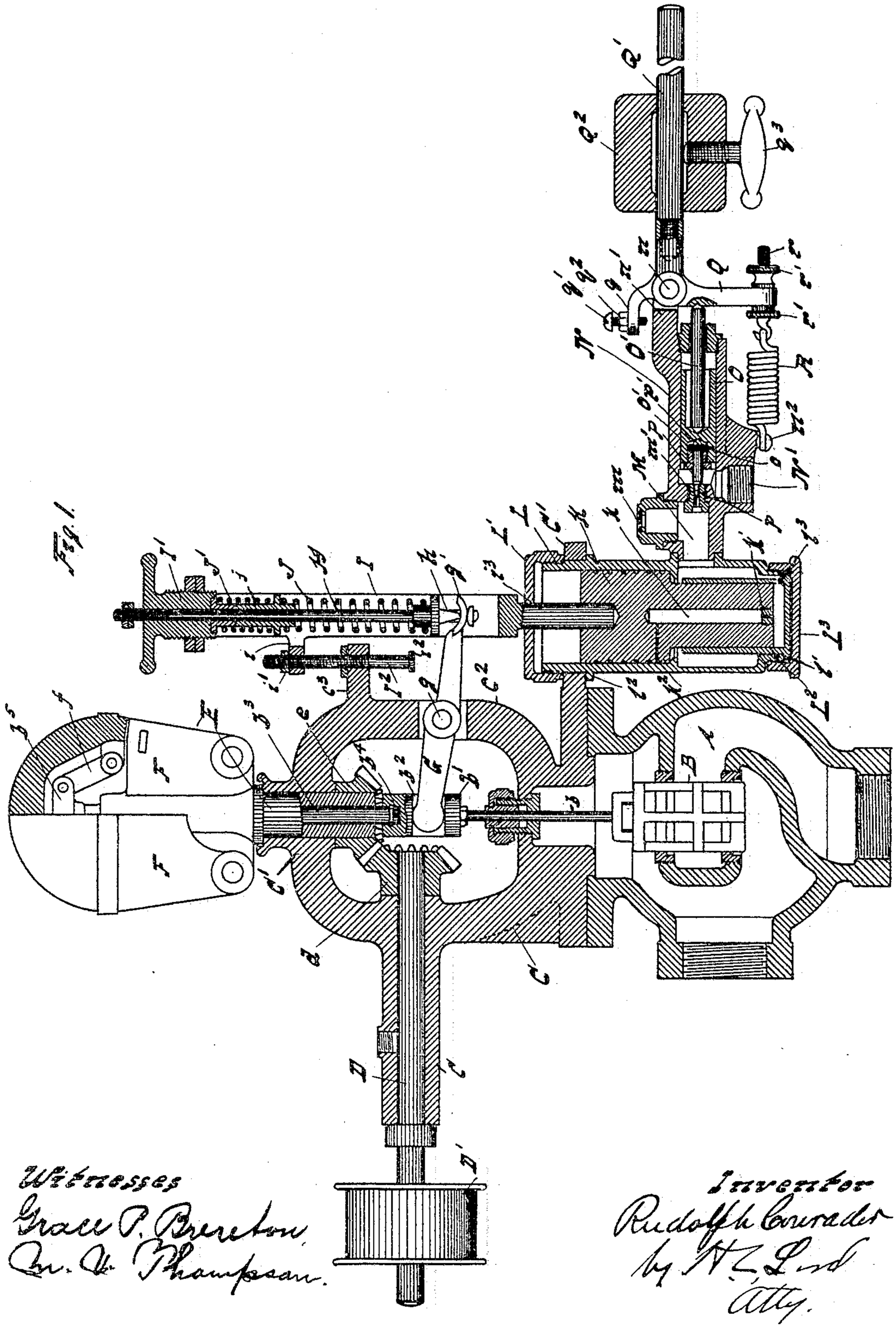
No. 775,391. PATENTED NOV. 22, 1904.

# R. CONRADER.

## PUMP GOVERNOR.

APPLICATION FILED JAN. 29, 1902.

NO MODEL. 3 SHEETS—SHEET 1.



Witnesses
Grace P. Breton
Jr. A. Thompson.

Inventor
Rudolph Conrader
by H. L. Lind
Atty.

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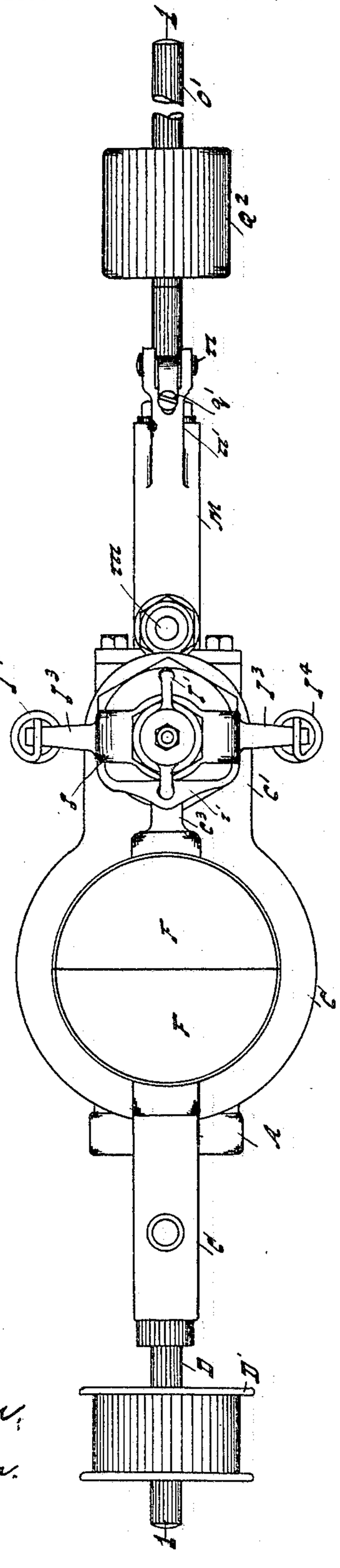
NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2.




Witnesses
Grace F. Brereton.
Wm. A. Thompson.

Inventor
Rudolph Conrader
by W. L. Lord
Atty

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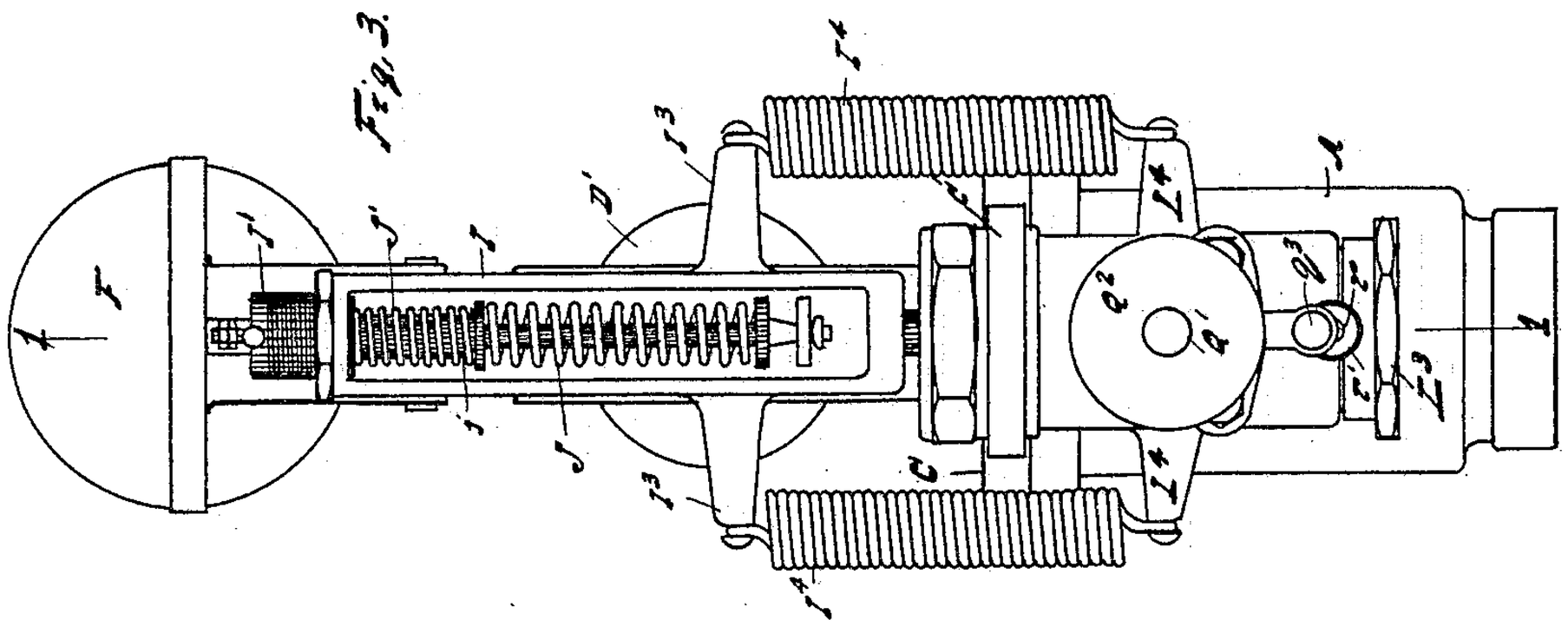
## PUMP GOVERNOR.

APPLICATION FILED JAN. 29, 1902.

NO MODEL. 3 SHEETS—SHEET 3.

Fig. 3.




Witnesses
Grace O. Brereton.
Jno. V. Thompson.

Inventor
Rudolph Conrader
by W. L. Lord
Atty

No. 775,391. Patented November 22, 1904.

# UNITED STATES PATENT OFFICE.

RUDOLPH CONRADER, OF ERIE, PENNSYLVANIA.

## PUMP-GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 775,391, dated November 22, 1904.

Application filed January 29, 1902. Serial No. 91,784. (No model.)

*To all whom it may concern:*

Be it known that I, RUDOLPH CONRADER, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented certain new and useful Improvements in Pump-Governors; and I do hereby 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.

This invention relates to pump-governors; and it consists in certain improvements in the construction thereof, as will be hereinafter fully described, and pointed out in the claims.

The invention forms an improvement on the governor shown in my Patent No. 664,468, of December 25, 1900. I do not wish to be limited, however, to a governor-regulator.

The invention is illustrated in the accompanying drawings, as follows:

Figure 1 shows a section on the line 1 1 in Figs. 2 and 3. Fig. 2 shows a plan view of the regulator. Fig. 3 shows a side elevation looking from the right of Fig. 2.

The invention is illustrated as applied to a pump-governor, and so illustrated A marks the valve-chamber; B, the valve; *b*, the valve-stem; C, the governor-frame, in which there is the drive-shaft bearing arm *c*, in which is journaled the drive-shaft D. The drive-pulley D′ is fixed on the drive-shaft D. The bevel-gear *d* is fixed on the inner end of the shaft D. The governor-carrier E is journaled in the head *c′* of the arm C′. Fixed on the lower end of the carrier is the bevel-gear *e*, meshing the bevel-gear *d*. Secured to the carrier in the usual manner are the governor-weights F F. The yoke *b′* is fixed on the shaft *b*. Journaled on this yoke and extending upwardly therefrom is the upper part of the stem $b^3$. On the top of this stem is the cross-head $b^5$. The link *f* connects this cross-head with the weights F. The yoke *b′* is provided with the slot $b^2$, in which is arranged the rounded end of the centripetal lever G. The centripetal lever G is journaled on the pin *g* of the arm $c^2$ of the governor-frame.

On the inner end *g′* of the lever G is arranged the pin H, which extends upwardly from said lever through the nut I′ on the yoke I. The yoke I is provided with the guide-pin $I^2$, which is secured to the arm *i*, extending from the yoke by means of a screw on said pin. It is locked in position by the jam-nut *i′*. The end of the pin is provided with the head $i^2$, which forms a stop which prevents the complete closing of the regulator-valve B. Arranged around the pin H are the springs J J′, the spring J being of greater strength than the spring J′. A shoulder-sleeve *j* is arranged within the spring J′, and this by contacting the nut I′ limits the action of the spring J′. When the sleeve *j′* is in contact with the nut I′, the spring J′ is thrown out of action and the governor is subjected to a centripetal force of the heavier spring J. The strength of the centripetal element may be adjusted by the nut I′, which is screwed into the yoke I.

The lower end of the yoke is provided with a stem $i^3$, which rests upon the piston K of the regulator-motor. The piston K operates in the cylinder L. The lower part of the piston is of smaller diameter than the upper and fits into the supplemental cylinder $L^2$. The cylinder L is secured to an extension C′ of the frame C. That the parts may be conveniently assembled the cylinder is provided with a shoulder $l^2$. The cylinder is passed through a perforation in the extension C′ and a cap L′ screwed onto the end of the cylinder against the extension, thus securing the parts. Air or fluid is admitted to the cylinder from the chamber M. The supplemental cylinder $L^2$ has the flange *l′* on its lower end, which engages the bottom of the cylinder L. The cap $L^3$ is screwed onto the bottom of the chamber L for securing the supplemental cylinder $L^2$ in place. A minute opening $l^3$ extends from the cylinder L into the supplemental cylinder $L^2$, and this arrangement operates as a dash-pot, preventing too rapid action of the piston K. In order that the parts may be thoroughly lubricated and an oil seal provided for the piston K, I provide the piston with the perforation *k*, into which there is a minute opening *k′* from the supplemental cylinder $L^2$. The perforation *k* communicates through the lateral opening $k^2$ with the surface of the piston K. The bottom part of the cylinder L

may be filled with oil, and this operated through the minute opening $l^3$ gives greater dash-pot effect than would direct application of air, and in addition the oil is forced through the openings $k'$, $k$, and $k^2$ to the surface of the piston. Arranged at the sides of the yoke I are the lugs $I^3$, and arranged at the side of the cylinder are the lugs $L^4$. The springs $I^4$ are tensioned between the lugs $I^3$ and $L^4$. These springs are preferably of just sufficient strength to a little more than overcome the force of the spring J.

Air is admitted to the cylinder L from the chamber M. A supply-opening $m'$ leads from the cylinder N into the chamber M and a minute vent-opening $m$ leads from the chamber M to the atmosphere. Arranged in the opening $m'$ is the valve P with the needle end $p$. The valve is provided with a cap $p'$ at its end and is secured to a plunger O by means of a flange-nut $o$, arranged in a cavity $o'$ in the plunger O. The plunger O operates in the cylinder N. The receiver connection N′ leads into the cylinder N between the end of the plunger and the supply-opening $m'$. Extending outwardly from the plunger is a stem O′, which engages the lever Q. The lever Q is pivoted on a pin $n$, and the pin $n$ is secured to the arm $n'$, extending from the cylinder N. A spring R is secured to the lug $n^2$ on the cylinder and the end of the lever Q. The mechanism for securing the spring to the lever comprises the adjusting-bolt $r$ and thumb-screws $r'$, by which the bolt may be locked in position. Extending from the lever Q is an arm Q′, on which is adjustably mounted the weight $Q^2$. A screw $q^3$ is provided for locking the weight in any position. An arm $q$ extends from the upper end of the lever Q. A set-screw $q'$ is arranged in this arm in position to limit the swinging of the lever Q and the outward movement of the plunger O. A jam-nut $q^2$ is provided for locking the set-screw in an adjusted position.

The operation of the device is as follows: Air being admitted to the cylinder N exerts pressure on the plunger O. The weight $Q^2$ and the initial strength of the spring R are sufficient to hold the valve P seated until the minimum desired pressure of the receiver is reached. When the pressure in the receiver rises above this point, the plunger O is forced outwardly, thus moving the valve P from its seat, but the needle-point remains in the supply-opening $m'$. The spring R is relatively quite short, so that its strength or tension rapidly increases as the plunger moves. Thus the plunger O will occupy a given position with a given receiver-pressure, and a given capacity of opening by the needle-point $p$ is effected. The air passing into the chamber M creates pressure in said chamber. There is a constant escape of air or fluid, however, from the chamber M through the vent $m$. The pressure in the chamber, therefore, where the capacity of the supply-opening $m'$ is less than the size of the vent, is not very materially increased; but where the supply-opening is made considerably larger through the action of the plunger and the needle-valve then the pressure rises in the chamber M, and consequently in the cylinder L, in proportion to the difference in the capacities of the openings $m$ and $m'$. The springs $I^5$ increase in strength more rapidly than the spring J decreases, so that with a given pressure in the cylinder L the piston K will occupy a certain position in said cylinder, thus giving to the yoke I a certain position, and this varying the force of the centripetal element changes the speed of the governor, but operating upon the regulating-valve influences it to regulate. This mechanism can be made exceedingly sensitive and is capable of very fine adjustments. Where the desired receiver-pressure is, for example, one hundred pounds, and it is desired to keep this within one or two pounds of this pressure, it will be observed that the difference in pressure, if directly applied to the piston K, would not so overcome the frictional resistances of the parts as to effect a ready response of the piston. By using a secondary motor, as exemplified by the plunger O, with the supply and vent openings and varying the capacities of these the pressure operating upon the piston K can be made to vary with a variation of two or three per cent. in the receiver almost any per cent. desired, so that a positive yet sensitive movement of the piston can be effected, and consequently closer regulation than is believed to have been practical with devices of this class heretofore constructed.

The variation of pressure on the piston K relatively to the variation in the receiver may be adjusted by the adjustments on the springs R, which will vary it the relative change in strength of said spring with a given movement. The moment at which the valve P is opened—that is, the adjustment which will hold the valve P to its seat until the desired minimum receiver-pressure is reached—is preferably made through the action of the weight. The weight, however, as shown, does not materially change the force applied to the plunger O as the plunger moves, this change being practically taken care of by the spring R. The weight $Q^2$ may be dispensed with and the entire regulating effected by the spring R. I prefer, however, to utilize the weight for the reason above described.

It will be noted that with the present structure a given receiver-pressure within the limits of pressure desired will maintain the piston K at a practically fixed point so long as the receiver-pressure remains constant. The consequent adjustment of the centripetal element in this position of the piston K effects such an action of the governor as to give to the pump or supply medium a fixed capacity, so

that if the amount of fluid drawn from the receiver remains constant the supply of the receiver will remain constant and the governor will give to the pump a volume which will maintain the pump at a constant speed. In this respect this governor is distinguished from most governors of this class in that they maintain the pump at the maximum speed until the pressure in the receiver reaches the desired minimum, and then reduce the pump immediately to the minimum speed until the pressure of the receiver is reduced to below the minimum desired, when the pump is again brought to its maximum speed; or, in other words, such devices do not regulate the pump to a speed that will supply the amount exhausted and maintain it at that speed.

What I claim as new is—

1. In a pump-governor, the combination of a centripetal element and a centrifugal element arranged to act in opposition to said centripetal element; a motor actuated by a fluid for varying the relative strength of one of the elements; means for connecting said motor with a fluid-receiver, said motor being arranged to act with a change of pressure in a receiver; and means for intensifying the change of fluid-pressure on the motor over a change of pressure in the receiver.

2. In a pump-governor, the combination of a centripetal element and a centrifugal element arranged to act in opposition to said centripetal element; a motor actuated by a fluid for varying the relative strength of one of the elements; means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor being arranged to act with a change of pressure in a receiver; and means for intensifying the change of fluid-pressure on the motor over a change of pressure in the receiver.

3. In a pump-governor, the combination of a centripetal element and a centrifugal element arranged to act in opposition to said centripetal element; a motor actuated by a fluid for varying the relative strength of one of the elements; means for connecting said motor with a fluid-receiver, said motor being arranged to act with a change of pressure in a receiver; means for intensifying the change of fluid-pressure on the motor over a change of pressure in the receiver; and means for controlling the extent of said intensifying action.

4. In a pump-governor, the combination of a centripetal element and a centrifugal element arranged to act in opposition to said centripetal element; a motor actuated by a fluid for varying the relative strength of one of the elements; means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor being arranged to act with a change of pressure in a receiver; means for intensifying the change of fluid-pressure on the motor over a change of pressure in the receiver; and means for controlling the extent of said intensifying action.

5. In a pump-governor, the combination of a centripetal element and a centrifugal element arranged to act in opposition to said centripetal element; a motor actuated by a fluid for varying the relative strength of one of the elements; means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor being arranged to act with a change of pressure in the receiver; means for intensifying the change of fluid-pressure on the motor over a change of pressure in the receiver; and means for controlling the extent of said intensifying action and its proportion to the change of pressure in the receiver.

6. In a pump-governor, the combination of a centripetal element and a centrifugal element arranged to act in opposition to said centripetal element; a motor actuated by the pump fluid for varying the strength of the centripetal element; means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor being arranged to act with a change of pressure in the receiver; and means for intensifying the change of fluid-pressure on the motor over a change of pressure in the receiver.

7. In a pump-governor, the combination of a centripetal element and a centrifugal element arranged to act in opposition to said centripetal element; a motor actuated by the pump fluid for varying the strength of one of the elements within the limits of power exerted by the other element; means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor being arranged to act with a change of pressure in the receiver; and means for intensifying the change of fluid-pressure on the motor over a change of pressure in the receiver.

8. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor for varying the relative strength of one of the elements; a counter-pressure device arranged against said motor and increasing in force with a movement of the motor; means for connecting said motor with a receiver, the fluid-supply of which is to be regulated; and means for intensifying a change of pressure on the motor over that of the change of pressure in the receiver.

9. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor for varying the relative strength of said elements; means for connecting said motor with a fluid-receiver, said motor having a supply-opening from said means of connection and a vent-opening.

10. In a pump-governor, the combination of a centrifugal element; a centripetal element

arranged to act in opposition to said centrifugal element; a motor for varying the relative strength of said elements; means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor having a supply-opening from said means of connection and a vent-opening.

11. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor arranged to vary the strength of the centripetal element; means for connecting said motor with a fluid-receiver, said motor having a supply-opening from said means of connection and a vent-opening.

12. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor arranged to vary the relative strength of said elements; means for connecting said motor with a fluid-receiver, said motor having a supply-opening from said means of connection, and a vent-opening; and means for varying the relative capacities of the supply and vent openings.

13. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor arranged to vary the relative strength of said elements; means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor having a supply-opening from said means of connection and a vent-opening; and means for varying the relative capacities of the supply and vent openings.

14. In a pump-governor, the combination of a centrifugal element; a centripetal element comprising a plurality of springs, said centripetal element being arranged to act in opposition to said centrifugal element; a motor for varying said springs in and out of action to vary the strength of said centripetal element; and means for connecting said motor with a fluid-receiver, said motor having a supply-opening from said means of connection and a vent-opening.

15. In a pump-governor, the combination of a centrifugal element; a centripetal element comprising a plurality of springs, said centripetal element being arranged to act in opposition to said centrifugal element; a motor for varying said springs in and out of action to vary the strength of said centripetal element; and means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor having a supply-opening from said means of connection and a vent-opening.

16. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor arranged to vary the relative strength of said elements; means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor having a supply-opening from said means of connection and a vent-opening; and means for automatically varying the relative capacities of the supply and vent openings.

17. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor for varying the relative strength of said elements; means for connecting said motor with a fluid-receiver, said motor having a supply-opening from said means of connection, and a vent-opening; and means actuated by fluid under receiver-pressure for varying the relative capacities of the supply and vent openings.

18. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor for varying the relative strength of said elements; means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor having a supply-opening from said means of connection, and a vent-opening; and means actuated by fluid under receiver-pressure for varying the relative capacities of the supply and vent openings.

19. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor for varying the relative strength of said elements; means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor having a supply-opening from said means of connection and a vent-opening; means for automatically varying the relative capacities of the supply and vent openings; and means for controlling the extent of variation with a given variation of receiver-pressure.

20. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor for varying the strength of said centripetal element; means for connecting said motor with a fluid-receiver, said motor having a supply-opening from said means of connection, and a vent-opening; and means for automatically varying the relative capacities of the supply and vent openings.

21. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor for varying the strength of said centripetal element; means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor having a supply-opening from said means of connection, and a vent-opening; and means for automatically varying the relative capacities of the supply and vent openings.

22. In a pump-governor, the combination of a centrifugal element; a centripetal element ar-

ranged to act in opposition to said centrifugal element; a motor for varying the strength of said centripetal element; means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor having a supply-opening from said means of connection and a vent-opening; means for automatically varying the relative capacities of said openings with a variation of receiver-pressure; and means for controlling the extent of variation with a given variation of receiver-pressure.

23. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor for varying the relative strength of said elements; a counter-pressure mechanism varying in strength with a movement of the motor; means for connecting said motor with a fluid-receiver, said motor having a supply-opening from said means of connection and a vent-opening.

24. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor for varying the relative strength of said elements; a counter-pressure mechanism varying in strength with a movement of the motor; means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor having a supply-opening from said means of connection and a vent-opening.

25. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor for varying the relative strength of said elements; a counter-pressure mechanism varying in strength with a movement of the motor; means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor having a supply-opening from said means of connection, and a vent-opening; and means for automatically varying the capacities of said openings.

26. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor for varying the relative strength of said elements; a counter-pressure mechanism varying in strength with a movement of the motor; means for connecting said motor with a fluid-receiver, the fluid-supply of which is to be regulated, said motor having a supply-opening from said means of connection, and a vent-opening; means for automatically varying the relative capacities of the openings with a variation of receiver-pressure; and means for controlling the extent of variation with a given variation of receiver-pressure.

27. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a motor for varying the relative strength of said elements, said motor being provided with a supply and a vent opening; a controlling-motor; means for connecting said controlling-motor with a receiver; and a valve actuated by said controlling-motor and arranged to vary the capacities of said supply and vent openings.

28. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a regulating-motor arranged to vary the relative strength of said elements, said motor being provided with a supply and a vent opening; a controlling-motor; a counter-pressure device on said controlling-motor arranged to increase in strength with a movement of said motor; means for connecting said controlling-motor with a receiver; a valve actuated by said controlling-motor and arranged to vary the capacity of one of said openings with a movement of said motor.

29. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a regulating-motor arranged to vary the relative strength of said elements; a controlling-motor; a counter-pressure device on said controlling-motor arranged to increase in strength with a movement of said controlling-motor; means for connecting said controlling-motor with a receiver; a valve actuated by said controlling-motor and arranged to vary the capacity of one of said openings with a movement of said motor; and means for adjusting the counter-pressure device to vary the movement of the controlling-motor with a given change of receiver-pressure.

30. In a pump-governor, the combination of a centrifugal element; a centripetal element arranged to act in opposition to said centrifugal element; a regulating-motor arranged to vary the relative strength of said elements, said motor being provided with a supply and a vent opening; a controlling-motor; a counter-pressure device on said controlling-motor arranged to increase in strength with a movement of said controlling-motor; means for connecting said controlling-motor with a receiver; a valve mechanism actuated by said motor for varying the capacity of one of said openings and for controlling the supply-passage; means for varying the valve action in the opening to vary the relative capacities of the openings after the supply-passage is opened by the valve mechanism.

31. In a pump-governor, the combination of the chamber A; the valve B, arranged to operate in said chamber; centrifugal governor-weights; a stem between said weights and the valve; a lever operating upon said stem; the springs operating against said lever and forming the centripetal element of the governor; a yoke against which said centripetal spring is tensioned; counter-pressure springs arranged

on said yoke, said counter-springs being of greater strength than the centripetal springs; a motor-cylinder; a plunger in said cylinder arranged to operate against said yoke; a supply-chamber in connection with said cylinder; a supply-opening and vent-opening; the valve P *p*, arranged to open and close the supply-opening and vary its capacity; the cylinder N; the connection N′; the plunger O, in the cylinder N, connected with the valve P *p;* the lever Q; connections between the lever Q, and the plunger O; the spring R, arranged on said lever and forming a counter-pressure device against the plunger O; the weight-arm Q′, on the lever Q; and adjustable weights $Q^2$, on said arm.

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

RUDOLPH CONRADER.

Witnesses:

GRACE E. YARD,

H. C. LORD.