

R. CONRADER.
PUMP GOVERNOR.

APPLICATION FILED SEPT. 25, 1905.

937,228.

Patented Oct. 19, 1909.

3 SHEETS—SHEET 1.

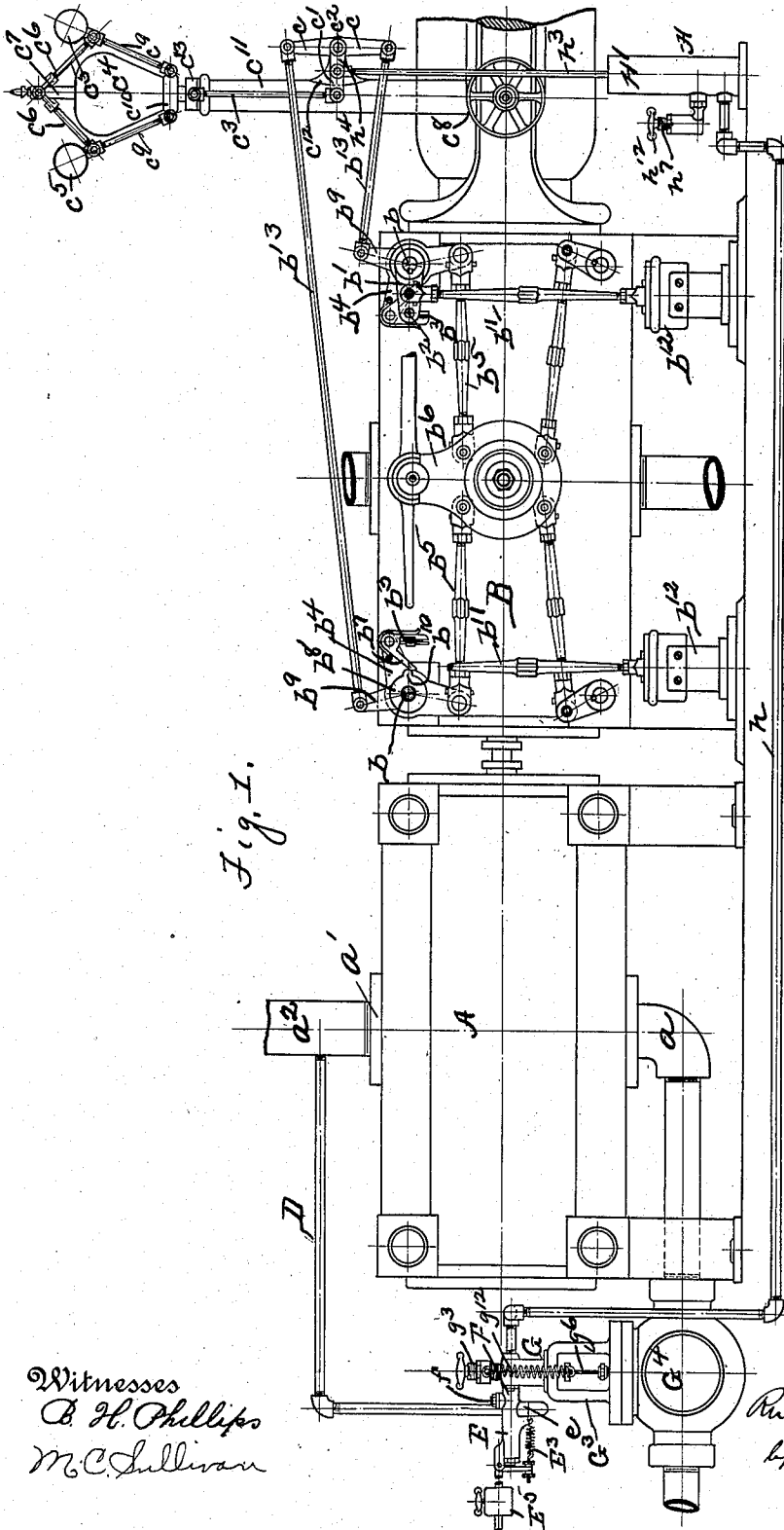


Fig. 1.

Witnesses
B. H. Phillips
M. C. Sullivan

Inventor
Rudolph Conrader
by H. C. L. m
Attorney

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3 SHEETS—SHEET 2.



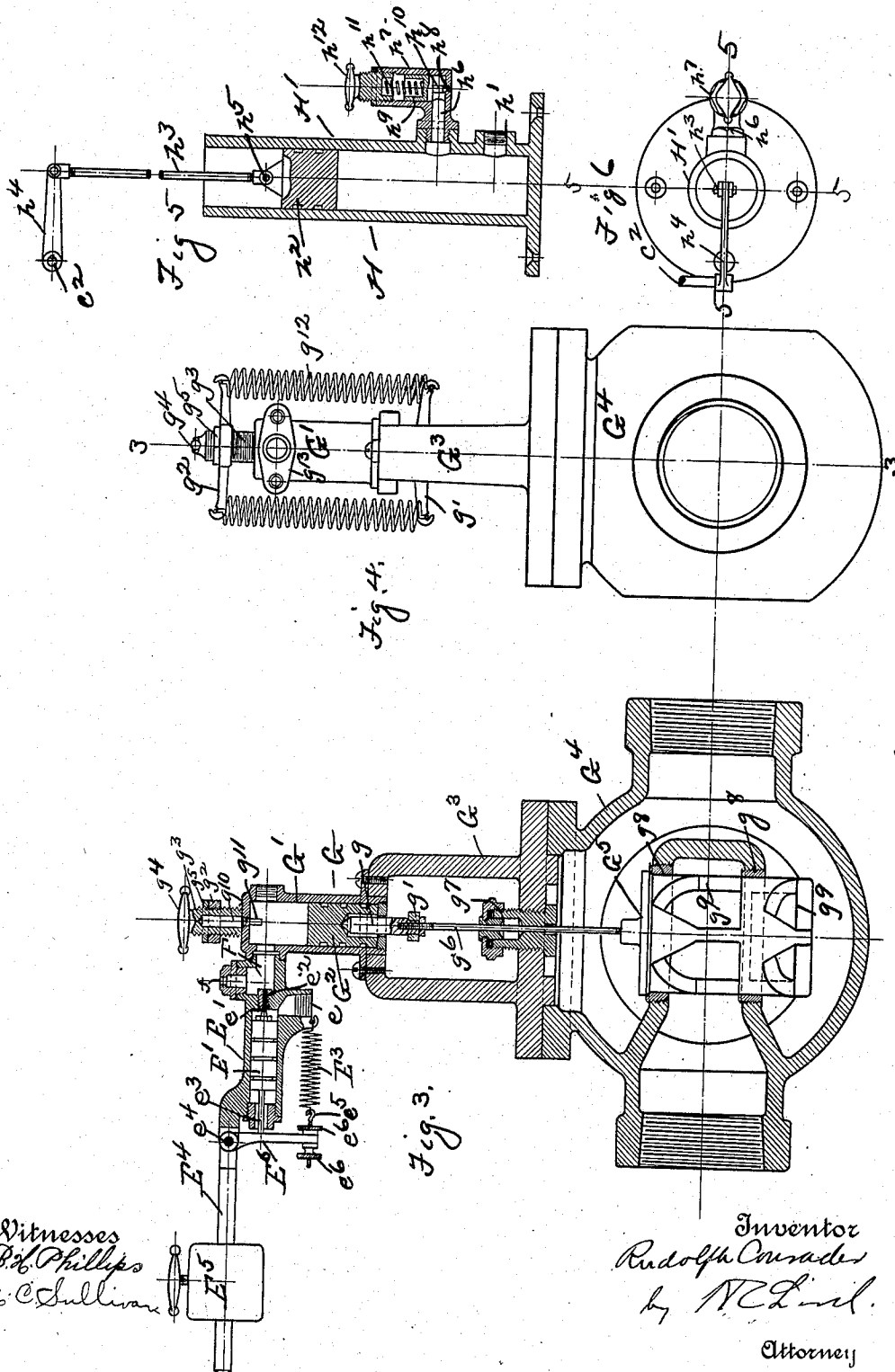
Inventor
Rudolph Conrad
by W.C. Lord
Attorney

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3 SHEETS—SHEET 3.



Witnesses
R. B. Phillips
M. C. Sullivan

Inventor
Rudolph Conrader
by N. C. Lind.
Attorney

UNITED STATES PATENT OFFICE.

RUDOLPH CONRADER, OF ERIE, PENNSYLVANIA.

PUMP-GOVERNOR.

937,228.

Specification of Letters Patent.

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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 new and useful Improvements in Pump-Governors, of which the following is a specification.

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

Pump governors have been heretofore made which would vary the speed of the pump as the requirements of the pump vary. Such a governor is shown in the patent issued to me November 22, 1904, #775,391. Relief devices have also been provided for compressors which would vary the quantity of fluid pumped with each stroke of the compressor. Such a device is shown in the patent issued to me November 22, 1904 #775,393.

I have been informed that compressors have been provided with governors which would maintain the maximum speed of the compressor until the maximum receiver pressure was reached when the governor would bring the engine of the compressor to its minimum speed and would at the same time unload the compressor so as to stop the delivery of any fluid from the compressor. If a compressor is run at a slower speed the quantity pumped may of course be varied even though the quantity of fluid delivered with each stroke remains constant. Where the expansive use of steam or fluid is utilized in the engine there must be some means of storing sufficient energy to carry the compressor to the end of the stroke and this is usually accomplished by means of a fly wheel. The stored energy of such a device running at a high speed is much greater than that running at a lower speed and consequently if it is sufficiently large to provide the necessary momentum for the slower speeds it will be much larger than is required or necessary for the higher speed.

With my present device I have combined a speed governor or speed controlling mechanism with a regulator or relief device for the compressor, the combined action of which is to reduce the load on the compressor as the speed of the engine is reduced, so that a fly wheel or other device for carrying the compressor through the stroke in

the high speeds will be sufficient to accomplish the same purpose in the slower speeds so that a very much smaller fly wheel may be used. Such a governor also gives a greater range of variations in supply than do any of the combinations heretofore referred to. Not only does it vary the number of strokes but it also varies the amount delivered with each stroke, so that the total quantity that the minimum speed with a minimum delivery at each stroke is the widest possible variation from that of the maximum speed with a maximum delivery at each stroke that it is possible to obtain. I have also provided a governor for a compressor which will vary the speed of the compressor by varying the point of cut off, the governor being controlled by the pressure of the pumped fluid. I also provide various details of construction as will appear more fully from the description and claims.

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

Figure 1 is a side elevation of a compressor with my governor mechanism thereon. Fig. 2, a plan view of the same. Fig. 3, a section on the line 3—3 in Fig. 4, being an enlarged view of the intensifying mechanism and relief device or regulator. Fig. 4, a side elevation of the same parts. Fig. 5, a section on the line 5—5 in Fig. 6, the same being a detailed view of the motor actuating the speed controlling mechanism. Fig. 6, a plan view of the same.

A marks the compressor or pump cylinder; B, the engine cylinder; *a*, the inlet to the compressor; *a'*, the outlet to the same; *a*², the pipe leading to the receiver which for the purpose of this application may be termed the receiver, it being a part into which the pumped fluid flows.

The engine cylinder is provided with an ordinary valve mechanism, the inlet valves (not shown) being arranged on the shafts *b*. The arms *b'* are fixed on these shafts. On the ends of these arms are arranged the ratchet pins *b*². Rock arms *b*⁴ are journaled on the shafts *b* and are provided with the release catches *b*³ these catches being arranged in the paths of the pins *b*². The arms *b*⁴ are rocked through the action of the links *b*⁵, these links being carried by the rocker plate *b*⁶. The arms *b*⁷, being actuated, close the valves in the usual manner through the links *b*¹¹ and suction springs *b*¹². The moment of release is controlled by the gov-

ernor in the usual manner, the release catches having the arms b^7 extending from them which ride the hubs b^8 of the governor rock arms b^9 . These hubs are provided with the projections b^{10} which contact with the arm b^7 and effect the release. By varying the position of these projections b^{10} the moment of release is varied. Reach rods b^{13} extend from the arms b^9 and are connected with the arms c , the arms c being fixed on the shaft c^2 . An arm c' also extends from the shaft c^2 and is pivotally connected to the upright rod c^3 . The rod c^2 is journaled in the projection c^{12} on the upright of the governor. The rod c^3 is connected to a collar c^{13} and this collar is connected with the weight c^4 of the governor. A spindle c' extends up through the center of the governor post c^{11} and is driven from a drive pulley c^8 . Links c^6 extend from the upper end of this spindle and are pivotally connected with the links c^9 . The weights c^5 are arranged on the links c^9 and are pivotally connected to the collar c^{10} , the collar c^{10} being arranged to move axially with the weight c^4 and collar c^{13} . This Corliss valve gear and the governor so far as described is a common type of Corliss valve gear and governor. The exhaust valves and other parts of it are operated in the ordinary well known manner.

The pipe D extends from the receiver to the cylinder E of a controlling motor entering said cylinder through a connection e . The piston E' is arranged in the cylinder E and controls the needle valve e' . The needle valve controls a passage e^2 which extends from the cylinder E to an intensifying chamber F. A stem e^3 extends from the piston outwardly through the cylinder and engages a lever E^6 . The lever E^6 is pivoted at e^4 . A spring E^3 is secured to a part of the cylinder and to the eye bolt e^5 . The eye bolt extends through the lever and the tension spring may be adjusted by means of the nuts e^6 . An arm E^4 also extends from the lever e^6 to which is attached the weight E^5 . The weight may be adjusted on the arm and of course exerts a more constant pressure than does the spring. Through the combined action of the weight and spring practically any movement of the piston E' desired may be accomplished with a given change of pressure in the pumped fluid or receiver pressure.

A minute opening f extends from the intensifying chamber F. The action of this intensifying chamber is thoroughly explained in my former patents heretofore referred to. Briefly it may be said that as the needle valve opens, increasing the passage to the opening e^2 while the minute opening f remains constant effects a variation of pressure in the intensifying chamber F starting with atmospheric pressure at the initial

opening of the valve e' to approximating the full receiver pressure with a full opening of the valve e' . Inasmuch as the piston E' may be loaded by means of the weight E^5 and the spring E^3 so as to effect a complete opening or closure of the valve E' with a very small variation of receiver pressure, say two or three pounds, it will be seen that this variation in the receiver pressure is intensified in the intensifying chamber to a variation extending from atmospheric pressure to the full receiver pressure. In other words, assuming that the receiver pressure may be one hundred pounds, a variation of two or three pounds in the receiver will effect a variation of say eighty-five pounds in the intensifying chamber.

The intensifying chamber is connected with a cylinder G' forming part of the motor controlling the charge regulating valve which in the construction shown not only operates to regulate the charge of the compressor but also in its ultimate position a complete relief device or unloading device. A pipe h extends from the cylinder G' to the cylinder H' of the governor motor H, being connected with said cylinder through the connection h' . A piston h^2 is arranged in this cylinder. A link h^3 extends from the piston h^2 and is pivotally connected with the arm h^4 fixed on the shaft c^2 . The link h^3 is preferably pivotally connected with the piston h^2 by means of the pivot h^5 . As the arm h^4 is acted upon through the influence of the motor acting through the shaft c^2 , arm c' , link c^{11} and incidental parts, it delivers the force of the motor to the weight c^4 and also the weight incident to the governor weights c^5 . As soon as the receiver pressure exceeds the desired minimum the valve e' is opened and air is delivered under the piston h^2 . Whatever pressure it exerts upon this piston is taken from the weight c^4 , forming the centripetal element of the governor, so that the governor weights c^5 with the same speed will naturally assume a position farther out and up or in other words a position which would effect an earlier cut off of the valve. This will with the same load decrease the speed of the pump. Of course this decreased speed of the pump will decrease the force of the centrifugal element but it will in its final position effect an earlier cut off than that prior to the time air pressure is delivered under the piston h^2 . As the pressure increases under the piston h^2 , it relieves more and more the weight forming the centripetal element of the governor thus effecting an earlier cut off and a slower speed. This variation is made very sensitive relatively to the fluid pressure in the receiver through the intensifying mechanism hereinbefore described.

With the piston of the motor directly connected with one of the elements of the gov-

error as in this device and with the minute openings incident to the intensifying mechanism, the piston not only acts as a motor for influencing the governor through the action of the pumped fluid but it also acts as a dash pot for the governor to prevent any tendency toward racing.

Governors of this class are often provided with some positive stop which will prevent the governor from effecting such a point of cut off as would stop the pump. This stop is ordinarily called a minimum stop. If such a stop were provided with this construction, the governor would lose this dash pot effect and unless peculiarly made might interfere with the action of the governor. I prefer therefore to provide a device for positively limiting the pressure that may be delivered to the piston h^2 . This I accomplish by means of the safety valve secured to the cylinder H' . The safety valve comprises a cylinder h^7 in which is arranged a piston h^9 . A waste passage h^8 extends from the bottom of the cylinder and is controlled by the valve h^{10} carried by the piston h^9 . The passage h^8 extends from the cylinder H' to the cylinder h^7 . A spring h^{11} is tensioned against the piston h^9 and normally holds the valve h^{10} in a closed position. A screw h^{12} is threaded into the end of the cylinder against the spring h^{11} . By means of this screw the spring may be tensioned to adjust the point at which the safety valve will act. When therefore any pressure is delivered under the piston h^2 above that desired, this pressure acting under the piston h^9 will move the piston h^9 opening the valve h^{10} and relieving this pressure. This in fact will provide a minimum stop for the governor.

It is desirable to control the charge of the compressor through the intake and as before stated if the intake is entirely cut off it will practically unload the compressor. I accomplish this by arranging a valve G^5 for controlling the intake and governing the action of this valve. The valve G^5 is arranged in the chamber G^4 . It controls the opening g^8 through the valve. The valve itself is provided with openings g^9 one of which acts on each opening g^8 , so that the valve will be practically balanced in each of its positions in the manner of the ordinary throttling valve. A piston G^2 is arranged in the cylinder G' . It has the stem g extending from it. The cylinder G' is mounted on a frame G^3 and the frame G^3 is mounted on the body G^4 of the valve G^5 . A valve stem g^6 extends from the stem g to the valve G^5 , forming a positive connection between them. A yoke g^7 is secured to the end of the stem g . Springs g^{12} are secured on this yoke, the opposite ends of the springs being secured to a yoke g^2 . The yoke g^2 is carried by screw threaded sleeves g^3 . This screw threaded sleeve is mounted on a pin g^{10} extending

from the top of the cylinder G' . It is provided with a handle g^2 by means of which it may be turned to tension the spring g^{12} and when these springs are properly adjusted, the adjustment may be secured by means of a lock nut g^5 . The pins g^{10} preferably extend through the cylinder, forming a stop g^{11} for preventing the piston G^2 from closing the upper end of the cylinder and thus the passage to the governor motor. Through this construction when air is turned into the cylinder G' by reason of an excess of pressure in the receiver as heretofore described, it acts on the piston G^2 and forces it downwardly, thus closing the valve G^5 . As shown in Fig. 3, the valve is entirely closed. As the pressure on the piston decreases, the springs g^{12} acting through the yoke g^7 on the stem g^6 opens the valve G^5 , thus permitting larger charges to be drawn in with each stroke of the pump.

It will be noted that the controlling mechanism for the engine controls it by varying the point of cut off, but in the broader features of my invention, I do not wish to be so limited. It will be noted also that the regulating device for regulating the charges in the compressor operates on the throttling principle, but in the broader features of my invention I do not wish to be limited to this construction.

In the general operation of the device the parts are preferably so adjusted that the valve G^5 is moved toward the closing point as the governor is influenced to effect an earlier cut off so that as the speed of the pump is decreased the charges are likewise decreased. As set forth in the early part of this description through this arrangement a small fly wheel may be used for as the speed is decreased the necessary momentum to expel the charge in the pump is also decreased. Preferably therefore the variation in the charge and speed are made to vary together. The parts may however be adjusted so that one will succeed the other to some extent, and while this will not permit of the use of so small a fly wheel and will not therefore be as efficient as the preferred arrangement, still it will increase the variations in the total discharge of the pump from the maximum to a point where it is completely unloaded as for example, if the mechanism is set so that the valve G^5 is gradually closed until reaching a position where it will deliver a minimum charge to the compressor before the governor is effectively actuated, the compressor will deliver decreasing charges but at a uniform speed until it reaches a minimum charge, and then will continue decreasing the speed until it reaches a minimum speed, or vice versa, the compressor may operate with a uniform charge but the adjustment of the springs g^2 will be such that the governor will be brought to its

minimum position before the valve G^5 is moved and then with a continued increasing pressure, the valve G^5 moves to its minimum position.

5 What I claim as new is:—

1. In a pump governor the combination of a speed controlling mechanism; a regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

2. In a pump governor, the combination of a speed controlling mechanism adapted to maintain different speeds between a desired minimum and maximum; a regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

3. In a pump governor, the combination of a speed controlling mechanism; means controlled by the pumped fluid for actuating said controlling mechanism to effect a variation of speed including intermediate speeds between the desired maximum and minimum; a regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

4. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor; a regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

5. In a pump governor, the combination with a speed controlling mechanism comprising a centrifugal governor having a centripetal element and a centrifugal element, one opposed to the other; means controlled by the pumped fluid for varying the power of one of said elements within the limits of power of the other of said elements; a regulating device for varying the charge of fluid pumped; and means acting on the regulating device for varying the charge as the controlling mechanism varies the speed.

6. In a pump governor, the combination of a speed controlling mechanism adapted to vary the speed by varying the point of cut off; a regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

7. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor adapted to vary the speed by varying the point of cut off; a regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

trolling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

8. In a pump governor, the combination of a speed controlling mechanism adapted to vary the speed by varying the point of cut off and comprising a centrifugal governor having a centripetal element and a centrifugal element, one in opposition to the other; means controlled by the pumped fluid for varying the power of one of said elements within the limits of power of the other of said elements; a regulating device for varying the charge of fluid pumped; and means acting on the regulating device to vary the charge as the controlling mechanism varies the speed.

9. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor; means controlled by the pumped fluid and acting upon said centrifugal governor for varying the speed; a regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

10. In a pump governor, the combination of a controlling mechanism adapted to vary the speed by varying the point of cut off; means controlled by the pumped fluid acting on said mechanism for varying the speed; a regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

11. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor, adapted to vary the speed by varying the point of cut off; means controlled by the pumped fluid acting on said centrifugal governor for varying the speed; a regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

12. In a pump governor, the combination of a Corliss valve gear; a controlling mechanism adapted to vary the point of cut off through said valve gear to vary the speed; a regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

13. In a pump governor, the combination of a Corliss valve gear; controlling mechanism adapted to vary the point of cut off through said valve gear to vary the speed; means actuated by pumped fluid for operating said controlling mechanism to vary the speed; a regulating device for varying the charge of fluid pumped; and means acting

on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

14. In a pump governor, the combination of a speed controlling mechanism comprising centrifugal weights adapted to vary the speed by varying the point of cut off, said weights being arranged to effect the predetermined cut off with a given position of the weights; a regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

15. 15. In a pump governor, the combination of a Corliss valve gear; a speed controlling mechanism comprising centrifugal weights operating upon said valve gear to vary the point of cut off, each position of the weights effecting a fixed point of cut off; a regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

16. In a pump governor, the combination of a Corliss valve gear; a controlling mechanism comprising a centrifugal governor having a centrifugal and a centripetal element adapted to vary the speed through said valve gear; means controlled by the pumped fluid for varying the relative strength of one of said elements within the limits of power of the other to vary the speed; a regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

17. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor having a centripetal element and a centrifugal element; a valve gear controlled by said valve mechanism and adapted to vary the speed by varying the point of cut off; and means controlled by the pumped fluid for varying the relative strength of one of the governor elements within the limits of power of the other of said elements; a regulating device for varying the charge of fluid pumped; and means acting on the regulating device to vary the charge as the controlling mechanism varies the speed.

18. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor having a centripetal element and a centrifugal element; a Corliss valve gear controlled by said valve mechanism and adapted to vary the speed by varying the point of cut off; means controlled by the pumped fluid for varying the relative strength of one of the governor elements within the limits of power of the other of said elements; a regulating device for

varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

19. In a pump governor, the combination of a centrifugally acting weight; a valve mechanism influenced by said weight; a fluid motor having its moving element connected with and acting with said weight; means actuated by the pumped fluid for controlling the fluid pressure on the motor, said motor having its fluid passages arranged to give a dash pot effect to the motor.

20. In a pump governor, the combination of a centrifugal element comprising a centrifugal weight, said weight being arranged to have its gravity act centripetally; a centripetal element acting in opposition to said centrifugal element; a valve mechanism influenced by said weight; a fluid motor having its moving element connected with and acting with said weight; means actuated by the pumped fluid for controlling the fluid on said motor to vary the relative strength of one of said elements within the limits of power of the other.

21. In a pump governor, the combination of a centrifugally acting weight; a valve mechanism influenced by said weight and adapted to effect the change of speed by a variation in the point of cut off; a fluid motor having its moving element connected with and acting with said weight; means actuated by the pumped fluid for controlling the fluid pressure on the motor; said motor having its fluid passages arranged to give a dash pot effect to the motor.

22. In a pump governor, the combination of a centrifugal element comprising a centrifugal weight, said weight being arranged to have its gravity act centripetally; a centripetal element acting in opposition to said centrifugal element; a valve mechanism influenced by said weight and adapted to effect a change of speed by varying the point of cut off; a fluid motor having its moving element connected with and acting with said weight; means actuated by the pumped fluid for controlling the fluid on said motor to vary the relative strength of one of said elements within the limits of power of the other.

23. In a pump governor, the combination of a centrifugal element; a centripetal element acting in opposition to said centrifugal element; a motor acting upon one of said elements and actuated by the pumped fluid, the moving element of the motor being directly connected with the centrifugal element and moving with each movement of said element.

24. In a pump governor, the combination of a centrifugal element; a centripetal element acting in opposition to said centrifugal element; a motor acting upon one of said

elements and actuated by the pumped fluid, the moving element of the motor being directly connected with the centrifugal element and moving with each movement of said element and varying the force of one of said elements within the power of the other.

25. In a pump governor, the combination of a centrifugal element; a centripetal element acting in opposition to said centrifugal element; a piston motor acting on one of said elements and actuated by the pumped fluid, the piston of said motor being directly connected with the centrifugal element and moving with each movement of said element, said piston motor having its fluid passages arranged to give a dash pot effect.

26. In a pump governor, the combination of a controlling valve; a fluid motor controlled by the pumped fluid arranged to influence said valve; and a device for limiting the pressure on said motor to limit its influence on the valve.

27. In a pump governor, the combination of a controlling valve; a centrifugal governor acting on said valve; a fluid motor controlled by the pumped fluid and arranged to influence said valve; and a device for limiting the pressure on said motor to limit its influence on the valve.

28. In a pump governor, the combination of a centrifugal element and a centripetal element arranged to act in opposition to each other; a controlling valve actuated by said elements; a fluid motor controlled by the pumped fluid and arranged to vary the power of one of said elements within the limits of power of the other of said elements; and a device for limiting the pressure on said motor to limit its action.

29. In a pump governor, the combination of a speed controlling mechanism; a fluid actuated motor arranged to influence said speed controlling mechanism and to be influenced by the pumped fluid; means for intensifying a change of pressure on the motor over a change of pressure in the pumped fluid; a regulating device for varying the charge of fluid pumped; and means acting on the regulating device to vary the charge as the speed varies.

30. In a pump governor, the combination of a controlling mechanism adapted to vary the speed by varying the point of cut off; a fluid actuated motor controlled by the pumped fluid acting on said controller mechanism for varying the speed; means for intensifying a change of pressure on the motor over a change of pressure in the pumped fluid; a regulating device for varying the charge of fluid pumped; means acting on the regulating device to vary the charge as the speed varies.

31. In a pump governor, the combination of a speed controlling mechanism compris-

ing a centrifugal governor adapted to vary the speed by varying the point of cut off; a fluid actuated motor controlled by the pumped fluid acting on said centrifugal governor for varying the speed; means for intensifying the change of pressure on the motor over a change of pressure on the pumped fluid; a regulating device for varying the charge of fluid pumped; and means acting on the regulating device to vary the charge as the speed varies.

32. In a pump governor, the combination of a speed controlling mechanism adapted to vary the speed by varying the point of cut off, and comprising a centrifugal governor having a centripetal element and a centrifugal element, one in opposition to the other; a fluid actuated motor controlled by the pumped fluid for varying the power of one of said elements within the limits of power of the other of said elements; means for intensifying a change of pressure in the motor over a change of pressure in the pumped fluid; a regulating device for varying the charge of fluid pumped; and means acting on the regulating device to vary the charge as the speed varies.

33. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor; a fluid actuated motor controlled by the pumped fluid for acting upon said centrifugal governor to vary the speed; means for intensifying a change of pressure on the motor over a change of pressure in the pumped fluid; a regulating device for varying the charge of fluid pumped; and means acting on the regulating device to vary the charge as the speed varies.

34. In a pump governor the combination of a Corliss valve gear; a controlling mechanism adapted to vary the point of cut off through the valve gear to vary the speed; a fluid actuated motor controlled by the pumped fluid for operating the controlling mechanism to vary the speed; means for intensifying a change of pressure on the motor over a change of pressure in the pumped fluid; a regulating device for varying the charge of fluid pumped; and means acting on the regulating device to vary the charge as the speed varies.

35. In a pump governor, the combination of a Corliss valve gear; a controlling mechanism comprising a centrifugal governor having a centripetal element and a centrifugal element adapted to vary the speed through said valve gear; a fluid actuated motor controlled by the pumped fluid for varying the relative strength of one of said elements within the limits of power of the other of said elements to vary the speed; means for intensifying a change of pressure on the motor over a change of pressure in the pumped fluid; a regulating device for

varying the charge of fluid pumped; and means acting on the regulating device for varying the charge as the speed varies.

36. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor having a centripetal element and a centrifugal element; a valve gear controlled by said valve mechanism and adapted to vary the speed by varying the point of cut off; a fluid actuated motor controlled by the pumped fluid for varying the relative strength of one of said elements within the limits of power of the other of said elements; means for intensifying a change of fluid pressure on the motor over a change of pressure in the pumped fluid; a regulating device for varying the charge of fluid pumped; and means acting on the regulating device to vary the charge as the speed varies.

37. In a pump governor, the combination of a speed controlling mechanism; an intake throttling regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device for varying the charge as the controlling mechanism varies the speed.

38. In a pump governor, the combination of a speed controlling mechanism adapted to maintain different speeds between a desired minimum and maximum; an intake throttling regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

39. In a pump governor, the combination of a speed controlling mechanism; means controlled by the pumped fluid for actuating said controlling mechanism to effect a variation of speed including intermediate speeds between the desired minimum and maximum; an intake throttling regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

40. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor; an intake throttling regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

41. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor having a centripetal element and a centrifugal element, one opposed to the other; means controlled by the pumped fluid for varying the power of one of said elements within the limits of power of the other of said elements; an intake throttling regulating device for vary-

ing the charge of fluid pumped; and means acting on the regulating device for varying the charge as the controlling mechanism varies the speed.

42. In a pump governor, the combination of a speed controlling mechanism adapted to vary the speed by varying the point of cut off; an intake throttling regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

43. In a pump governor, the combination of a speed controlling mechanism adapted to vary the speed by varying the point of cut off and comprising a centrifugal governor having a centripetal element and a centrifugal element, one in opposition to the other; means controlled by the pumped fluid for varying the power of one of said elements within the limits of power of the other of said elements; an intake throttling regulating device for varying the charge of fluid pumped; and means acting on the regulating device to vary the charge as the controlling mechanism varies the speed.

44. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor; means controlled by the pumped fluid and acting upon said centrifugal governor for varying the speed; an intake throttling regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

45. In a pump governor, the combination of a controlling mechanism adapted to vary the speed by varying the point of cut off; means controlled by the pumped fluid acting on said mechanism for varying the speed; an intake throttling regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

46. In a pump governor, the combination of a Corliss valve gear; a controlling mechanism adapted to vary the point of cut off through said valve gear to vary the speed; an intake throttling regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

47. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor having a centripetal element and a centrifugal element; a valve gear controlled by said valve mechanism and adapted to vary the speed by varying the point of cut off; means controlled by

the pumped fluid for varying the relative strength of one of the governor elements within the limits of power of the other of said elements; an intake throttling regulating device for varying the charge of fluid pumped; and means acting on the regulating device to vary the charge as the controlling mechanism varies the speed.

48. In a pump governor, the combination of a speed controlling mechanism; a fluid actuated motor arranged to influence said speed controlling mechanism and to be influenced by the pumped fluid; means for intensifying a change of pressure on the motor over a change of pressure in the pumped fluid; an intake throttling regulating device for varying the charge of fluid pumped; and means acting on the regulating device to vary the charge as the speed varies.

49. In a pump governor, the combination of a controlling mechanism adapted to vary the speed by varying the point of cut off; a fluid actuated motor controlled by the pumped fluid acting on said controlling mechanism for varying the speed; means for intensifying a change of pressure on the motor over a change of pressure in the pumped fluid; an intake throttling regulating device for varying the charge of fluid pumped; means acting on the regulating device to vary the charge as the speed varies.

50. In a pump governor, the combination of a Corliss valve gear; a controlling mechanism adapted to vary the point of cut off through the valve gear to vary the speed; a fluid actuated motor controlled by the pumped fluid for operating the controlling mechanism to vary the speed; means for intensifying a change of pressure on the motor over a change of pressure in the pumped fluid; an intake throttling regulating device for varying the charge of fluid pumped; and means acting on the regulating device to vary the charge as the speed varies.

51. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor having a centripetal element and a centrifugal element; a valve gear controlled by said valve mechanism and adapted to vary the speed by varying the point of cut off; a fluid actuated motor controlled by the pumped fluid for varying the relative strength of one of said elements within the limits of power of the other of said elements; means for intensifying a change of fluid pressure on the motor over a change of pressure in the pumped fluid; an intake throttling regulating device for varying the charge of fluid pumped; and means acting on the regulating device to vary the charge as the speed varies.

52. In a pump governor the combination of a speed controlling mechanism; a regulating device for varying the charge of fluid pumped; means acting on the controlling

mechanism and regulating device to vary the charge as the controlling mechanism varies the speed; comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying a change of pressure on said motor over a change of pressure in the pumped fluid.

53. In a pump governor, the combination of a speed controlling mechanism adapted to maintain different speeds between a desired minimum and maximum; a regulating device for varying the charge of fluid pumped; means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed; comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying a change of pressure on said motor over a change of pressure in the pumped fluid.

54. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor; a regulating device for varying the charge of fluid pumped; means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed; comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying a change of pressure on said motor over a change of pressure in the pumped fluid.

55. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor having a centripetal element and a centrifugal element, one opposed to the other; means controlled by the pumped fluid for varying the power of one of the other of said elements; a regulating device for varying the charge of fluid pumped; means acting on the regulating device for varying the charge as the controlling mechanism varies the speed, said means comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying a change of pressure on the motor over a change of pressure in the pumped fluid.

56. In a pump governor, the combination of a speed controlling mechanism adapted to vary the speed by varying the point of cut off; a regulating device for varying the charge of fluid pumped; means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed; comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying a change of pressure on said motor over a change of pressure in the pumped fluid.

57. In a pump governor, the combination of a speed controlling mechanism adapted to vary the speed by varying the point of cut off and comprising a centrifugal gov-

ernor having a centripetal element and a centrifugal element, one in opposition to the other; means controlled by the pumped fluid for varying the power of one of said elements within the limits of power of the other of said elements; a regulating device for varying the charge of fluid pumped; means acting on the regulating device to vary the charge as the controlling mechanism varies the speed, said means comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying a change of pressure on the motor over a change of pressure in the pumped fluid.

58. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor; means controlled by the pumped fluid and acting upon said centrifugal governor for varying the speed; a regulating device for varying the charge of fluid pumped; means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed; comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying the change of pressure on said motor over a change of pressure in the pumped fluid.

59. In a pump governor, the combination of a controlling mechanism adapted to vary the speed by varying the point of cut off; means controlled by the pumped fluid acting on said mechanism for varying the speed; a regulating device for varying the charge of fluid pumped; means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed; comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying the change of pressure on said motor over a change of pressure in the pumped fluid.

60. In a pump governor, the combination of a Corliss valve gear; a controlling mechanism adapted to vary the point of cut off through said valve gear to vary the speed; a regulating device for varying the charge of fluid pumped; means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed; comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying the change of pressure on said motor over a change of pressure in the pumped fluid.

61. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor having a centripetal element and a centrifugal element; a valve gear controlled by said valve mechanism and adapted to vary the speed by varying the point of cut off; means controlled by the pumped fluid for varying the relative strength of one of the governor elements within the limits of power of the other of

said elements; a regulating device for varying the charge of fluid pumped; means acting on the regulating device to vary the charge as the controlling mechanism varies the speed, said means comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying the change of pressure on the motor over a change of pressure in the pumped fluid.

62. In a pump governor, the combination of a speed controlling mechanism; a fluid actuated motor arranged to influence said speed controlling mechanism and to be influenced by the pumped fluid; means for intensifying a change of pressure on the motor over a change of pressure in the pumped fluid; a regulating device for varying the charge of fluid pumped; means acting on the regulating device to vary the charge as the speed varies, said means comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying the change of pressure on the motor over a change of pressure in the pumped fluid.

63. In a pump governor, the combination of a controlling mechanism adapted to vary the speed by varying the point of cut off; a fluid actuated motor controlled by the pumped fluid acting on said controlling mechanism for varying the speed; means for intensifying a change of pressure on the motor over a change of pressure in the pumped fluid; a regulating device for varying the charge of fluid pumped; means acting on the regulating device to vary the charge as the speed varies, said means comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying the change of pressure on the motor over a change of pressure in the pumped fluid.

64. In a pump governor the combination of a Corliss valve gear; a controlling mechanism adapted to vary the point of cut off through the valve gear to vary the speed; a fluid actuated motor controlled by the pumped fluid for operating the controlling mechanism to vary the speed; means for intensifying a change of pressure on the motor over a change of pressure in the pumped fluid; a regulating device for varying the charge of fluid pumped; means acting on the regulating device to vary the charge as the speed varies, said means comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying the change of pressure on the motor over a change of pressure in the pumped fluid.

65. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor having a centripetal element and a centrifugal element; a valve gear controlled by said valve mechanism and adapted to vary the speed by varying the point of cut off; a fluid actuated motor controlled by the pumped fluid for

varying the relative strength of one of said elements within the limits of power of the other of said elements; means for intensifying a change of fluid pressure on the motor over a change of pressure in the pumped fluid; a regulating device for varying the charge of fluid pumped; means acting on the regulating device to vary the charge as the speed varies, said means comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying the change of pressure on the motor over a change of pressure in the pumped fluid.

66. In a pump governor the combination of a speed controlling mechanism; an intake throttling regulating device for varying the charge of fluid pumped; means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed; comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying a change of pressure on said motor over a change of pressure in the pumped fluid.

67. In a pump governor, the combination of a speed controlling mechanism comprising a centrifugal governor having a centripetal element and a centrifugal element, one opposed to the other; means controlled by the pumped fluid for varying the power of one of said elements within the limits of power of the other of said elements; an intake throttling regulating device for varying the charge of fluid pumped; means acting on the regulating device for varying the charge as the controlling mechanism varies the speed, said means comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying a change of pressure on the motor over a change of pressure in the pumped fluid.

68. In a pump governor, the combination of a controlling mechanism adapted to vary the speed by varying the point of cut off; means controlled by the pumped fluid acting on said mechanism for varying the speed; an intake throttling regulating device for varying the charge of fluid pumped; means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed; comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying the change of pressure on said motor over a change of pressure in the pumped fluid.

69. In a pump governor, the combination of a Corliss valve gear; a controlling mechanism adapted to vary the point of cut off through said valve gear to vary the speed; an intake throttling regulating device for varying the charge of fluid pumped; means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed;

comprising a fluid actuated motor controlled by the pumped fluid; and means for intensifying the change of pressure on said motor over a change of pressure in the pumped fluid.

70. In a pump governor, the combination of a speed controlling mechanism adapted to maintain different speeds between a desired maximum and minimum; and an intake regulating device for varying the charge pumped.

71. In a pump governor, the combination of a speed controlling mechanism adapted to maintain different speeds between a desired minimum and maximum; an intake regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

72. In a pump governor, the combination of a speed controlling mechanism; means controlled by the pump fluid for actuating said controlling mechanism to effect a variation of speed including intermediate speeds between the desired maximum and minimum; an intake regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

73. In a pump governor the combination of a speed controlling mechanism; an intake throttling regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

74. In a pump governor, the combination of a speed controlling mechanism; means controlled by the pump fluid for actuating said controlling mechanism to effect a variation of speed including intermediate speeds between the desired maximum and minimum; an intake throttling regulating device for varying the charge of fluid pumped; and means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed.

75. In a pump governor, the combination of a speed controlling mechanism; a regulating device for varying the charge of fluid pumped; a motor controlling said mechanism; a motor controlling said device; and a single means controlling the energy acting on both motors.

76. In a pump governor, the combination of a speed controlling mechanism; a regulating device for varying the charge of fluid pumped; a fluid actuated motor controlling said mechanism; a fluid actuated motor controlling said device; and a single valve mechanism controlling said motor.

77. In a pump governor, the combination of a speed controlling mechanism; a regulat-

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ing device for varying the charge of fluid pumped; a fluid actuated motor controlled by the pumped fluid for actuating said mechanism; a fluid actuated motor controlled by the pumped fluid for actuating said device; and a single means for intensifying a change of pressure on said motors over a change of pressure in the pumped fluid.

78. In a pump governor, the combination of a controlling mechanism adapted to vary the speed by varying the point of cut off; means controlled by the pumped fluid acting on said mechanism for varying the speed; a regulating device for varying the charge of

fluid pumped; means acting on the controlling mechanism and regulating device to vary the charge as the controlling mechanism varies the speed, to act upon said controlling mechanism and regulating device to vary the charge pumped as the speed varies.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

RUDOLPH CONRADER.

Witnesses:

C. D. HIGBY,
M. C. SULLIVAN.