Jan. 20, 1931. A. P. STEINER ET AL 1,789,785

HYDRAULIC SPEED CHANGE

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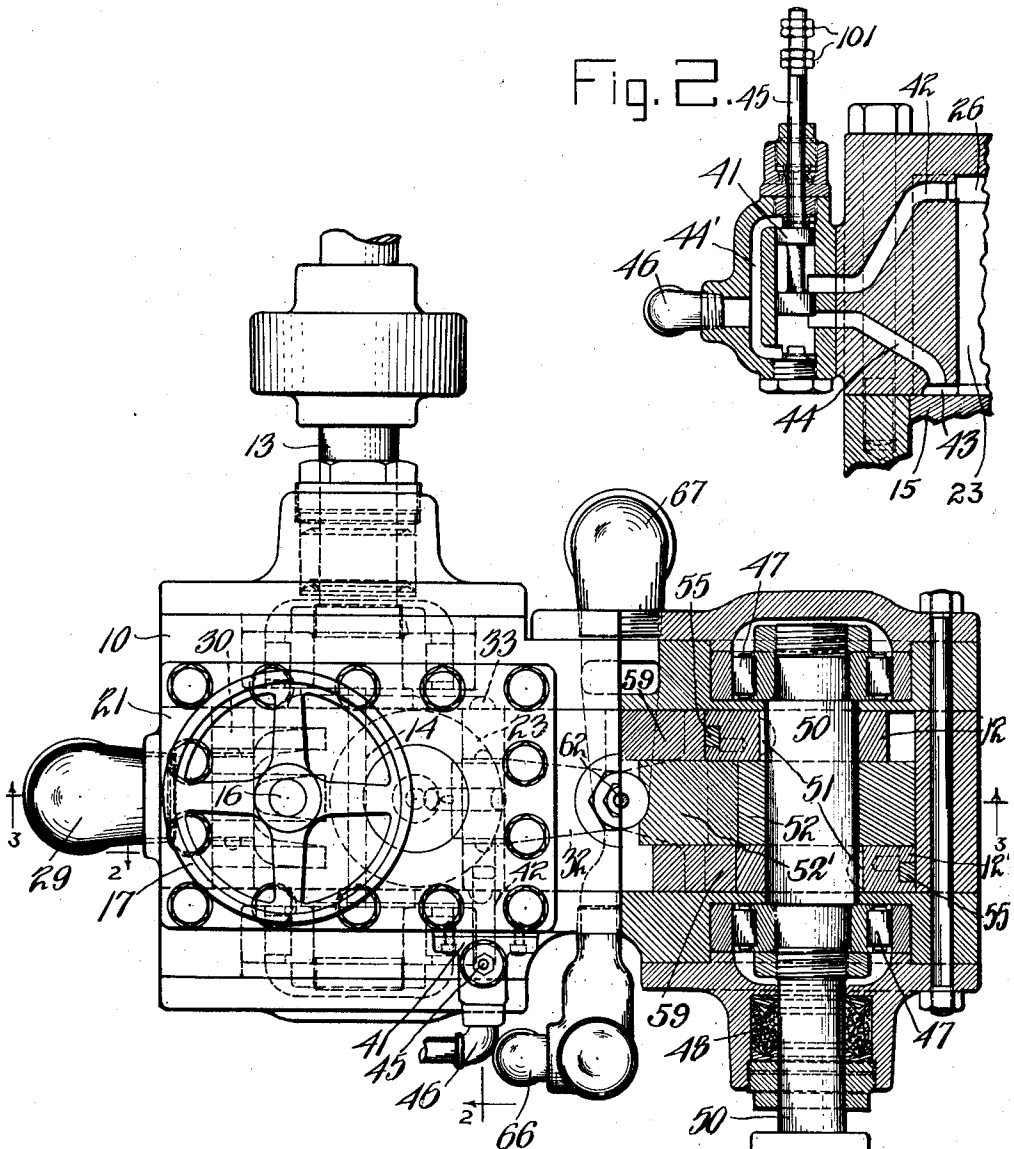


Fig. 2.

Fig. 1.

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Fig. 4.

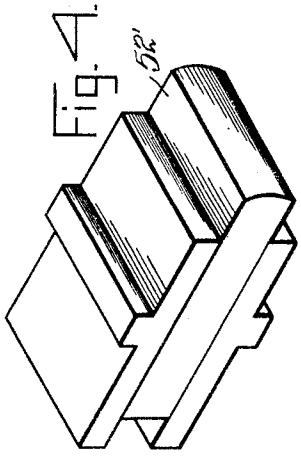


Fig. 3.

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HYDRAULIC SPEED CHANGE

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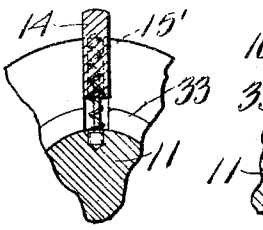


Fig. 5.

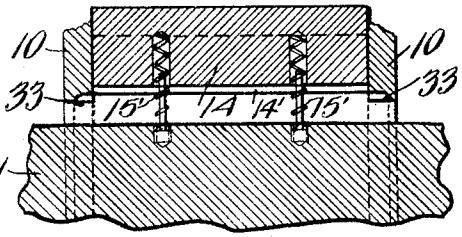


Fig. 6.

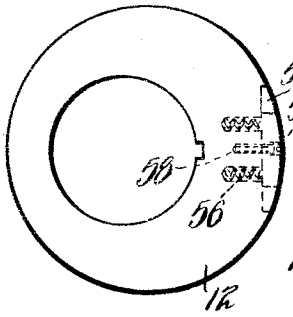


Fig. 7.

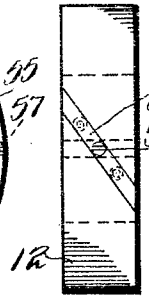


Fig. 8.

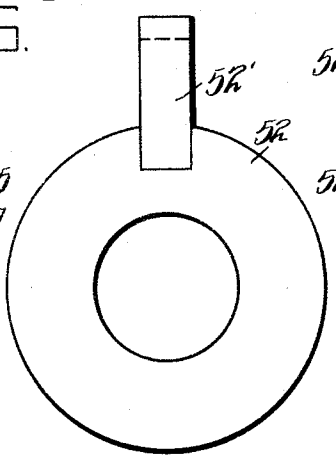


Fig. 9.

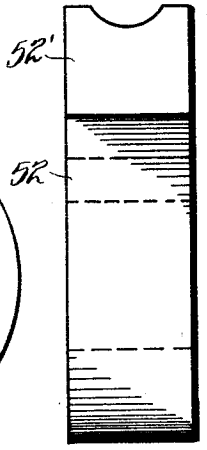


Fig. 10.

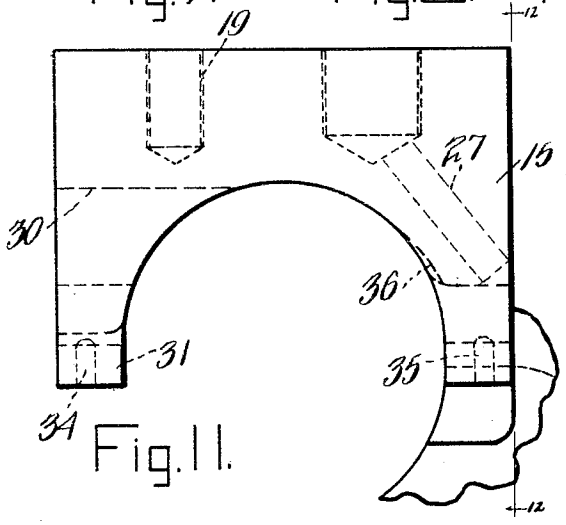


Fig. 11.

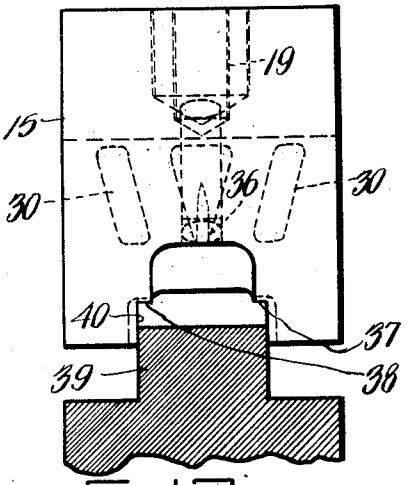


Fig. 12.

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HYDRAULIC SPEED CHANGE

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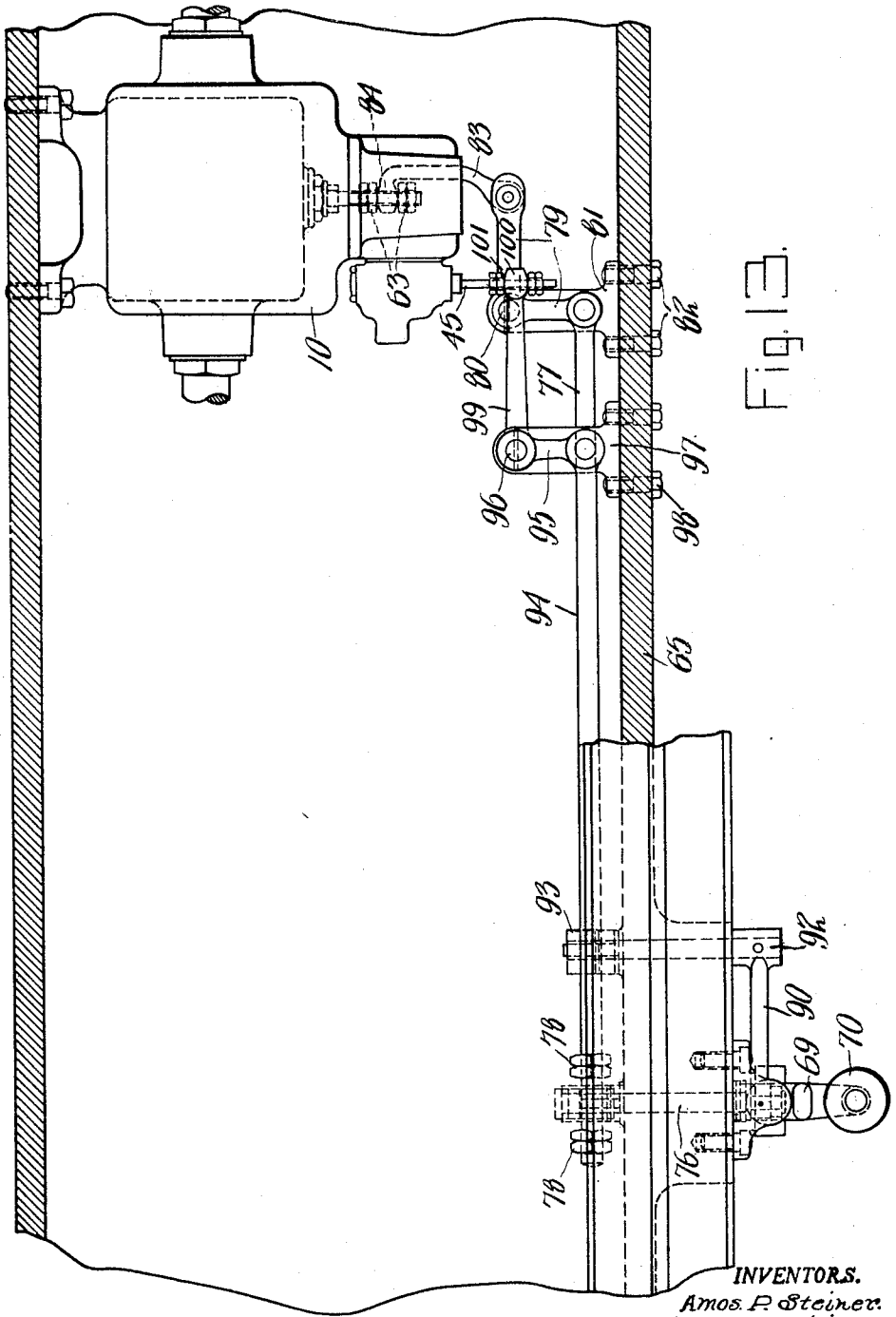


Fig. 13.

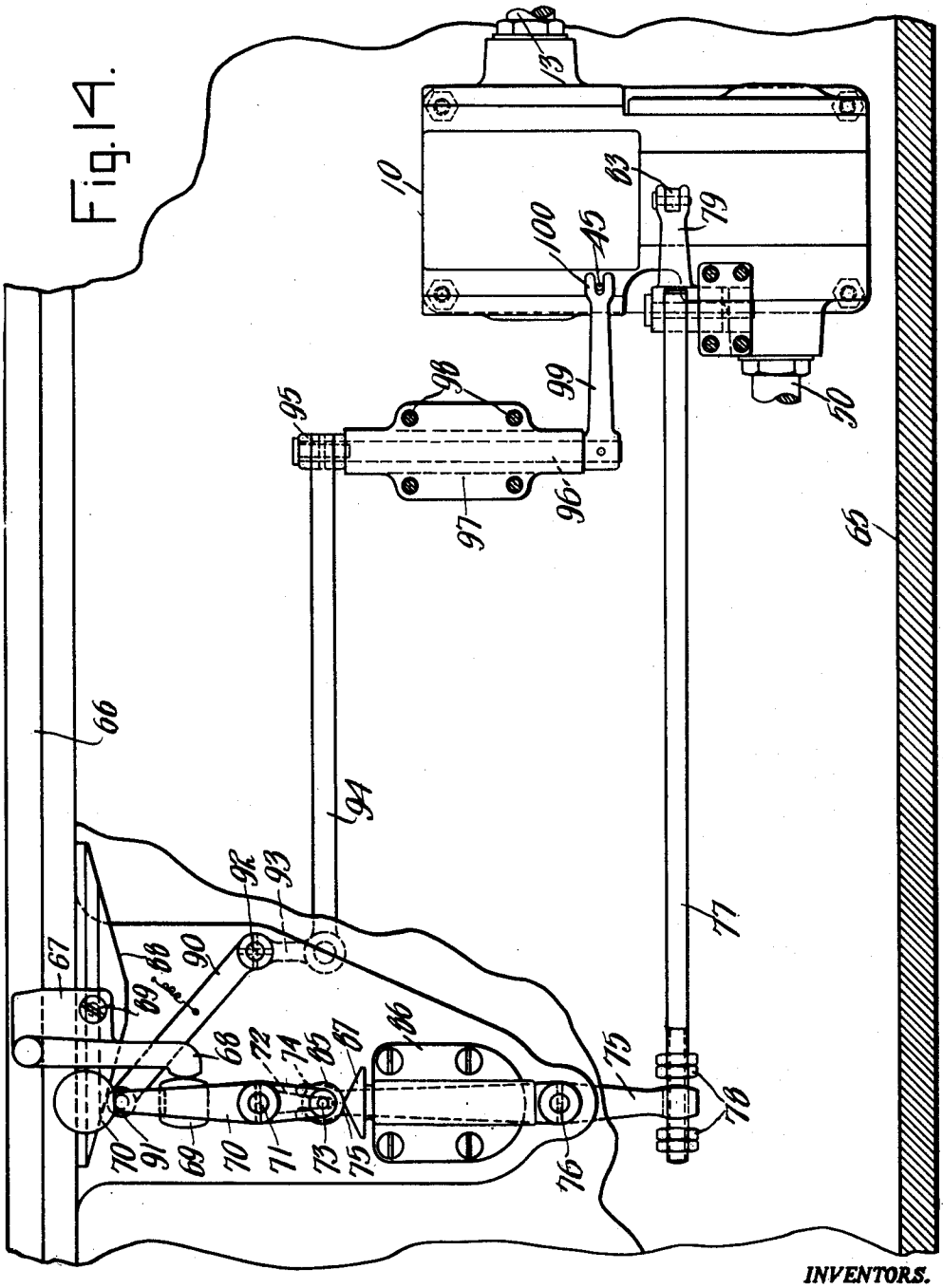
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Filed July 13, 1926 5 Sheets-Sheet 5

Fig. 14.



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UNITED STATES PATENT OFFICE

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HYDRAULIC SPEED CHANGE

Application filed July 13, 1926. Serial No. 122,197.

Our said invention relates to a device for utilizing the energy of fluid under pressure for driving certain machinery such as for example, the work carriage of a grinding machine, or any other mechanism requiring a reciprocating or continuous motion.

Our invention has several objects, one of which is to provide means for varying the capacity or output of a pump within certain variable limitations whereby the speed of a motor and device driven thereby may be correspondingly varied.

Another object of the invention is to provide means for reversing the direction of rotation of the motor.

Referring to the accompanying drawings which are made a part hereof and on which similar reference characters indicate similar parts,

Figure 1 is a top plan view of the device with the motor or driven part in section,

Figure 2, a section on line 2—2 of Figure 1,

Figure 3, a longitudinal vertical section on the line 3—3 of Figure 1,

Figure 4, a detail perspective of a pressure retaining blade of the motor,

Figure 5, a fragmentary detail showing one of the pump blades in end elevation,

Figure 6, a section taken at right angles to Figure 5,

Figure 7, a side elevation of one of the rotors, of the motor,

Figure 8, a view taken at right angles to Figure 7,

Figure 9, a detail showing an end elevation of a dividing segment of the motor,

Figure 10, a similar view at right angles to Figure 9,

Figure 11, a side elevation of the adjustable block,

Figure 12, an end elevation at right angles to Figure 11 and in part a section on line 12—12 of Figure 11,

Figure 13 a front elevation of my pump-motor combination applied to the bed of a grinding machine with part of the casing broken away, and

Figure 14 a top plan view with a part of the top casing broken away.

In the drawings reference character 10 indicates a housing, 11 a pump propeller mounted in one end of the housing and 12 and 12′ a pair of motor rotors mounted in the other end of the housing.

The propeller is mounted on a shaft 13 and is provided with a plurality of propeller blades 14. The shaft 13 is preferably formed integrally with the propeller 11 and is supported by end plate bearings. The propeller blades 14 are slidably mounted in radial slots in the propeller so that there is contact at all times between the blades and a sliding block 15 which forms the upper wall of the chamber in which the propeller is mounted. The propeller blades 14 are forced outwardly by springs 15′ and by fluid pressure so that there is contact at all times between the blades and the sliding block which regulates the pressure fluid through the pump. In order to insure a firm contact between each blade and the block 15 each blade 14 is slotted in its bottom at 14′, see Figure 6, to allow fluid pressure to be introduced at that point and a semi-circular groove in the end plate of the housing 10 permits pressure fluid to pass through the same to the underside of the blades when they are in the uppermost position in contact with the sliding block 15. This causes the blades to be forced radially outward which action is assisted by the springs 15′ under each blade as well as by the action of the centrifugal force.

The sliding block 15 used to vary the capacity of the pump is adjustably mounted in the housing 10 above the propeller 11 and is movable toward and away from the propeller so that by adjusting the relative position of said block the flow of pressure fluid through the pump may be regulated for varying the speed of the rotors 12 and 12′. The sliding block 15 is supported on the end of a shaft 16 which extends outwardly through a cap 21 formed separately from the block, the cap being secured in any desired manner to the housing 10. The shaft 16 is provided on its outer end with a hand wheel 17, said shaft having its inner end provided with screw threads 18 which engage co-operating threads in a recess 19 of the sliding block. An annular enlargement 20 is provided on the shaft

16 which engages the underside of the cap 21 and forms a stop and prevents the shaft from being disconnected from the sliding block 15. As shown the shaft 16 to which the sliding block is connected is mounted toward one side or eccentrically of the propeller of the pump and an unbalanced condition caused by fluid pressure on the block would make difficult the operating of the hand wheel 17 to raise and lower the sliding block. To facilitate raising and lowering the block by means of the hand wheel we preferably provide means for partially balancing the sliding block which comprises a piston 23 having a piston ring 24 and a small reduced end 25 threaded into and movable with the sliding block 15. A cylindrical opening 26 is provided in the cap 21 for the reception of the piston 23. A passage 27 extends from the discharge passage of the pump to a second passage 28 which extends through the piston 23 and through which passages pressure fluid may pass to the outer extremity of the piston and press the piston and sliding block downwardly toward the pump in proportion to the pressure within the same. The face area of said piston is such that the total pressure acting on said piston to push it down is less than the total pressure acting to push the block 15 up. This difference in pressure tends to steady said block.

An intake pipe 29 is connected to the housing 10 and is adapted to supply fluid to the pump through ports 30 in the block 15 and an opening 31 formed between the block and the housing, the amount of such fluid being determined by the position of the sliding block 15 and said housing is further provided with discharge port 32 through which the fluid is forced by action of the pump to the motor for operating said motor. The wall of the housing adjacent each end of the propeller 11 is provided with a curved groove 33 which extends about the upper portion of the same and permits pressure fluid to pass to the underside of the blades 14 when they are in contact with the sliding block 15, or in their uppermost position. Pressure fluid causes contact between the blades and block.

The opening 31 between the sliding block and the housing permits fluid to pass in therethrough to the rear of the propeller blade.

In order to prevent throttling or complete stoppage of the space between the extremities of the sliding block and the pump body, or housing, relief passages 34 and 35 are cut on each side of the ports. On account of this construction when the block 15 is lowered any pressure fluid which might be entrapped and stop the downward movement of the block is released through the passages 34 and 35. In order to equalize the pressure on both sides of the blade of the pump the slidable block is cut away at 36, see Figure 11, to permit pressure fluid to be admitted behind the blade and eliminate any irregularity in the discharge of the pressure fluid which would result in an objectionable knocking in the pump. Co-operating surfaces or stops 37 and 38 on each side of the ports limit the downward movement of the block so that it never comes in contact with the propeller 11. As shown in Figure 12 the housing is provided with a tongue 39 which is adapted to project into and interlock with the recess 40 in the sliding block 15.

In order to increase or diminish the supply of pressure fluid furnished by the pump when the device which is driven or reciprocated reaches the limit of its movement and reverses its direction of travel, we provide means for automatically lowering and raising the sliding block. Said mechanism comprises structure shown in Figure 2 which consists of a piston valve 41 secured to the pump adjacent the front or in any convenient location and having communication with the upper end of the cylinder 26 through the port 42 and with a chamber or space 43 between the upper surface of the block and the cap 21 through the port 44. The valve stem 45 is connected to a reciprocating part of the mechanism operated in such a way that when said part approaches the limit of its travel the valve will be operated to allow fluid from the cylinder to pass through the ports 27, 28, 42 and 44. Said pressure fluid will act upon the top of the piston 23 and said block to force them downwardly and reduce the flow of pressure fluid through the pump and incidentally reduce the speed of the motor. As the reciprocating part of the mechanism driven reaches the limit of its travel and begins its travel in the other direction the valve will be thrown to its original position cutting off the pressure fluid to 43 and thus release the block 15 thereby allowing the flow of pressure fluid through the pump to gradually build up until it reaches the capacity for which the hand wheel is set. The ends of the valve are connected by means of a port 44′ and having communication with an exhaust 46 for returning the pressure fluid to a reservoir or other receptacle.

The motor comprises a shaft 50 mounted upon the roller bearings 47 in the ends of the casing for said motor. A stuffing box 48 is provided for preventing the escape of any lubricant or pressure fluid which may find its way around said shaft 13, the latter being connected to drive mechanism not shown, such as for example a carriage traverse or any other mechanism which requires a reciprocating or continuous movement. A pair of rotors 12 and 12′ are secured to the shaft on diametrically opposite sides thereof by means of keys 51, said rotor being separated from each other by means of a segment or partition member 52. The rotors 12 and 12′ are eccentrically mounted on the shaft 50 and

preferably have non-circular or flattened peripheries as such form of rotor possesses advantages over the bladed type rotor in that only one blade is required with the present construction.

Upper and lower passages 53 and 54 communicate with the passage 32 from the pump at one end and have their other ends terminating in the cylinder wall adjacent one of the rotors and additional similar passages are provided in similar relation to the other rotor, each of the upper passages serving alternately with the corresponding lower passage to intake and exhaust the pressure fluid received from the pump for driving the respective rotor. Each rotor is provided with a shoe 55 and 55′ which extends diagonally across a bearing surface of the rotor and two springs 56 hold such shoe against the surface of the cylinder wall and render it impossible for fluid to pass through the cylinder and to the respective discharge ports without acting on such rotors while the motor is running. Alined openings 57 and 58 are provided in the shoe 55 and in the rotor for the insertion of a screw not shown when it is desired to perform a machining operation upon the rotor and shoe. The casing for the rotors is provided with recesses which extend longitudinally of the rotor shaft and in substantially parallel relation thereto between the inlet and discharge ports 53 and 54 and a plate or blade 59 is disposed in said recesses in a position to bear against the periphery of its respective rotor. Ports 60 are provided which communicate with the rear extremities of said blades at all times to cause the blades to be continually held in their innermost positions against the rotors. The pressure on the blades is maintained equal to or slightly greater than the pressure within the cylinder so that the blades are held firmly against the rotors at all times. In order to direct the pressure fluid as desired, either into the upper or lower passages to the rotors, a reversing valve 61 is provided and having a valve stem 62 extending from the casing at one side and which may be connected with any desired reversing lever of the machine being operated to cause reciprocation of the valve and consequently the clockwise and counterclockwise rotations of the rotors and shaft upon which they are mounted. Locknuts 63 are provided on the valve stem 62 for varying the adjustment between the valve stem and the mechanism to which it is attached. The stops 64 may be provided for limiting the end-wise movement of the valve 61.

In Figures 13 and 14 we have illustrated mechanism for operating the reversing valve 61. In said figures reference character 65 indicates the frame or bed of a machine to which my invention is applied and provided with a reciprocating work carriage 66. A reversing dog 67 is adjustably mounted on the carriage 66 adjacent each end and only one of which is shown and said dog is provided with a finger 68 adapted to engage a lug 69 on a manually operable reversing lever 70. The reversing lever 70 is mounted on the extremity of a shaft 71 without the frame or bed of the machine, said shaft extending through the frame to the inside of the same and being provided with an arm 72 having a pin 73 which engages the bifurcated end 74 of a lever 75. The lever 75 is pivotally mounted upon a shaft 76 and the outer end of the lever 75 is provided with an opening therethrough in which the end of a connecting rod or link 77 is loosely mounted. The connecting rod or link 77 is provided with spaced pairs of lock-nuts 78 between which the lever 75 may slide, such structure forming a lost motion connection. To the opposite end of the connecting rod or link 77 is secured one arm of a bell crank lever 79 supported on a fulcrum or pivot 80. A bracket 81 is secured by means of bolts 82 within the frame 65 and the longer arm of said bell crank lever 79 is pivotally connected with a valve operating link 83 which has its opposite end 84 bent at right angles and bifurcated and disposed around the valve stem 62 between the spaced pairs of lock nuts 63 shown in Figure 3.

In order to cause the lever 79 to operate quickly to shift the valve 61 without hesitation or in a gradual manner, as would be the case with the entire operation usually performed by the movement of the carriage, the reversing lever is extended for a short distance beyond its supporting shaft or fulcrum 71 and a roller 85 is mounted thereon and adjacent said roller is mounted a bracket or housing 86 having a spring-pressed plunger 87 supported therein said plunger having its head provided with oppositely inclined surfaces forming a double faced cam and being positively pressed against the roller 85 by its spring. This structure causes practically no movement of the link 77 when the roller 85 is ascending one side or cam face of the plunger 87 but upon passing the apex of said cam face or roller the outwardly projected plunger will cause the roller to snap over said apex and down the opposite cam face practically instantaneously shifting the parts associated therewith and the reversing valve 61.

In Figures 13 and 14 we have also illustrated mechanism for increasing and decreasing the out-put of the pump 11 and associated carriage 66 which is adapted to decrease the speed of the carriage 66 toward the end of its travel and to increase the speed of said carriage at the begining of its travel in a reverse direction. In order to slow up the carriage toward the end of the travel it is necessary to shift the valve 41 to one posi-

tion and in order to speed up the carriage it is necessary to shift the same valve to the opposite position.

In order to provide operating means for the valve controlled by the position of the carriage, a cam 88 is also adjustably carried by the dog 67, held in position by a set-screw 89, and by adjusting said cam longitudinally of the carriage the amount of retardation may be varied. A lever 90 having a roller 91 carried at one end has its opposite end fixed on a shaft 92 on the outside of the frame. The inner end of said shaft 92 extends into the interior of the frame and has fixed on its inner end an arm 93 to the opposite end of which is pivoted one extremity of a connecting rod or link 94 and to the opposite end of which is pivoted an arm 95 fixed on a shaft 96 journaled in a bracket 97 secured by means of bolts 98 to the frame 65. An arm 99 is fixed on the opposite end of shaft 96 and said arm is provided with a bifurcated extremity 100. The bifurcated end is adapted to engage the valve stem 45 of the valve 41 for operating the same and spaced lock nuts 101 are provided between which the bifurcated end 100 is adapted to be positioned.

In order to reduce the speed of the carriage 66 toward the end of its travel the cam 88 must be set so that the arm 90 will be depressed before the reversing lever 70 is thrown and the amount of time intervening between the depression of the arm 90 and the throwing of the reversing lever 70 may be varied by adjusting said cam 88.

It will be obvious to those skilled in the art that various changes may be made in our device without departing from the spirit of our invention, and we therefore, do not limit ourselves to what is shown in the drawings and described in the specification, but only as set forth in the appended claims.

Having thus fully described our said invention, what we claim as new and desire to secure by Letters Patent, is:

1. The combination with a device having a reciprocating movement of a motor for driving such device, fluid passages leading to said motor, a pump for supplying fluid through said passages, valved means in said fluid passages for directing the fluid in opposite directions for reversing the motor, means for varying the capacity of said pump, means operable near the limit of movement of the reciprocating device for operating the said capacity varying means to reduce pump capacity and thus to relieve the load on the pump, substantially as set forth.

2. The combination with a device having a reciprocating movement of a motor for driving such device, fluid passages leading to said motor, a pump for supplying fluid through said passages, valved means in said fluid passages for directing the fluid in opposite directions for reversing the motor, means for varying the capacity of said pump, means operable near the limit of movement of the reciprocating device in either direction for operating the said capacity varying means, and means operable at the limit of the reciprocation for operating the said reversing means, substantially as set forth.

3. The combination with a device having a reciprocating movement of a motor for driving such device, fluid passages leading to said motor, a pump for supplying fluid through said passages, valved means in said fluid passages for directing the fluid in opposite directions for reversing the motor, means for varying the capacity of said pump, means for limiting the movement of said capacity varying means and automatically operable means for operating the capacity varying means as the recipricating device approaches the limit of its movement in one direction and begins its movement in the opposite direction, substantially as set forth.

In witness whereof, we have hereunto set our hands and seals at Waynesboro, Pennsylvania, this 6th day of July, A. D., nineteen hundred and twenty-six.

AMOS P. STEINER.
HAROLD E. BALSIGER.