C. J. COLEMAN.

HYDRAULIC GOVERNOR.

APPLICATION FILED JULY 22, 1908.

995,117.

Patented June 13, 1911.

3 SHEETS—SHEET 1.

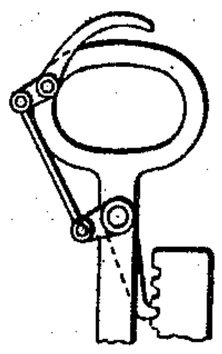
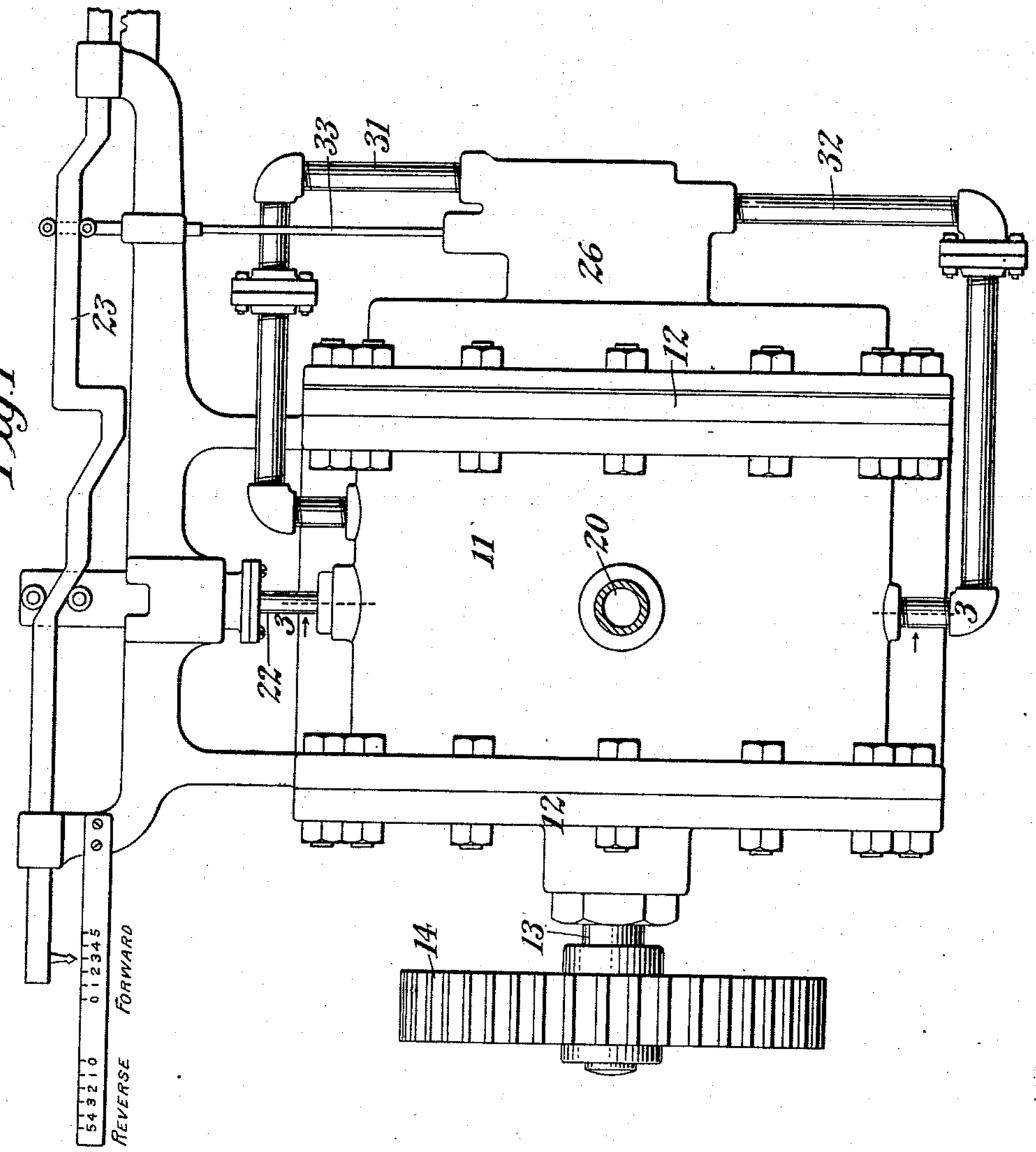


Fig. 1



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Wm. Ashley Kelly

Inventor:
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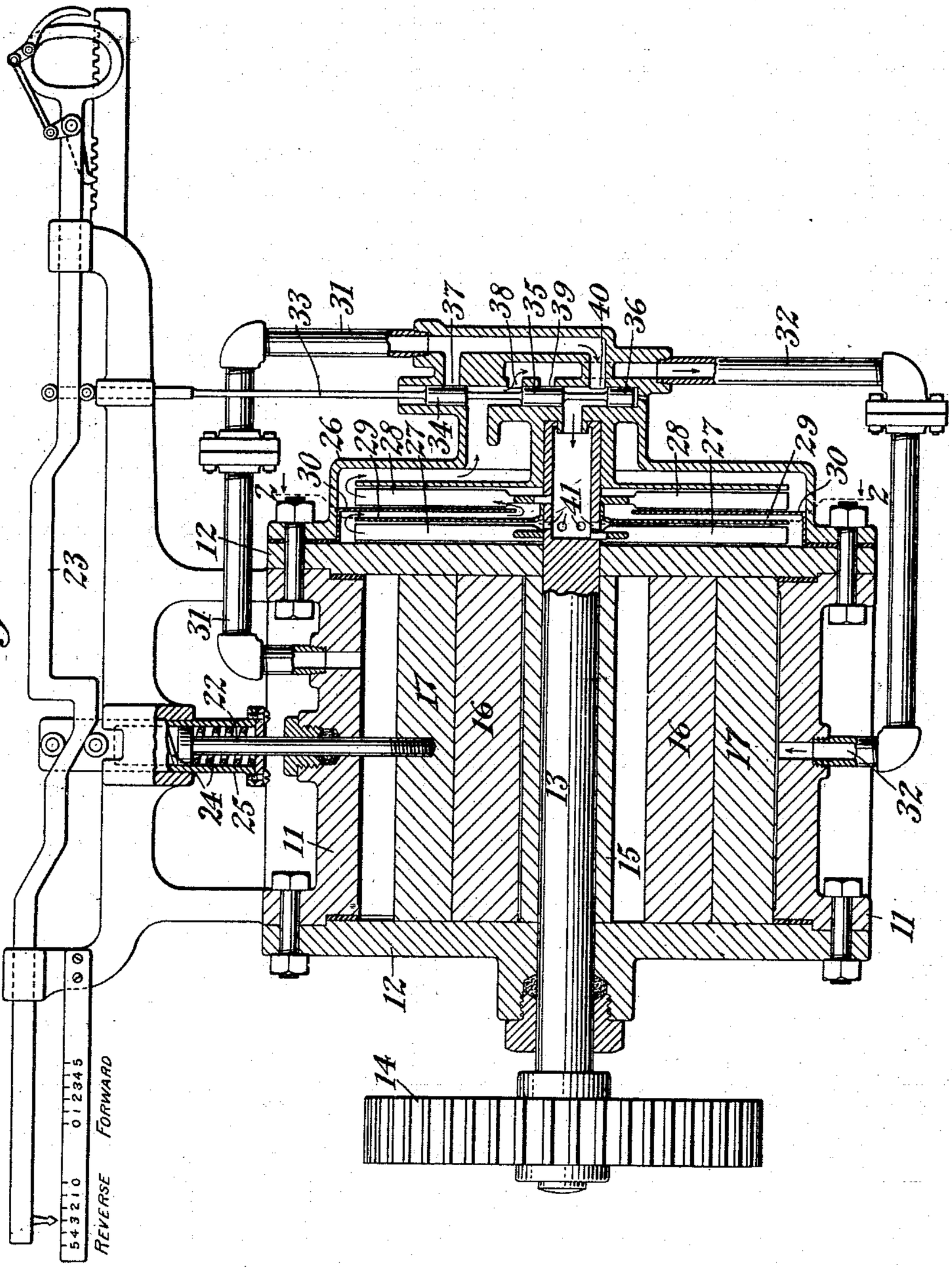

Fig. 2

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3 SHEETS—SHEET 3.

Fig. 4

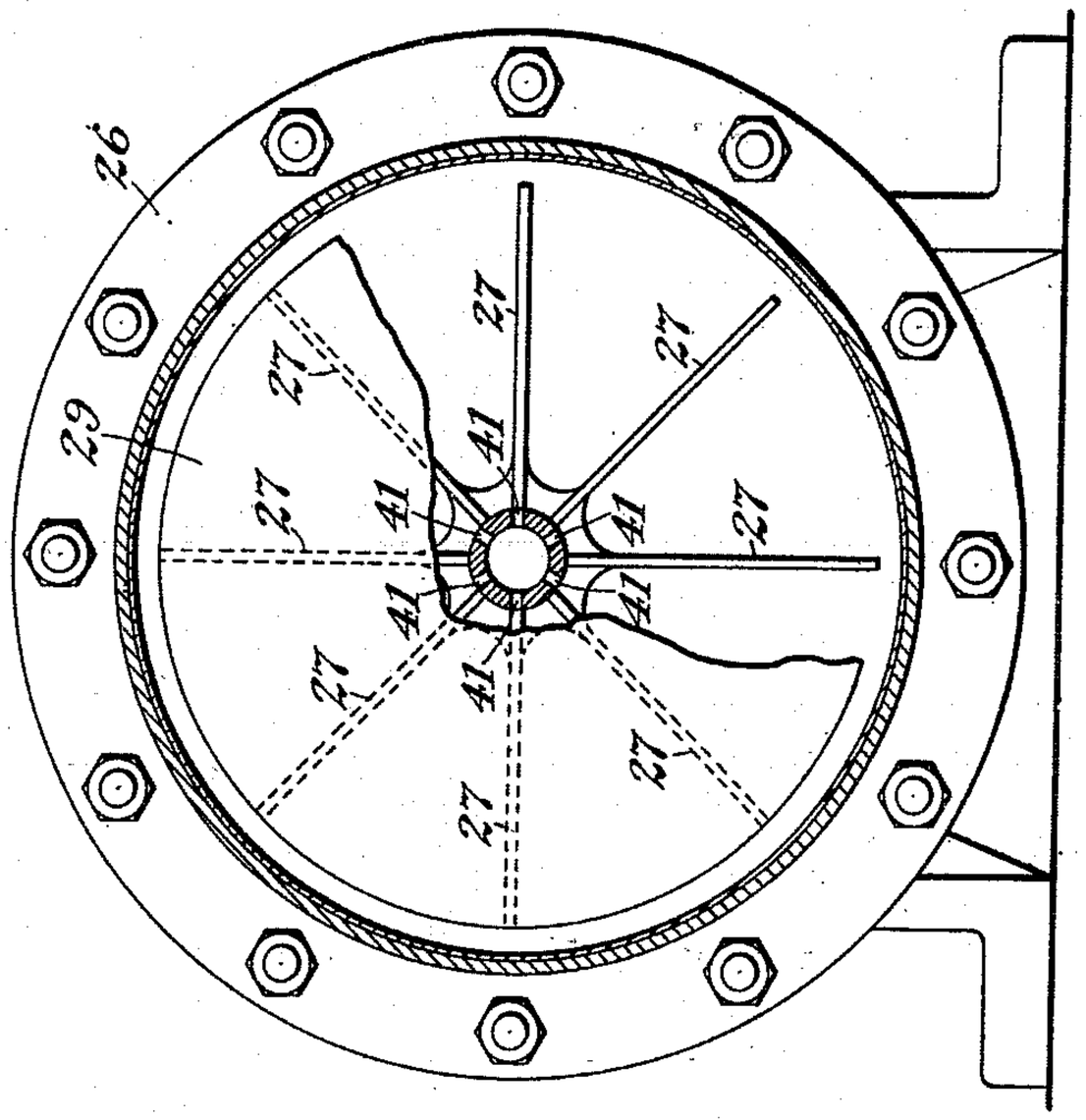
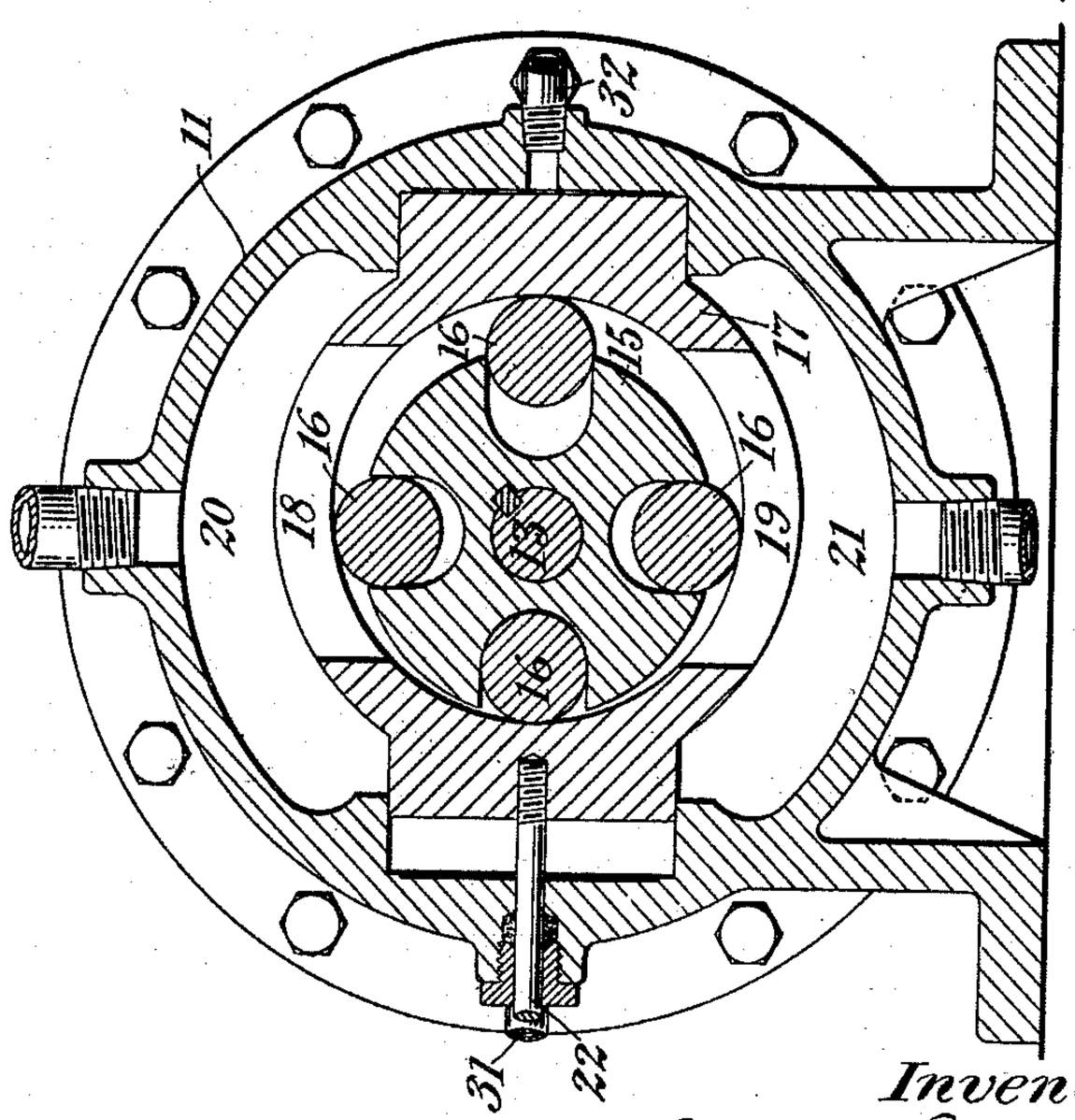


Fig. 3



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UNITED STATES PATENT OFFICE.

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HYDRAULIC GOVERNOR.

995,117. Specification of Letters Patent. **Patented June 13, 1911.**

Application filed July 22, 1908. Serial No. 444,725.

To all whom it may concern:

Be it known that I, CLYDE J. COLEMAN, a citizen of the United States, residing at the borough of Manhattan, city of New York, in the county of New York and State of New York, have invented a certain new and useful Improvement in Hydraulic Governors, of which the following is a specification, reference being had therein to the accompanying drawings, forming part thereof.

My invention relates generally to means for regulating the speed of motors and relates particularly to a hydraulic pressure device for governing hydraulic motors which are adapted to operate under substantially constant hydraulic pressure and are required to operate at varying fixed speeds when subjected to varying loads, by regulating the eccentric relation of the rotary piston of the motor to the cylinder.

The principal object of my invention is to secure simplicity, delicacy and accuracy of speed regulation of the motor; other objects and advantages of my invention will appear from the following description.

My invention includes a hydraulic device for regulating the speed of motors, such hydraulic speed-regulating device being attached to and operated by the motor and the pressure exerted by it being proportioned to the speed of the motor; such device being shown as a centrifugal pump in the illustrated embodiment of my invention.

My invention also includes manually controllable means to regulate the effect of the hydraulic pressure of the governor on the speed of the motor and so vary the fixed speed at which the motor operates.

My invention also includes manually controllable means for reversing the connections of the governor with the motor only while the motor is in its neutral or inoperative position.

My invention also includes certain other features and details of construction which will appear from the particular description of the embodiment of my invention shown. Such embodiment will now be shown with reference to the accompanying drawings, after which I shall point out my invention in claims.

Figure 1 is a top view of a hydraulic motor together with the complete hydraulic regulating mechanism, showing the connections between the governor and motor and the manually controllable means to regulate and reverse the governor and motor. Fig. 2 is a horizontal central section of what is shown in Fig. 1. Fig. 3 is a vertical section on the line 3—3 of Fig. 1 looking toward the right, showing the governor connections. Fig. 4 is a sectional view of the governor on the line 2—2 of Fig. 2 looking toward the left.

The hydraulic motor shown is of the type which consumes variable quantities of liquid per cycle according to the amount of load upon the motor or the amount of work that it is required to do, and belongs to the particular class of this type in which the liquid consuming capacity is altered by changing the eccentricity of a rotary piston relatively to its cylinder. This hydraulic motor has a cylindrical casing comprising the flanged side inclosure or frame 11, having downward extensions as shown forming a base or support for the motor, and the end pieces or heads 12 which form also cylinder heads for the motor. The side inclosure and the heads are joined together in a liquid-tight manner with interposed gaskets which are drawn together by bolts as shown. A rotary shaft 13 passes centrally through the heads 12 and has its bearings therein made liquid-tight by packing glands. Exteriorly to the casing one end of the shaft 13 carries a gear wheel 14 for operatively connecting the motor to any tool or mechanism to be driven thereby; and the other end extends into and operates the governor which is fastened to the end piece 12 and of which my invention chiefly consists and which will be fully described hereinafter. Interiorly of the casing a rotary piston 15 is concentrically fixed upon the shaft 13 as by a key as shown and fits closely at its ends between the heads 12. The piston is provided with longitudinal channels or grooves in which are located rollers or cylindrical wings 16, the wings being free to move radially in the grooves and, when the motor is in operation, being forced outwardly by centrifugal force.

The cylinder for the motor comprises a cylindrical block 17 with rectangular ex-

tensions constituting pistons on two opposite sides, as shown, which extend into corresponding recesses in the casing and allow the cylinder to slide transversely to the axis of the piston, thereby varying the relative degree of eccentricity of the cylinder to the piston. The cylinder embraces the piston and is of a bore cylindrical but of a larger diameter than the piston, exclusive of the radially movable wings, which in operation are held in contact with the inner surface of the cylinder by centrifugal force.

The cylinder is provided with an inlet port 18 and an outlet or exhaust port 19 located vertically diametrically opposite to each other. These ports are of sufficient width to always communicate respectively with corresponding inlet and exhaust openings 20 and 21 in the casing at any position of the cylinder. As the piston is intended to rotate in either direction, according to the position of the cylinder, the inlet and exhaust ports respectively extend equally in opposite directions circumferentially of the bore of the cylinder, so as to preserve corresponding relations to the piston in the opposite positions of the cylinder. The exhaust port is of sufficient width to prevent trapping of the exhaust liquid by the rollers or wings of the piston such as would lock the motor.

The lateral sliding movement of the cylinder is limited in each direction by the bottoms of the recesses so that the cylinder and piston cannot come in contact and thus lock the motor. The bottom of the recesses is hollowed outward so that the cylinder projections cannot fit tightly into the bottom of the recesses and thus ready movement of the cylinder is facilitated. The cylinder projections are of a sufficient width to always close the recess even when the cylinder is in its farthest opposite position, as shown in Fig. 3, and fit so tightly into the recess that there can be no communication between the recess and the motor.

It is evident that the direction of rotation of the piston will be changed by shifting the slidable cylinder from one side to the other of the piston. If a motive liquid be supplied to the motor at a constant pressure or at a pressure which does not vary so widely as to be beyond the limits of motor control, then the speed of the motor will depend upon the extent to which the cylinder is shifted away from its middle position. It is obvious that the motor will run at the highest speed or will produce the greatest torque when the piston eccentricity is the greatest. By shifting the cylinder so as to produce different degrees of eccentricity to its piston, the motor may be kept at a constant or fixed speed while doing variable amounts of work, and likewise the motor may be made to operate at different set or fixed speeds regardless of the amount of work that it is doing, within the capacity of the motor.

The means for shifting the cylinder to different positions consists of a spring rod 22 screwed into one side of the cylinder, as shown, which is operated by a sliding lever 23. The spring rod has a flat head, which is held between two mutually and equally opposed helical compression or thrust springs 24 preferably under some initial tension, which are retained in place by the spring box 25, which slides through a sleeve in the frame as shown. In Fig. 1, the lever is positioned so as to pull the cylinder one way to its farthest eccentric position and in Fig. 2 the reverse condition is shown. It is evident that in Fig. 2, though the cylinder 17 is in contact with the shoulder in the recess and can be pushed no farther, still, by pressing the bar in until the index points to 4 or 5, an increased pressure will be exerted on the spring rod and the outer spring 24 will be compressed and its tension increased, with the result that a greater resistance is offered to moving the cylinder toward its concentric position than is the case when the lever is in the position shown in Fig. 2. And the same result for movement in the opposite direction is attained by pulling the bar to the right from the position shown in Fig. 1 until the index points to 4 or 5. Consequently this provides a manually controllable means to regulate the resistance to the action of the governor as hereinafter described, and hence a means for changing the fixed speed at which the motor operates.

To secure a substantially constant motor speed at varying loads, the hydraulic governor, shown at the right of Figs. 1 and 2 within the casing 26, is provided. The casing 26 is fastened in a liquid-tight manner to the head 12 by means of bolts and gaskets. The governor consists of two sets of centrifugal blades or fans, 27 and 28, arranged as spokes in a wheel as shown in Fig. 4. These blades are fastened to the extension of shaft 13 and rotate as the shaft is rotated. Between the two sets of blades are two disks or partitions 29 and 30, the former integral with the shaft but not extending to the casing 26, and the latter integral with the casing but not extending to the shaft. Thus communication between the two sets of blades is provided as shown by the arrows. Communication between the governor and motor is provided by pipes 31 and 32, which are screwed into the casing 26, as shown, and enter the bottom of the recesses into which the cylinder extensions slide. A three-piston valve 33 is operated by the sliding bar 23, and its three pistons 34, 35 and 36 control respectively the four ports 37, 38, 39 and 40, so that when the valve is down,

as shown in Fig. 2, ports 37 and 39 are closed and 38 and 40 are open; and when the valve is raised as in Fig. 1, ports 38 and 40 are closed and 37 and 39 opened. Pipe 32 communicates with ports 38 and 39 and 31 communicates with ports 37 and 40. That portion of the shaft 13 which extends into the governor casing is hollow, as shown, and perforations 41 are provided which communicate between the hollow in the shaft and the blades 27. The governor chamber is partitioned so as to form the proper communications between the pipes and ports and the blade chambers of 27 and 28. This whole system is filled with liquid and when the shaft revolves and so rotates the blades 27 and 28, the liquid is made to rotate and hydraulic pressure is exerted, which is communicated to one side or the other of the motor through pipes 32 or 31, according to whether the pistons of the valve 33 are down or up, respectively. This operation will now be more fully described.

In Fig. 2, the cylinder 17 is shown as pushed to its farthest eccentricity toward the side with which pipe 32 communicates. This is done by pushing the sliding bar 23 inward, as shown. At the same time that the spring rod and cylinder are pushed in by the lever, it is evident that the piston-valve 33 is also pushed down, thus, since ports 37 and 39 are closed and 38 and 40 open, forming communication from pipe 31 through port 40, through the hollow shaft, the perforations 41, the blade-chamber 27 to blade-chamber 28, out of port 38 and thence through pipe 32 to the cylinder 17. If it be assumed that the motor is receiving liquid at a substantially constant pressure, then so long as the load upon the motor is constant, the speed will remain constant. Should the load on the motor be diminished, the tendency to increased speed will cause the blades 27 and 28 to be rotated faster and hence increased hydraulic pressure exerted which is communicated by pipe 32, as described, to the cylinder 17, pressing it toward the center, and thus, since it is less eccentric, the liquid consuming capacity is lessened and the speed diminished until it becomes steady at the normal rate. When the cylinder was pressed toward the center by the governor, it compressed the outer spring 24, and hence, as soon as the speed is reduced and the pressure exerted through 32 diminished, the spring will return the cylinder to its former position. Thus a fixed speed is maintained. If now the bar is pushed in to its farthest extent, as already described, the tension of the springs will be increased and more pressure must be exerted by the governor to move the cylinder toward its concentric position and hence the fixed speed of the motor is increased.

When the motor is reversed, as shown in Fig. 1, the reverse condition obtains in the governor, since, when the sliding bar is pulled out to reverse the motor, the piston-valve is also pulled out until ports 37 and 39 are open and pistons 35 and 36 close ports 38 and 40. Communication may then be traced as follows: from pipe 32, through port 39, through the hollow shaft, perforations 41, blade-chamber 27 to 28, and thence through port 37 to pipe 31, and so to the side of the motor to which the cylinder 17 is moved. The operation of the governor is just the same as previously described; and the tension of the springs may be increased by pulling the lever out until the index reaches 4 or 5, and thus the fixed speed of the motor in its forward movement be increased.

It is now apparent that the motor is adapted and is automatically controlled so as to maintain a substantially fixed speed while operating under varying loads. It is also obvious that variations in the pressure of the motive liquid within certain restricted limits will not vary the speed of the motor by reason of the operation of the hydraulic governor.

It is evident in Fig. 2 that the reversal of the piston-valve, that is, its passing up or down the slanting portion between the positions shown in Figs. 1 and 2, takes place while the cylinder is in its neutral or inoperative position, that is, while the spring-rod is on the horizontal portion between the positions shown in Figs. 1 and 2.

It is obvious that various modifications may be made in the construction shown and above particularly described within the principle and scope of the invention.

I claim:

1. In combination with a hydraulic motor comprising a rotary piston and a slidable cylinder embracing the piston, means actuated by the motor for creating hydraulic pressure, and means adapted to deliver the hydraulic pressure thus created to one side of the cylinder when the motor is running in one direction and to the other side of the cylinder when the motor is reversed.

2. In combination with a hydraulic motor comprising a rotary piston and a slidable cylinder embracing the piston and with means for reversing the motor, means actuated by the motor for creating hydraulic pressure, two pressure pipes connecting the hydraulic pressure-creating means with the motor, one pipe leading to each side of the slidable cylinder, and means combined with the reversing means and actuated in conjunction therewith to open one of the pressure pipes and close the other.

3. In combination with a reversible rotary motor and means for reversing the motor, a hydraulic governor for regulating the speed of the motor, comprising a plurality

of rotatable fans for giving centrifugal force to a liquid, the fans being rotated by the motor and reversed therewith, two pressure-conducting pipes leading from the governor to the motor, one arranged to communicate with the motor when the motor is running in one direction and the other to communicate with the motor when the motor is running in the opposite direction, and means combined with the reversing means and arranged to open one pipe and close the other as the motor is reversed.

4. In combination with a hydraulic motor comprising a rotary piston and a slidable cylinder embracing the piston and with means for reversing the motor, a hydraulic governor for regulating the relative eccentricity of the piston and cylinder, comprising a plurality of rotatable fans for giving centrifugal force to a liquid, the fans being rotated by the motor and reversed therewith, two pressure-conducting pipes leading from the governor to the motor, one pipe leading to one side of the slidable cylinder and the other pipe leading to the other side of the slidable cylinder, and means combined with the reversing means and arranged to open one pipe and close the other as the motor is reversed.

5. In combination with a hydraulic motor comprising a rotary piston and a cylinder embracing the piston, a governor for regulating the eccentricity of the cylinder and motor, comprising a plurality of rotatable fans for giving centrifugal force to a liquid, means for transmitting such force as desired, and resilient means tending to oppose the force exerted by the governor liquid and to maintain the speed of the motor.

6. In combination with a hydraulic motor comprising a rotary piston and a cylinder embracing the piston, a hydraulic governor for regulating the eccentricity of the cylinder and motor, comprising a plurality of rotatable fans for giving centrifugal force to a liquid, a plurality of pressure pipes leading therefrom to opposite sides of the cylinder of the motor, and manually operable means to open or close the pressure pipes as desired.

7. In combination with a hydraulic motor comprising a rotary piston and a cylinder embracing the piston, a hydraulic governor for regulating the eccentricity of the cylinder and motor, comprising a plurality of rotatable fans for giving centrifugal force to a liquid, two pressure pipes leading therefrom to conduct the force to opposite sides of the cylinder of the motor manually-operable means to open one of the pressure pipes and close the other as the motor is reversed, and resilient means tending to oppose the force thus exerted and to maintain the speed of the motor.

8. In combination with a hydraulic motor having a rotary piston and an adjustable cylinder embracing the piston, a hydraulic governor comprising a plurality of rotatable fans for giving centrifugal force to a liquid, the fans being rotated in the liquid by the motor, the force created thereby being proportionate to the speed with which the fans are rotated, controlling passages opening respectively into the casing at each side of the cylinder laterally, pipes to conduct the force thus created through such controlling passages to act upon the cylinder of the motor and vary the degree of cylinder eccentricity relative to the piston, and manually operable means for directing the governing force through either the one pipe or the other at will.

9. In combination with a hydraulic motor having a rotary piston and an adjustable cylinder embracing the piston, a hydraulic governor comprising a plurality of rotatable fans for giving centrifugal force to a liquid, the fans being rotated in the liquid by the motor, controlling passages opening respectively into the casing at each side of the cylinder laterally, pipes to conduct the force thus created through such controlling passages to act upon the cylinder of the motor and vary the degree of cylinder eccentricity relative to the piston, manually-operable means for directing the governing force through either the one pipe or the other at will, and resilient means tending to oppose the force thus exerted on the cylinder and restore it to its former position.

10. In combination with a hydraulic motor having a rotary piston and an adjustable cylinder embracing the piston, a hydraulic governor comprising a plurality of rotatable fans for giving centrifugal force to a liquid, the fans being rotated in the liquid by the motor, controlling passages opening respectively into the casing at each side of the cylinder laterally, pipes to conduct the force thus created through such controlling passages to act upon the cylinder of the motor and vary the degree of cylinder eccentricity relative to the piston, manually-operable means for directing the governing force through either the one pipe or the other at will, resilient means tending to oppose the force thus exerted on the cylinder and restore it to its former position, and manually-controllable means to increase the force of the resilient means and thus increase the fixed speed at which the motor operates.

11. In combination with a hydraulic motor having a rotary piston and an adjustable cylinder embracing the piston, a hydraulic governor comprising a plurality of rotatable fans for giving centrifugal force to a liquid, the fans being rotated in the liquid by the motor, controlling passages opening respectively into the casing at each side of the cylinder laterally, pipes to conduct the force thus created through such

controlling passages to act upon the cylinder of the motor and vary the degree of cylinder eccentricity relative to the piston, ports opening from the governor to the pipes, a three-piston valve manually operable to open and close such ports as desired, resilient means tending to oppose the force thus exerted on the cylinder and restore it to its former position, and manually-controllable means to increase the force of the resilient means and thus increase the fixed speed at which the motor operates.

In testimony whereof I have affixed my signature in presence of two witnesses.

CLYDE J. COLEMAN.

Witnesses:

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BERNARD COWEN.