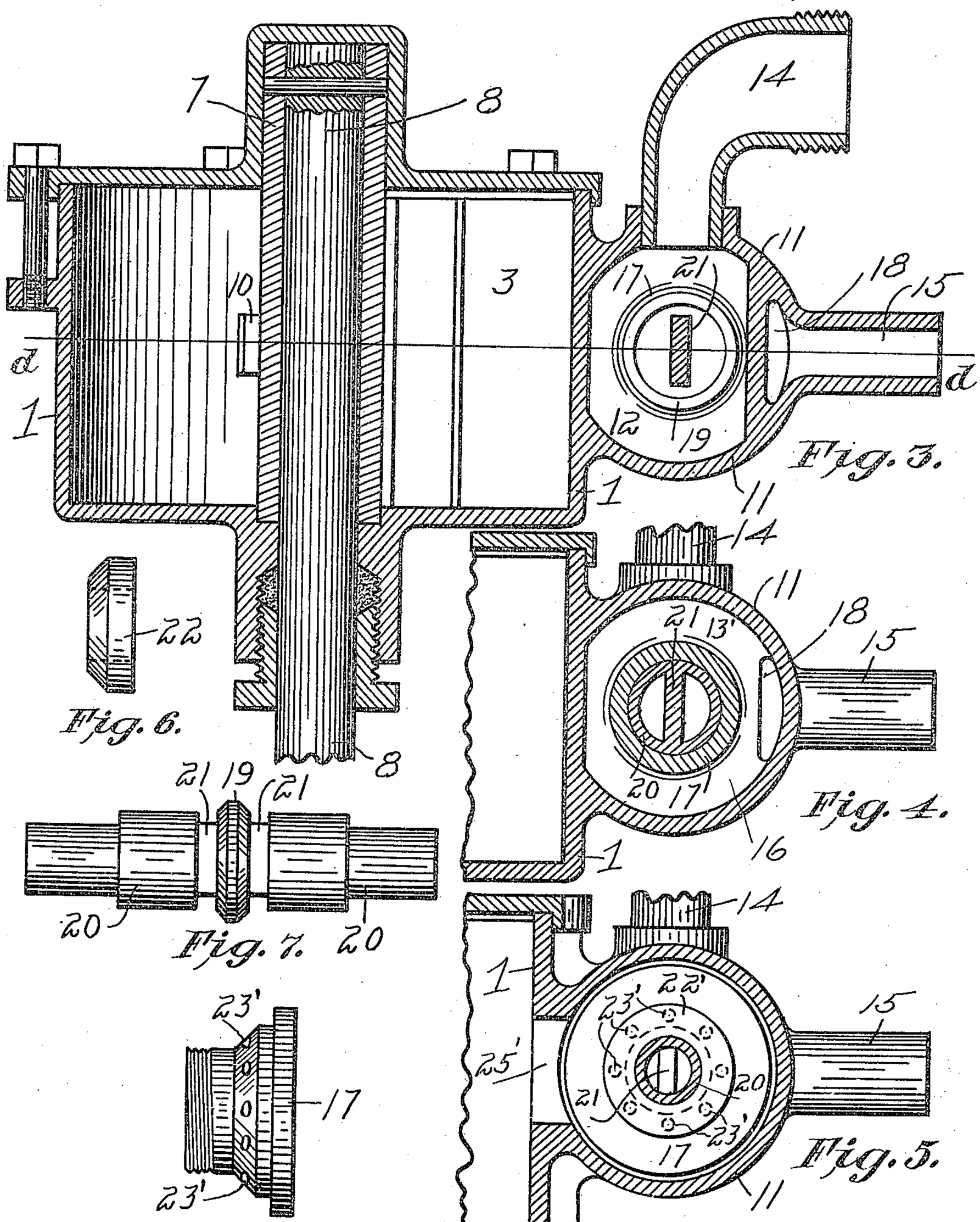


Fig. 3.

Fig. 6.

Fig. 7.

Fig. 4.

Fig. 8.

Fig. 5.

Witnesses

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# UNITED STATES PATENT OFFICE.

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## HYDRAULIC MOTOR.

962,623. Specification of Letters Patent. Patented June 28, 1910.

Application filed January 13, 1909. Serial No. 472,016.

*To all whom it may concern:*

Be it known that I, PETER T. COFFIELD, a citizen of the United States, residing at Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Hydraulic Motors; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

This invention relates to improvements in hydraulic motors.

The object of the invention is to provide a motor of the above type, which, owing to its simplicity and efficiency, is adapted for a variety of domestic uses, such for example, as a means for operating a washing machine. In order for a motor to be available for such purposes, it should be of such a construction as will insure its continuous operation in unskilled hands with the possibility of parts needing replacing or repairs reduced to a minimum. One of the fundamental requisites of such a motor, is that it shall be devoid of springs, and another requisite is that it shall be positive in its operation and free from gears. In other words, the motor must be springless and gearless in order to best meet the requirements. These objects are accomplished by providing valves which are prevented from finding a balanced position in their shifting movements, the entire valve mechanism being controlled by the live fluid, and the piston being mounted directly upon a shaft to which it is firmly connected, enables the dispensing with gearing as a means for connecting the driven shaft with the machine to be driven.

In the accompanying drawings, Figure 1, is a horizontal sectional view on the line *d d* of Fig. 3. Fig. 2, is a sectional view of the valve mechanism corresponding to Fig. 1, the piston cylinder being broken away. Fig. 3, is a vertical sectional view through the motor on the line *a a* of Fig. 1. Fig. 4, is a sectional view on the line *b b* of Fig. 1. Fig. 5, is a sectional view on the line *c c* of Fig. 1. Fig. 6, is an elevation of one of the exhaust valves removed from its support. Fig. 7, is a detail view of the main inlet valve, the exhaust valves being removed therefrom. Fig. 8, is a detail view of one of the bushings providing seats for the main inlet and exhaust valves.

In a detail description of the invention, similar reference characters indicate corresponding parts.

The piston cylinder 1 and the valve chest 11 are preferably made of a single casting with the necessary ports 25 25′ and 30 30′ to be again referred to. The ends of the valve chest are closed by heads 28. On the interior of the piston cylinder there is a partition 3 extending from the inner circumference of said cylinder to the hollow shaft 7 which supports the oscillating piston 2. The hollow shaft 7 carrying the oscillating piston 2 is provided with bearings in the opposite heads of the cylinder, and said hollow shaft receives and is rigidly connected with a power-transmitting shaft 8. The piston is provided with the necessary packing 9, and the partition or wall 3 is also provided with the necessary packing 6, and said partition and the piston divide the cylinder into two chambers 4 and 5, and in addition to this function, the partition serves as an abutment which coöperates with arms or stops 10 projecting from opposite sides of the piston, to limit the oscillating movement of said piston.

It will be noted that the valve mechanism is entirely removed from the piston cylinder, it being wholly confined within the chest 11. In the central portion of said chest an admission chamber 12 is arranged, into which the motive fluid initially enters through the inlet 14 which may be connected with a water faucet or any other means for supplying the motive fluid. On the sides of the admission chamber 12 are exhaust chambers 13 and 13′ communicating with port 18 which leads to the outlet 15. The admission chamber 12 and the exhaust chambers 13 and 13′ are separated by walls 16 which are parts of the casting, and bushings 17, the latter being connected with the walls by screw-threads or otherwise. The bushings 17 are important elements and perform several functions; they each have a series of ports 23 23′ extending from a valve seat formed in the outer ends of said bushings and communicating with the exhaust chambers 13 and 13′, and the inner ends of said bushings provide valve seats for the

main inlet valve. The seats formed in the outer ends of the bushings coöperate with the exhaust valves. In the admission chamber 12 and between the inner ends of the bushings 17, the main inlet valve 19 is placed, the same having oppositely-disposed tapered surfaces which alternately engage the seats. The valve 19 is provided with tubular extensions 20 with which it is connected by integral intervening portions 21. The tubular extensions 20 are separated from the valve proper a sufficient distance to permit the live motive fluid to readily and alternately pass into said tubular extensions. On the outer ends of said tubular extensions are mounted the exhaust valves 22 and 22′, and the several functions of which will be described. These valves 22 and 22′ alternately control the ports 23 in the bushings as hereinbefore indicated. 24 and 24′ designate two chambers at the outsides of the bushings 17 and with which the piston cylinder communicates through ports 25 and 25′. The chambers and ports thus referred to, alternately become passage-ways for the in-going and out-going fluid. The exhaust valves 22 and 22′ are located in the chambers 24 and 24′, and while performing the functions of exhaust valves, they also cooperate with plungers or valve actuators presently described, in trapping the incoming water at one or the other side of the main inlet valve until said valve has been completely shifted. The means for throwing the main inlet valve 19 in opposite directions, comprises two water-actuated plungers or valve actuators 26 and 26′ which are located in the ends of the valve chest and cooperate with the bushings 17 in providing the chambers 24 and 24′. These plungers are actuated in both of their movements by water pressure as will be more particularly described. The outward movements of said plungers are limited by lugs 27 which strike the heads 28 of the valve chest. On the outer sides of said plungers and between them and the heads of the valve chest are arranged fluid chambers 29 and 29′ which communicate with the interior of the piston cylinder through the ports 30 and 30′. On the inner sides of said plungers there are tubular extensions 31 and 31′ which perform auxiliary valves in conjunction with the exhaust valves 22 and 22′ in trapping the motive fluid coming directly through the inlet valve and until said inlet valve has been completely shifted. These extensions or auxiliary valves 31 and 31′ insure a complete movement of the exhaust and inlet valves by maintaining said valves in an unbalanced position during the time in which said valves are being shifted. When the piston reaches the end of its stroke for example, as shown in Fig. 1, the live fluid from the cylinder passes into the port 30 and into the chamber 29, and the force of said fluid moves the plunger 26 to the right. The valve extension 31 engages the exhaust valve 22 and moves the same to its seat and thereby closes the exhaust ports 23, at the same time, said plunger moves the main inlet valve to the opposite seat as shown in Fig. 2.

Referring further to Fig. 1, as the motor is shown in this view, the piston has reached the end of a stroke as before stated, and the admission valve 19 is in an initial position of a shifting movement of the valves. The piston having passed the port 30, the incoming water passes through said port in the rear of the plunger 29. It will be understood that the water pressure thus exerted against said plunger, is greater than that exerted against the valve 19 from the opposite direction, and such excess of pressure moves said valve 19 and the exhaust valve 22′ from their seats, and at the same time prevents the motive fluid from passing through the valve 19 until the exhaust valve 22 reaches its seat in the end of the bushing 17, at which time, the unequal pressures on the valve 19 will complete its movement to its opposite seat against the lesser pressure.

Referring to Fig. 2, the position of the main inlet valve 19 is that to which it has been completely thrown after the live fluid shifts the plunger, and the piston 2 commences its return stroke from the position shown in Fig. 1. When the valves are thrown to the positions shown in Fig. 2, the port 25′ becomes an exhaust port, and the port 25 an admission port, and vice versa. Owing to the passage through one or the other of the tubular extensions 20 of the main valve 19 being closed by one or the other of the auxiliary valves 31 31′ engaging one or the other of the exhaust valves 22 22′, the main valve 19 is unbalanced during its entire movement; this is due to the fact, that all the pressure due to the live fluid is behind one or the other of the plungers 26 26′. After the valves have reached one of their positions, for example, that shown in Fig. 2, the major portion of the cylinder chamber becomes an exhaust chamber, therefore, the pressure of the motive fluid behind the plunger 26 in the chamber 29 decreases and the live fluid is permitted to flow through the tubular extension 20 on that side of the main inlet valve and forces the plunger 26 back against the end of the valve chest, thereby opening the auxiliary valve 31 and permitting the live fluid to pass into the cylinder chamber 4, in front of the piston to drive said piston in the opposite direction.

The motive fluid first enters chamber 12 through the initial inlet 14—Fig. 3, thence into one or the other of the tubular extensions 20 through the main valve 19, thence into one or the other of the chambers 24 24′

by way of the auxiliary valves 31 or 31′, and into one or the other of the cylinder chambers 4 or 5 through ports 25 or 25′. The live fluid thus admitted to the cylinder at one or the other end of the valves exerts pressure against the piston to move the same in one or the other of its movements. In the meantime, the dead or exhaust fluid passes into one or the other of the chambers 24 24′ from the cylinder. One or the other of the exhaust valves 22 22′ being open, the dead fluid is permitted to pass into chamber 13 or 13′, from whence it passes into the outlet 15 through the inter-communicating passage-way 18. The exhaust valves 22 22′, when seated, are held in such position by the pressure of the live fluid in the respective chambers 24 24′, and vice versa, and thus the flow of the live and dead fluids is reversed. The live fluid and the dead fluid have a free and unobstructed movement or flow to and from the chambers 4 and 5 during the entire movement of the piston back and forth. It will be observed that the valves at no time of their shifting movements come into a balanced position, but at all times are subject to the action of the motive fluid. I am, therefore, enabled to dispense with any means such as springs and the like, to perform any part of the valve operation.

While I have shown and described a motor with a piston moving on a pivotal axis, I do not wish to be understood as limiting my valve mechanism and arrangement solely to such type of motor, because it is equally adaptable to a motor employing a piston which is movable on a longitudinal axis, as any one skilled in the art will readily understand, and the essentials of my invention may thus be employed.

I wish to further state that while I have shown and described the buttons or exhaust valves 22 22′ loosely mounted on the tubular extensions of the main inlet valve, I do not wish to limit myself to this particular manner of mounting said valve, although it is preferable to make them independent parts to facilitate the work of construction. I also prefer to have the stroke of the plungers 26 26′ somewhat greater than the stroke of the valves in order to at all times insure their complete movement and to obviate the slightest possibility of inoperativeness. It will be borne in mind that the main object of the invention is to combine efficiency and reliability of operation to such an extent as to render the motor suitable for a broad range of domestic use.

I claim:

1. In a hydraulic motor, a cylinder, a piston within said cylinder, puppet valves for admitting and exhausting the motive fluid to and from the cylinder, and means actuated wholly by the water pressure to cause a complete reversal of the valves at each end of the piston stroke.

2. In a hydraulic motor, a cylinder, a piston within the cylinder, inlet and exhaust valves, plungers arranged to engage said valves, and ports coöperating with the valves and plungers, the piston controlling the ports leading to the plungers, the valves, plungers and ports, being constructed and arranged to operate with a liquid, and the plungers imparting the entire movement to the valves.

3. In a hydraulic motor, a cylinder, a piston movable within said cylinder, an inlet valve having tubular extensions through which the motive fluid alternately flows to opposite sides of the piston, exhaust valves, and means enabling said valves to receive their entire movement by fluid pressure.

4. In a hydraulic motor, a cylinder, a piston in said cylinder, valves controlling the admission of the motive fluid to said piston, means for actuating said valves, and means whereby the flow of live fluid to the rear of the piston is prevented until the valves have been entirely shifted.

5. In a hydraulic motor, a cylinder, a piston, valves controlling said piston, plungers operating said valves, means on said plungers coacting with said valves in controlling the motive fluid while the plungers are completely shifting said valves, and ports to conduct the live fluid to said plungers.

6. In a hydraulic motor, a cylinder, a piston, valves controlling said piston comprising an inlet valve having tubular extensions, plungers operating said valves and themselves closing the ends of the tubular extensions and thereby acting as valves to control the motive fluid while said plungers are shifting the first mentioned valves, and ports to conduct live fluid to the plungers.

7. In a hydraulic motor, a cylinder, a piston within said cylinder, a main valve controlling the admission of motive fluid to opposite sides of the piston, a plunger arranged at each end of said main valve, said plungers being actuated by the pressure of the motive fluid to completely shift said main valve to one or the other of its seats, and means interposed between said plungers and said main valve to control the passage of the motive fluid to the piston until the main valve has been completely shifted.

8. In a hydraulic motor, a cylinder, a piston in said cylinder, a main valve controlling the admission of motive fluid to opposite sides of the piston, a plunger arranged at each end of said main valve and adapted to completely shift said main valve to its opposite seat through the water pressure exerted upon said plungers, means interposed between the main valve and the plungers which controls the admission of the motive fluid from the main valve to the

piston until said main valve has been completely shifted.

9. In a hydraulic motor, a cylinder, a piston therein, a main valve primarily admitting the motive fluid which actuates the piston, a water-actuated plunger on each side of said main valve which completely shifts said main valve to admit the motive fluid on one or the other side of the piston, an exhaust valve interposed between each of the plungers and the main valve and controlling the exhaust from the motor cylinder as well as the inlet to the motor cylinder from the main valve by coöperating with the plungers in excluding the admission of the motive fluid from the main valve to the motor cylinder until said main valve has been completely shifted by one or the other of the plungers.

10. In a hydraulic motor, a cylinder, a piston in said cylinder, a valve chest having ports communicating between chambers in the ends of the valve chest and the opposite sides of the cylinder, and ports forming communication between intermediate chambers in the valve chest and opposite sides of the cylinder, plungers arranged in the ends of the valve chest and providing the end and intermediate chambers, a main valve controlling the initial admission of the motive fluid, and auxiliary valves coöperating with the plungers and controlling the admission of the motive fluid from the main valve to the intermediate chambers and thence to the cylinder, the plunger being actuated by the motive fluid admitted to the end chambers from the cylinder to shift the main valve from one seat to the other, and the auxiliary valve coöperating with said plungers in excluding the motive fluid from the intermediate chambers until the valve has been completely shifted, after which the motive fluid passing through said valve actuates the plungers and thus admits said motive fluid to the cylinder.

11. In a hydraulic motor, a cylinder, a piston, inlet and exhaust valves, said inlet valve having tubular extensions, plungers adapted to reverse said valves, said plungers alternately acting as valves to control the motive fluid while actuating said valves.

12. In a hydraulic motor, a cylinder, a piston therein, a main inlet valve, exhaust valves alternately coöperating and moving with said main valve, fluid-pressure actuated plungers adapted to unseat and completely shift said valves to their operative positions thereby reversing the course of motive fluid to the piston and at the same time withholding said fluid from the piston until the main inlet and exhaust valves have been completely shifted.

13. In a motor, a cylinder, a piston therein, a main inlet valve, fluid-actuated plungers adapted to completely shift said valve and in the meantime prevent the fluid entering said valve from passing into the cylinder until said valve has been completely shifted.

14. In a motor, a cylinder, a piston therein, a main inlet valve admitting motive fluid to opposite sides of the piston, plungers alternately actuated in opposite directions by the motive fluid passing directly from said valve, and motive fluid passing directly from the cylinder at the end of each stroke of the piston, said plungers in one of their movements, alternately actuating the main valve, and in the other of their movements admitting the motive fluid to the piston.

15. In a motor, a cylinder, a piston therein, a main reciprocable inlet valve, reciprocable fluid-pressure actuated plungers adapted to simultaneously shift said main valve and trap the fluid entering therethrough in the movement of said plungers in one direction, and to admit said trapped fluid to the piston in the movement of said plungers in the opposite direction thereby reversing the travel of the piston.

16. In a motor, a cylinder, a piston therein, a main inlet valve, exhaust valves movable with the main inlet valve, bushings supporting the main inlet valve and providing seats in its opposite ends for the main inlet valve and the exhaust valves, said bushings having exhaust ports in the ends which provide seats for the exhaust valves, and fluid-pressure actuated plungers adapted to alternately engage the exhaust valves to seat the same and to completely shift the main inlet valve and to trap the motive fluid entering said valve until said valve has been completely shifted, after which the pressure of the trapped water returns said plungers to their outer positions.

17. In a motor, a cylinder, a piston therein, a main inlet valve, exhaust valves supported upon said main inlet valve, bushings supporting the main inlet valve and providing seats for said valve and for the exhaust valves, said bushings having exhaust ports therein, and fluid-pressure actuated plungers having valve extensions adapted to alternately engage the exhaust valves when said plungers are alternately actuated in one direction, and to shift the main inlet valve and exhaust valve and to trap the fluid entering the main inlet valve until the pressure of said fluid moves said plunger to its outer position.

18. In a motor, a cylinder, a piston therein, a valve chest the ends of which communicate with opposite sides of the cylinder and intermediate portions of which communicate with intermediate parts of the cylinder, a main inlet valve, exhaust valves mounted upon said main inlet valve and movable therewith, bushings supporting the main inlet valve and providing seats for said main inlet valve and for the exhaust valves, said bushings

providing exhaust chambers with ports leading thereto, and fluid-pressure actuated plungers having extensions adapted to engage the outer sides of the exhaust valves to move said valves and the main inlet valve and to trap the incoming water until the movement of said valves is completed.

19. In a hydraulic motor, a cylinder, a piston, inlet and exhaust valves, the inlet valve having tubular extensions, plungers, said plungers engaging said valves and operated by water pressure at each end of the piston stroke, said plungers acting alternately to seal the motive fluid from the ends of the valves, thereby mantaining said valves in an unbalanced position during their entire movement, and ports to conduct live fluid to the plungers.

20. In a hydraulic motor, a cylinder, a piston, an inlet valve having tubular extensions through which the motive fluid is alternately conducted to opposite sides of the piston, exhaust valves mounted on said tubular extensions, and means which enable said valves to be operated entirely by fluid pressure.

In testimony whereof I affix my signature, in presence of two witnesses.

PETER T. COFFIELD.

Witnesses:
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