N. McCARTY.

GOVERNED PUMP.

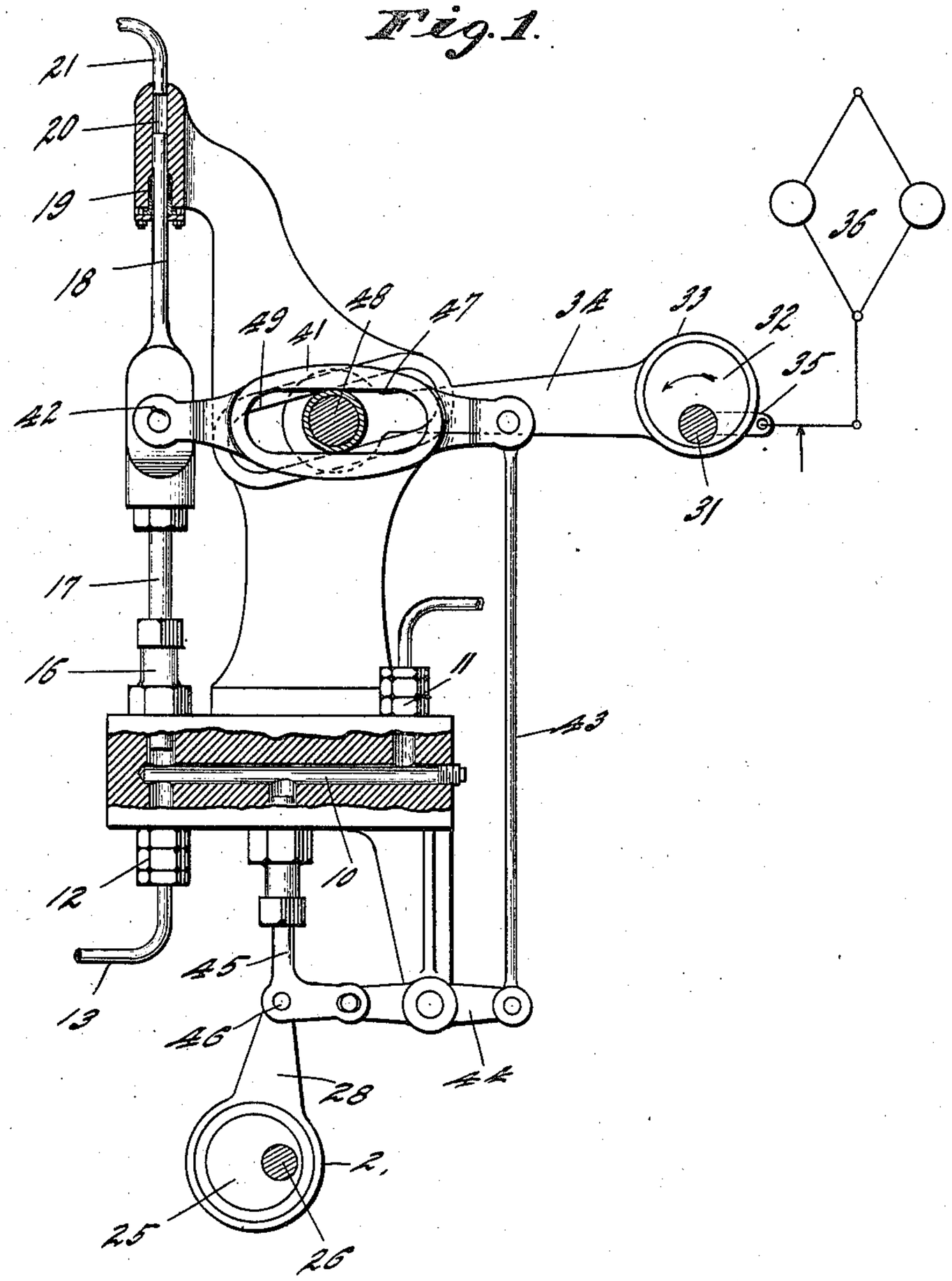
APPLICATION FILED DEC. 18, 1908.

943,987.

Patented Dec. 21, 1909.

3 SHEETS—SHEET 1.

Fig. 1.



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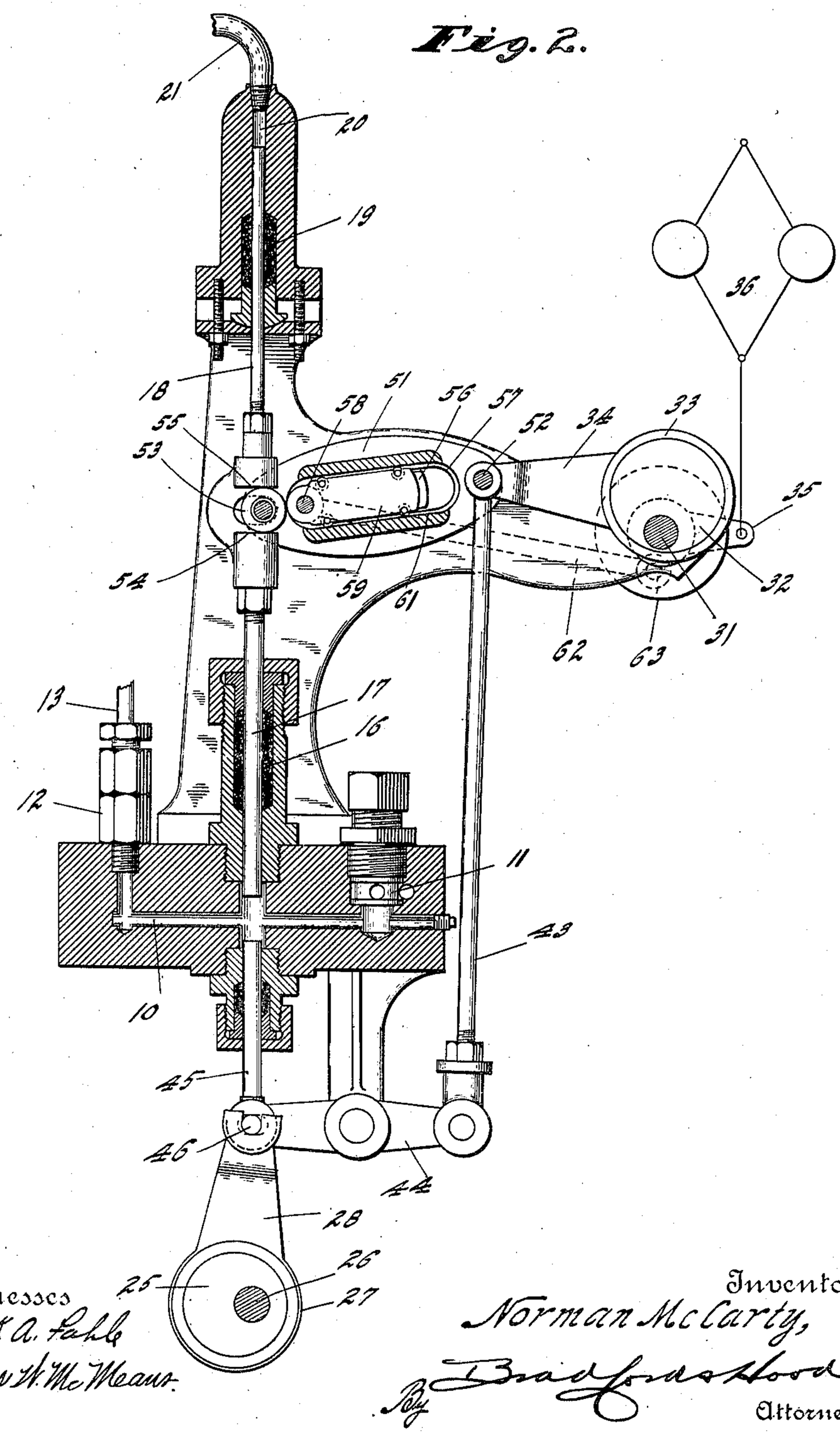
3 SHEETS—SHEET 2.

Fig. 2.



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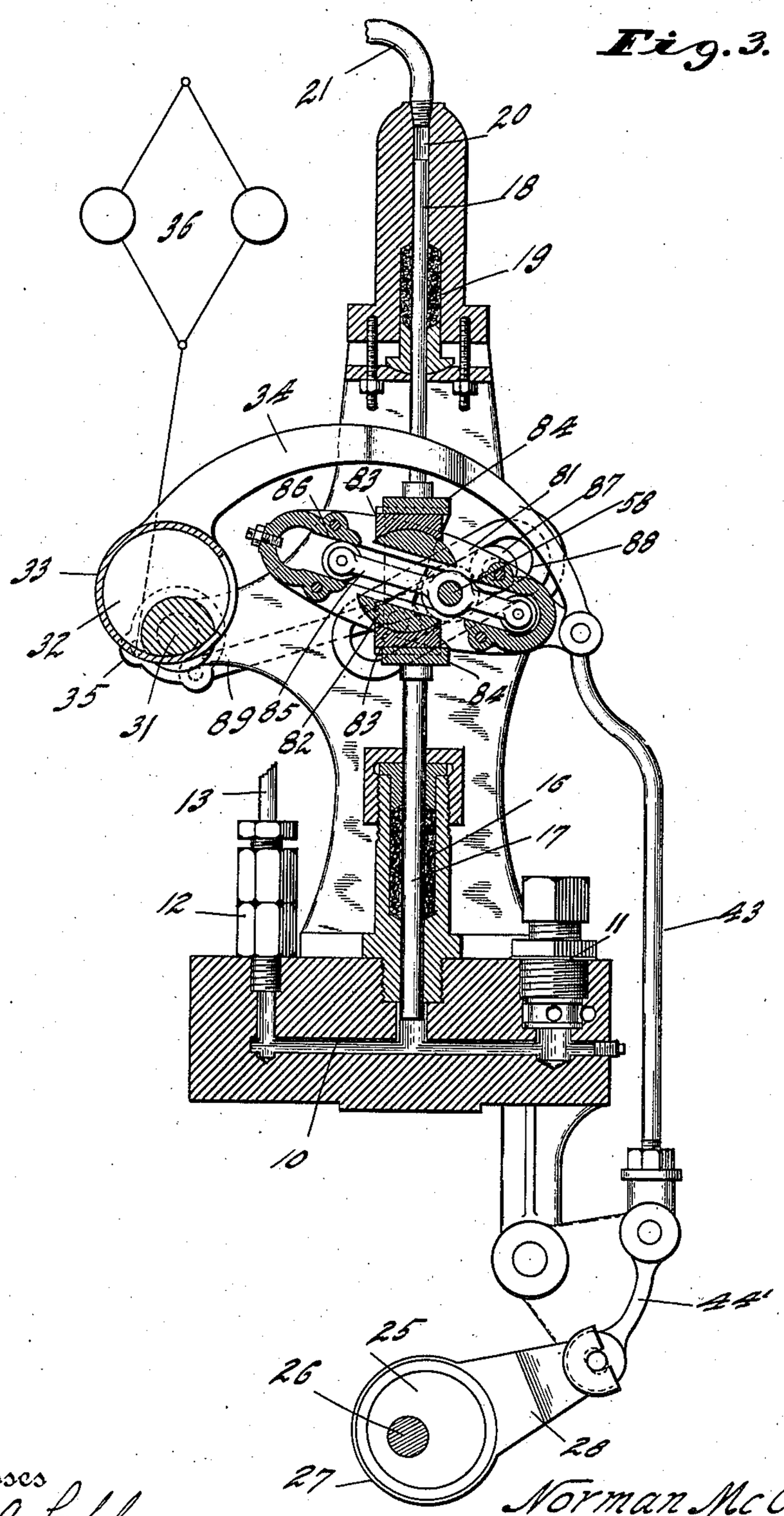
3 SHEETS—SHEET 3.

Fig. 3.



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UNITED STATES PATENT OFFICE.

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GOVERNED PUMP.

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To all whom it may concern:

Be it known that I, NORMAN McCARTY, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented certain new and useful Improvements in Governed Pumps, of which the following is a specification.

In that class of internal combustion motors in which the liquid fuel is introduced into the combustion chamber after there has been sufficient compression of an initial air charge to raise such air charge to a temperature high enough to ignite the injected fuel, it has been found that the only practical means of controlling the speed of the motor is by accurately measuring each injected volume of fuel, and for that purpose a pump is ordinarily used, said pump being provided with a suction valve which is controlled in such manner as to permit greater or less back-flow.

The object of my present invention is to provide a pump wherein the outflow is controlled by means of a piston of variable throw, such throw being controlled by a speed controlled governor connected to the motor. In one form of such apparatus the piston of movable throw acts as a compensator for an ejecting piston of fixed throw and is positively actuated in connection therewith, the compensating piston of movable throw serving to increase, to a greater or less extent, the capacity of the pump chamber subsequent to a charging of such chamber. In another form of the present invention the piston of fixed throw is omitted and the piston of variable throw depended upon for the ejection of material from the pump chamber.

A further object of my invention is to provide means by which there will be a uniform pump loading on the governor in both directions of the stroke of the ejecting mechanism thus eliminating "jumping" of the speed controlled governor which controls the pump.

The accompanying drawings illustrate my invention.

Figure 1 is a side elevation in partial section of a pump constructed in accordance with my invention, the fulcrum of the controlling lever being movable; Fig. 2 a similar view of a pump wherein both the fulcrum and the controlling lever are movable to vary the lever ratio, and Fig. 3 a view similar to Fig. 2 with the fixed stroke piston omitted, thus showing the operability of the device with the variable stroke piston alone.

In the drawings, 10 indicates a pump chamber, 11 a suction valve or check valve giving admission thereto, and 12 a check valve through which the discharge passes from the pump chamber 10 to the discharge pipe 13, the check valve 12 preventing any back flow from the discharge pipe 13. As is common in this art a very considerable pressure is maintained in the discharge pipe 13 as said pipe connects with the atomizer by means of which the fuel is blown into the combustion chamber of the motor.

Leading into the pump chamber 10, through a suitable packing gland 16, is a variable stroke piston 17 the total possible stroke of which produces a displacement in the pump cylinder equal to the maximum discharge from the pump chamber. Piston 17 at its outer end is provided with a balancing piston 18, having an area preferably one half the area of piston 17, and said piston 18 passes through a suitable packing gland 19 into a chamber 20 which is connected by a pipe 21 with any suitable source of pressure, but preferably with the atomizer with which pipe 13 is connected so that a constant ratio of pressures be maintained.

The pump mechanism is driven by means of an eccentric 25 carried by a shaft 26 driven from the motor (not shown) the eccentric 25 carrying a strap 27 to which is secured the driving arm 28.

The controlling mechanism for controlling the stroke of piston 17 comprises, in part, a rock shaft 31 carrying an eccentric 32 upon which is mounted an eccentric strap 33 provided with an arm 34. The rock shaft 31 is connected by an arm 35 with the speed controlled governor 36. To this extent the structures shown in the three figures of the drawings are identical and are therefore correspondingly numbered.

In Fig. 1 the controlling mechanism for the variable stroke governing piston comprises, in addition to the parts already described, a lever 41 which is pivoted at 42 to the compensating piston 17 and at its opposite end is connected, by a link 43 and a lever 44, with a fixed-stroke piston 45 which

enters the pump chamber, said piston 45 being connected at 46 with the arm 28 of the driving eccentric. Lever 41 is provided with an intermediate slot 47 receiving a fulcrum 48 which fulcrum is movably mounted in a stationary guide 49 the axis of which is in a plane practically coincident with the angle of the lever 41 when the governing plunger 17 is at its innermost position. By this arrangement it is possible to vary the ratio of the controlling lever 41, and consequently vary its effect upon the compensating or governing piston 17, while at the same time causing the piston 17, to always reach an initial and certain innermost position. The fulcrum 48 is connected to arm 34 of eccentric strap 33 and is moved thereby.

In Fig. 2 the construction is shown as provided with a fixed-stroke piston 45 which is connected at 46 to arm 28 and this piston is connected by lever 44 with link 43. The controlling lever of the compensating piston 17 differs somewhat in form, but not in the principle, from that shown in Fig. 1 and is the same as is shown in Fig. 3. In Fig. 2 a controlling lever 51 is connected at 52 to the eccentric arm 34 and to the upper end of link 43. At its opposite end lever 51 is provided with a pair of rollers 53, (one on each side) which take between a pair of opposed shoulders 54 and 55 formed on the compensating piston 17. A fulcrum carrier 56 is movably mounted in a stationary guide 57, the angle of which corresponds to the angle of lever 51 when the piston 17 is in its innermost position as shown in the drawings, and this fulcrum carrier 56 is provided with a fulcrum 58 which projects into a carrier 59 (similar to carrier 56) which lies within a slot 61 formed in lever 51. The carrier 59 is arranged to receive fulcrum 58 at one end so that said fulcrum may be brought close to the axis of rollers 53 and thus reduce, when fulcrum 58 is at one extreme of its position, the effect of the movement of link 43 upon lever 51. A link 62 connects fulcrum 58, or the carriers to which it is connected, with a wrist pin 63 carried by rock shaft 31 said wrist pin being opposite eccentric 32 so that, as the rock shaft 31 is moved lever 51 will be shifted bodily in one direction and fulcrum 58 will be shifted in the opposite direction, thus varying the ratio of the arms of lever 51 by an amount double what it would be if only the fulcrum, or only the lever, were shifted. By this arrangement a very small movement of the speed controlled governor 36 will serve to produce a very considerable effect on the driving connection of the compensating piston 17.

The construction shown in Fig. 3 differs from that shown in Fig. 2 merely by the omission of the fixed-stroke piston 45 and the substitution of a bell crank lever 71 in place of the lever 44 in order to properly time the movement of piston 17 relative to the driving shaft 26. In Fig. 3 I have shown a construction of the controlling lever 81, and its mounting, which permits a substantial elimination of the lever ratio, *i. e.*, which reduces one arm of the lever practically to zero so that when the fulcrum 58 is in one extreme position there will be either no movement whatever of the compensating piston 17 or only such slight movement as is necessary to inject that small quantity of fuel which is sufficient to keep the motor running under no load or its fixed minimum load. Lever 81 extends across the axis of piston 17 and is provided with a pair of fingers 82 which together form a trunnion therefor upon which shoes 83 83 are journaled, said shoes having a transverse sliding movement between shoulders 84. 84 formed on piston 17. The fulcrum 58 is journaled in a carrier 85 which is longitudinally movable within a slot 86 formed in lever 81 and said fulcrum is also journaled in a carrier 87 which is longitudinally movable within an inclined slot 88 formed in a portion of the main frame of the structure. Fulcrum 58 is connected by a link 89 with the shaft 31. In Fig. 3 fulcrum 58 is shown at one extreme of its possible movement in which position lever 81 has the greatest possible effect upon piston 17, being driven by means of link 43 and bell-crank-lever 44′ from the arm 28. By shifting eccentric 32 to the right the parts will be shifted until the axis of fulcrum 58 practically coincides with the axis of trunnion 82 so that in that position the lever 81 will have the least possible effect upon piston 17. It will be seen, therefore, that the stroke of piston 17 may be varied from maximum to minimum by rocking shaft 31.

Turning now to Fig. 1, it will be seen that, in operation, the controlling piston 17 will always be brought to a certain initial innermost position owing to the fact that the inclination of guide 49 corresponds with the initial position of the controlling lever 41. At this time the ejecting piston 45 is at its outermost position and pump chamber 10 has therefore its initial receiving capacity, which is constant, and fuel flows from the reservoir into chamber 10 past the suction valve 11. Further movement of shaft 26 causes an inward or displacing movement of piston 45 and this movement, through lever 45 and link 43, swings the controlling lever 41 upon fulcrum 48 and causes the controlling piston 17 to rise, thus increasing the capacity of the pump chamber. If fulcrum 48 be in one extreme position the upward movement of the left hand end of lever 41 will be sufficient to retract the controlling piston 17 an amount sufficient to increase the capacity of the pump chamber

by an amount exactly equal to the displacement of piston 45 and there will be no outflow from the pump chamber. By shifting fulcrum 48 to the left the length of the right hand end of controlling lever 41 will be increased, the length of the left hand end of said lever decreased, and the fulcrum of the lever moved downward so that the effect of the unchanged length of stroke of the right hand end of lever 41 upon piston 17 will be materially decreased although there has been but a very small movement of the rock-shaft 31. The pump-chamber-enlarging movement of piston 17 will, therefore, be decreased to a greater or lesser extent depending upon the amount of change produced by the shifting of fulcrum 48 and there will be a difference between the capacity-increase due to the insertion of piston 45 into chamber 10, and the consequent discharge of a greater or less amount of material from the pump chamber.

In Fig. 3 the action is substantially the same as that already described except that, as the fulcrum is moved in one direction the lever is shifted in the other direction and consequently the leverage ratio is varied (by a given amount of movement of the governor) very considerably more than it is in the construction shown in Fig. 1, and the sensitiveness of the apparatus is therefore greatly increased. In the construction shown in Fig. 3 the time of movement of the plungers 17 is advanced 180° relative to the movement of shaft 26 and the governing plunger becomes itself the ejecting plunger. Its initial position is constant and certain but its outward and return throws are varied by the action of the speed controlling governor so that the inflow and subsequent outflow from the pump will be varied in accordance with the needs of the motor.

Turning now to the balancing feature of the invention. Assuming that the pressure maintained in pipe 13 is a thousand pounds to the square inch and that piston 17 presents an area of one-fifth of an inch, there will be a total upward pressure of 200 lbs. upon piston 17 whenever said piston is moved downwardly and this force would of course operate, at least to some extent, in resisting a change of relation between the controlling lever and its fulcrum and would therefore operate against the speed controlled governor. On the other hand the upward movement of the piston 17 causes it to be relieved practically from all pressure and consequently the speed controlled governor will be relieved on the up stroke of piston 17 to whatever extent it had been loaded on the down stroke of piston 17. If therefore a load of one-half the load on piston 17 be applied to said piston in opposition to the first load, there will be a balancing of forces at all times acting upon the speed controlled governor, excepting only the short times of reversal of movement of the piston 17. Consequently the piston 18, which is connected to piston 17, has one-half of the area of piston 17 and chamber 20 is connected to the same source of pressure as pipe 13 so that there is a downward load of 100 lbs. exerted at all times upon piston 17 through piston 18. Consequently, on the up stroke of piston 17, there is a friction load of 100 lbs. upon the connection between piston 17 and the governor 36 and on the down stroke of piston 17 there is also a friction load of 100 lbs. upon this connection, this load being the difference between the resisting pressure against piston 17 in chamber 10 and the pressure on piston 18. It is true that the direction of these two forces upon the connecting mechanisms between piston 17 and the speed controlled governor are not the same but it will be noticed that the formation and arrangement of the parts connecting the piston 17 with the speed controlled governor is such that forces applied to the left hand end of the controlling lever operate as friction loads rather than motive loads upon the speed controlled governor and cannot in fact be appreciably transmitted to the speed controlled governor as motive loads, the eccentric 32 preventing this.

I claim as my invention:

1. The combination, with a pump chamber having an inlet valve, an outlet valve and a piston coöperating with the pump chamber, of a compensating piston also cooperating with the pump chamber, a positive reversing driving connection between the pump piston and the compensating piston whereby movement of the pump piston will produce opposite movement of the governing piston relative to the pump chamber, and means for adjusting said driving connection to vary the effect of the movement of the pump piston upon the compensating piston.

2. The combination, with a pump chamber having an inlet valve, outlet valve and a piston coöperating with the pump chamber, of a compensating piston also coöperating with the pump chamber, a lever engaging the compensating piston, a reversing connection between said lever and the pump piston, and means for varying the lever ratio and for shifting the lever to vary the effect of movement of the pump piston on the compensating piston.

3. The combination, with a pump chamber having an inlet valve, outlet valve and a piston coöperating with the pump chamber, of a compensating piston also coöperating with the pump chamber, a lever engaging the compensating piston, a reversing connection between said lever and the pump piston, and means for varying the lever ra-

tio to vary the effect of movement of the pump piston on the compensating piston.

4. The combination, with a pump chamber having an inlet valve, an outlet valve and a piston coöperating with the pump chamber, of a compensating piston also cooperating with the pump chamber, a reversing driving connection between the pump piston and the compensating piston whereby movement of the pump piston may produce opposite movement of the governing piston relative to the pump chamber, and means for adjusting said driving connection to vary the effect of the movement of the pump piston upon the compensating piston, and means for applying a partial balancing force upon the compensating piston in opposition to the force resulting thereon within the pump chamber said balancing force being equal to half the internal force.

5. The combination, with a pump chamber having an inlet valve, an outlet valve and a piston coöperating with the pump chamber, of a compensating piston also cooperating with the pump chamber, a reversing driving connection between the pump piston and the compensating piston whereby movement of the pump piston may produce opposite movement of the governing piston relative to the pump chamber, and means for adjusting said driving connection to vary the effect of the movement of the pump piston upon the compensating piston, and means for applying a partial balancing force upon the compensating piston in opposition to the force resulting thereon within the pump chamber.

6. The combination, with a pump chamber having an inlet valve, outlet valve and a piston coöperating with the pump chamber, of a compensating piston also coöperating with the pump chamber, a lever engaging the compensating piston, a reversing connection between said lever and the pump piston, and means for varying the lever ratio and for shifting the lever to vary the effect of movement of the pump piston on the compensating piston and means for applying a partial balancing force upon the compensating piston in opposition to the force resulting thereon within the pump chamber said balancing force being equal to half the internal force.

7. The combination, with a pump chamber having an inlet valve, outlet valve and a piston coöperating with the pump chamber, of a compensating piston also coöperating with the pump chamber, a lever engaging the compensating piston, a reversing connection between said lever and the pump piston, and means for varying the lever ratio to vary the effect of movement of the pump piston on the compensating piston, and means for applying a partial balancing force upon the compensating piston in opposition to the force resulting thereon within the pump chamber, said balancing force being equal to half the internal force.

8. The combination, with a pump chamber having an inlet valve, outlet valve and a piston coöperating with the pump chamber, of a compensating piston also coöperating with the pump chamber, a lever engaging the compensating piston, a reversing connection between said lever and the pump piston, and means for varying the lever ratio and for shifting the lever to vary the effect of movement of the pump piston on the compensating piston and means for applying a partial balancing force upon the compensating piston in opposition to the force resulting thereon within the pump chamber.

9. The combination, with a pump chamber having an inlet valve, outlet valve and a piston coöperating with the pump chamber, of a compensating piston also coöperating with the pump chamber, a lever engaging the compensating piston, a reversing connection between said lever and the pump piston, and means for varying the lever ratio to vary the effect of movement of the pump piston on the compensating piston and means for applying a partial balancing force upon the compensating piston in opposition to the force resulting thereon within the pump chamber.

10. The combination, with a pump chamber having an inlet valve, an outlet valve and a piston coöperating with the pump chamber, of means for variably controlling the movement of said piston relative to the pump chamber, a speed controlled governor connected with said controlling means, and means for applying a partial balancing force upon the piston in opposition to the force resulting from within the pump chamber.

11. The combination, with a pump chamber having an inlet valve, an outlet valve and a piston coöperating with the pump chamber, means adapted for connection with a speed controlled governor engaging the piston and variably controlling the throw, a balancing piston carried by the first piston, a pressure chamber coöperating with said last mentioned piston, and fluid conductors connecting said pressure chamber and the outlet side of the outlet valve of the pump chamber with a common source of fluid pressure.

12. The combination, with the piston of a pump, of a driving lever therefor, a fulcrum for said lever, and means for shifting said fulcrum relative to the lever to vary the lever ratio thereof to vary the stroke of the piston.

13. The combination, with the piston of a pump, of an operating lever connected with said piston, a fulcrum for said lever, and means for shifting said fulcrum rela-

tive to the lever into or out of substantial coincidence with the connection between said lever and piston.

14. The combination, with the piston of a pump, of an operating lever having a trunnion, a sliding shoe connection between said lever and trunnion, a fulcrum for said lever movable longitudinally thereof toward and from the axis of the trunnion, a support for said fulcrum, and means for varying the relation of the fulcrum to the trunnion.

15. The combination, with the piston of a pump, of an operating lever having a trunnion, a sliding shoe connection between said lever and trunnion, a fulcrum for said lever movable longitudinally thereof toward and from the axis of the trunnion, a guide within which the fulcrum is supported said guide being inclined relative to the line of movement of the piston, and means for shifting the fulcrum in its guide and relative to the trunnion.

16. The combination, with the piston of a pump, of an operating lever having a trunnion, a sliding shoe connection between said piston, and trunnion, a fulcrum for said lever movable longitudinally thereof toward and from the axis of the trunnion, a guide within which the fulcrum is supported and means for shifting the fulcrum in its guide and relative to the trunnion.

17. The combination, with the piston of a pump, of an operating lever having a trunnion, a sliding shoe connection between said piston, and trunnion, a fulcrum for said lever movable longitudinally thereof toward and from the axis of the trunnion, a guide within which the fulcrum is supported said guide being inclined relative to the line of movement of the piston for simultaneously shifting the fulcrum and lever in opposite directions to vary the distance between the trunnion and fulcrum.

18. The combination, with the piston of a pump, of an operating lever having a trunnion, a sliding shoe connection between said piston and trunnion, a fulcrum for said lever movable longitudinally thereof toward and from the axis of the trunnion, a guide within which the fulcrum is supported and means for simultaneously shifting the fulcrum and lever in opposite directions to vary the distance between the trunnion and fulcrum.

19. The combination, with a pump chamber having an inlet valve and an outlet valve, of two plungers arranged in said pump chamber, positive driving connections for simultaneously oppositely moving said plungers relative to the pump chamber, and means for varying the displacement of at least one of said pistons to vary the discharge of volume through the outlet valve.

In witness whereof, I, have hereunto set my hand and seal at Indianapolis, Indiana, this third day of December, A. D. one thousand nine hundred and eight.

NORMAN McCARTY. [L. S.]

Witnesses:
ARTHUR M. HOOD,
THOMAS W. McMEANS.