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GOVERNING MECHANISM

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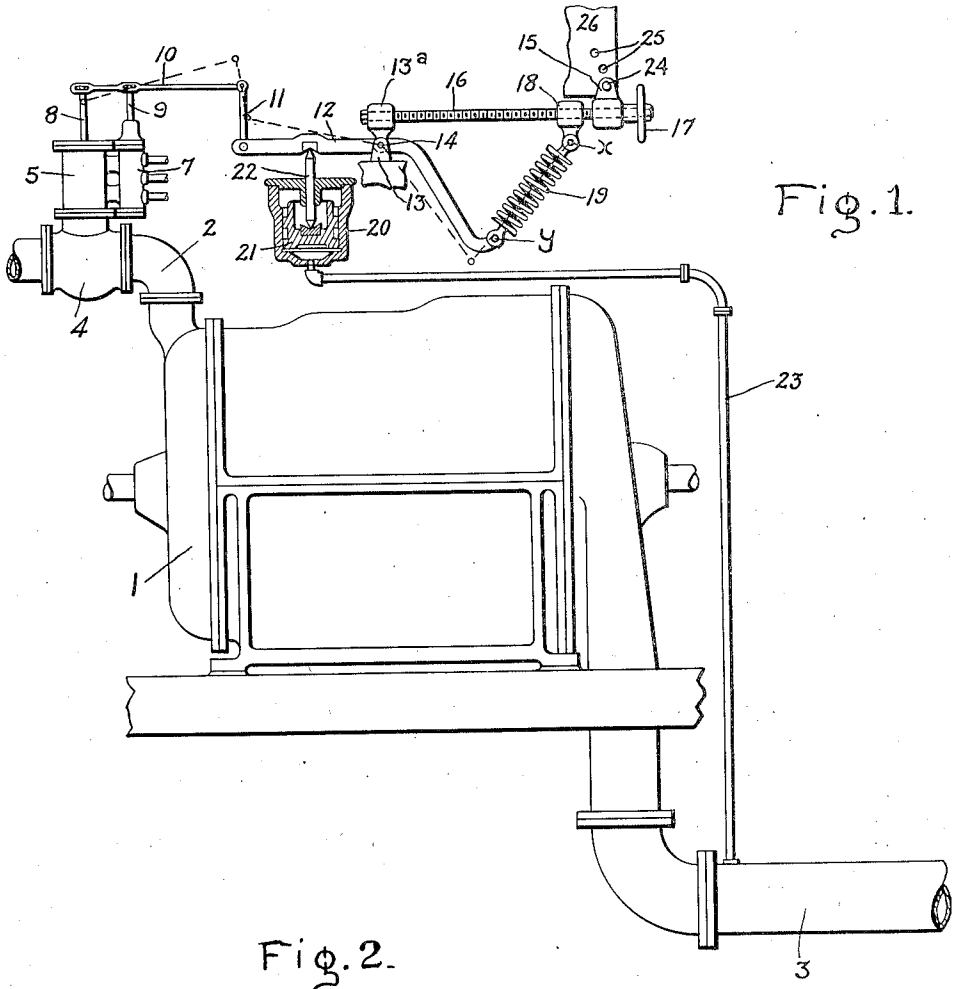
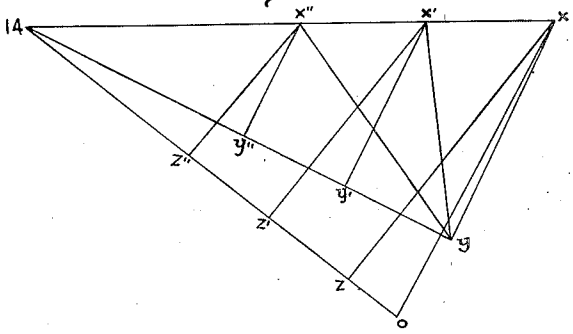


Fig. 1.

Fig. 2.



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UNITED STATES PATENT OFFICE.

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GOVERNING MECHANISM.

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The present invention relates to governors such as are used for controlling the speed of prime movers, and has for its object to provide an improved governor which can be adjusted in a simple manner over a comparatively wide speed range and which will give the same percentage of regulation between no load and full load for all settings.

For a consideration of what we believe to be novel and our invention, attention is directed to the accompanying description and the claims appended thereto.

In the drawing, Fig. 1 is a diagrammatic view of a governor embodying our invention, and Fig. 2 is a diagram illustrating the operation of the governor.

Referring to the drawing, 1 indicates a prime mover, which in the present instance is shown as being a steam turbine. The steam inlet conduit is indicated at 2 and the exhaust conduit at 3. In inlet conduit 2 is a regulating valve 4 adapted to be moved by a fluid-actuated motor of usual and well known type comprising a cylinder 5 in which is a piston connected to the valve 4, and a pilot valve 7. The stem 8 of the fluid-actuated motor, which stem is connected to the piston in cylinder 5, and the stem 9 of the pilot valve are connected to a floating lever 10 which in turn is connected by a link 11 to one end of a governor lever 12. Governor lever 12 is fulcrumed on a stationary support 13, the fulcrum point being indicated at 14. Pivoted at fulcrum point 14 is a bracket 13^a, and mounted in bracket 13^a and a second bracket 15 is a threaded rod 16 adapted to be turned by a hand wheel 17. On rod 16 is a nut 18 which can be made to travel along the rod by turning hand wheel 17. Nut 18 is connected to the end of lever 12 by a tension spring 19 which forms the adjusting spring for the governing mechanism, the point of connection of the spring with nut 18 being indicated at x and its point of connection with lever 12 being indicated at y.

In the present instance the governor is shown as being a pressure governor, the same comprising a cylinder 20 in which is a piston 21 connected to lever 12 by a stem 22. Piston 21 has a definite range of movement, the bottom of cylinder 20 and its cover plate forming stops which limit the travel of the piston in the cylinder. The lower end of cylinder 20 is connected by a pipe 23 to the exhaust conduit 3 of the turbine whereby the underside of piston 21 is subjected to the pressure in conduit 3. This arrangement forms what is termed a back pressure governor, the turbine being regulated to maintain a substantially constant pressure in the exhaust conduit. As is known, turbines regulated in this way are utilized in cases where the exhaust from the turbine is used for industrial purposes, such as heating, for example.

With the above-described arrangement, if the turbine is running and the back pressure increases, then the pressure under piston 21 will be increased, thereby moving the piston upward in cylinder 20. This will effect a movement of lever 12 against the tension of spring 19 and thereby raise pilot valve 7 so as to admit actuating fluid to the upper portion of fluid motor cylinder 5 thus causing the piston therein to move downward and close somewhat valve 4. At the same time the movement of valve 4 toward closed position will serve to restore the pilot valve. On the other hand, if the back pressure decreases, then spring 19 will move piston 21 downward, thereby moving the pilot valve in a direction to effect an increase in the opening of valve 4. This is the usual and well known method of operation of a governing mechanism of this type. The pressure which the governor maintains depends among other things upon the tension of spring 19 and the governor may be set for different pressures by changing the tension of the spring. This may be accomplished by turning rod 16 so as to move nut 18 along the rod.

In order for a governor to be stable in operation, that is, in order that it will not hunt, it is necessary that it have a certain degree of regulation between no load and full load. This is well understood, and means in the present instance that if stable operation is to be obtained, the exhaust pressure in conduit 3 must be a certain amount higher at no load than at full load on the turbine. The percentage change in pressure between no load and full load is termed the percentage of regulation and, as pointed out above, the object of our invention is to provide an improved governing mechanism which is adjustable over a wide range and wherein for all adjustments the percentage of regulation remains constant.

We have found that this result is accom-

plished if the arrangement of the parts is such that the path of travel of the pivot point x, when nut 18 is moved by turning rod 16, is in a direct line to and from the fulcrum point 14. Or, in other words, such result is accomplished if the rod 16 along which the nut 18 is moved in changing the tension of spring 19 to adjust the setting of the governor is parallel to a line joining points 14 and x. With this arrangement the change in turning force between no load and full load exerted on lever 12 at the point y bears always a constant definite relation to the turning force at no load for all points of adjustment of nut 18 along rod 16.

In Fig. 1 the full lines show the positions of the parts at full load and the dotted lines indicate the positions which they assume at no load, the point x remaining stationary and the point y moving downward as spring 19 is distended due to increase in pressure under piston 21. Fig. 2 is a diagram showing the positions of the parts at full load and no load for several adjustments of the nut 18. The horizontal line $14\text{--}x$ is a line joining the point 14 with the point x, in Fig. 1 and is the line along which pivot point x moves when nut 18 is adjusted along threaded rod 16. In this connection, it will be noted that when nut 18 is adjusted along rod 16 the upper end of spring 19 is moved, while the lower end remains stationary at y. For the position, x, $x\text{--}y$ indicates the full load position of spring 19 and $x\text{--}o$ indicates the no load position of spring 19. The distance $x\text{--}y$ represents the turning force of spring 19 on the lever at full load. Since in the position $x\text{--}y$ the spring 19 stands at a right angle to the lever the distance $x\text{--}y$ represents not only the turning force of the spring but also the actual force of the spring, it being understood that by the turning force of the spring is meant the component of the force of the spring tending to turn the lever on its pivot while by the actual force of the spring is meant the total force exerted by the spring. The line $x\text{--}z$ drawn from the point x perpendicular to the line $14\text{--}o$ represents the turning force on the lever when the spring is in the no load position represented by the line $x\text{--}o$. The distance $x\text{--}z$ minus $x\text{--}y$ represents the change in turning force between no load and full load.

x' indicates a second position to which the nut 18 has been adjusted, the upper pivot point of spring 19 being positioned now at x'. For position x', $x'\text{--}y$ indicates the full load position of spring 19 and $x'\text{--}o$ indicates the no load position of spring 19. Also, in this position, the distance, $x'\text{--}y$ represents the total force of the spring at full load; the distance $x'\text{--}o$ represents the total force of the spring at no load; the line $x'\text{--}y'$ drawn from the point x' perpendicular to line $14\text{--}y$ represents the turning force of the spring at full load; the line $x'\text{--}z'$ drawn from the point x' perpendicular to line $14\text{--}o$ represents the turning force of the spring at no load, and the distance $x'\text{--}z'$ minus $x'\text{--}y'$ represents the change in turning force between full load and no load. A third position of nut 18 is indicated at x'', $x''\text{--}y$ indicating the full load position of the spring and $x''\text{--}o$ indicating the no load position of the spring. The line $x''\text{--}y''$ drawn from the point x'' perpendicular to line $14\text{--}y$ represents the turning force of the spring at full load, the line $x''\text{--}z''$ drawn from the point x'' perpendicular to line $14\text{--}o$ represents the turning force of the spring at no load, and the distance $x''\text{--}z''$ minus $x''\text{--}y''$ represents the change in turning force between no load and full load. The distances $x\text{--}z$ minus $x\text{--}y$, $x'\text{--}z'$ minus $x'\text{--}y'$ and $x''\text{--}z''$ minus $x''\text{--}y''$ are proportional to the actual changes in pressure required in conduit 3 in order to move the governor valves from closed position to open position which means adjusting the turbine from no load to full load condition.

With this arrangement,

$$\frac{(x\text{---}z)}{(x\text{---}z)-(x\text{---}y)}=\frac{(x'\text{---}z')}{(x'\text{---}z')-(x'\text{---}y')}=\frac{(x''\text{---}z'')}{(x''\text{---}z'')-(x''\text{---}y'')}$$

That is to say, for different positions of the nut 18 along rod 16, the change in turning force between no load and full load exerted by the spring on lever 12 bears always a constant and definite relation to the turning force of the spring at no load.

The rod 16 may make any desired angle with lever 12 and the arrangement may be such that this angle is adjustable so as to change the initial setting of the spring 19, whereby the characteristics of the governor are modified. To this end bracket 15 may be attached by a pin 24 in any one of the spaced holes 25 in supporting plate 26.

By our invention, we are enabled to adjust the governor over a wide range by means of turning hand wheel 17, i. e., by only one adjusting means, and at the same time obtain always the same percentage regulation for all adjustments.

While we have illustrated and described our invention as being used in connection with a back pressure governor, it is to understood that it is not necessarily limited thereto, but may be used in connection with any type of governor to which it may be found adapted.

In accordance with the provisions of the patent statutes, we have described the principle of operation of our invention, together with the apparatus which we now consider

to represent the best embodiment thereof, but we desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. In a governing mechanism, the combination of a device responsive to an operating condition of a machine with which the mechanism is to be used, a governor lever to which the device is connected, a pivot for the governor lever, a spring having one end connected to the governor lever, a support for the other end of the spring, and means for moving the support to vary the angular relation between the spring and the lever and the tension of the spring, the point of connection between the spring and the support moving along a path such that the change in turning force between no load and full load exerted by the spring on the lever bears always a constant and definite relation to the turning force at no load for all points of adjustment of the support.

2. In a governing mechanism, the combination of a device responsive to an operating condition of a machine with which the mechanism is to be used, a governor lever to which the device is connected, a pivot for the governor lever, a spring having one end connected to the governor lever, a support for the other end of the spring, means for moving the support to vary the angular relation between the spring and the lever and the tension of the spring, the point of connection between the spring and the support and the means for moving the support being so arranged that such point of connection moves in a straight line toward and away from the pivot point for the governor lever.

3. In a governing mechanism, the combination of a device responsive to an operating condition of a machine with which the mechanism is to be used, a governor lever to which the device is connected, a pivot for the governor lever, a spring having one end connected to the governor lever, a support for the other end of the spring, and a rod along which said support may be moved, said rod extending in a direction such that the point of connection between the spring and the support moves in a straight line toward and away from the pivot point of the governor lever.

4. In a governing mechanism, the combination of a device responsive to an operating condition of a machine with which the mechanism is to be used, a governor lever to which the device is connected, means providing a stationary pivot for the governor lever, a bracket pivoted in line with the governor lever pivot, an adjustable bracket, a rod mounted in said brackets, a member adapted to be adjusted along said rod, and a governor spring connected to the governor lever and to said member, the point of connection between said spring and member being such that for any position of adjustment of the member along the rod, the change in turning force between no load and full load exerted by the spring on the governor lever bears always a constant and definite relation to the turning force at no load.

In witness whereof, we have hereunto set our hands this ninth day of June, 1925.

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