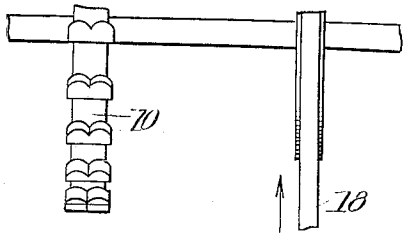
No. 865,082. PATENTED SEPT. 3, 1907.

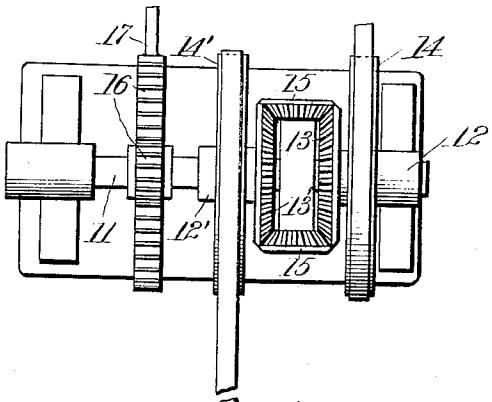
E. F. CASSEL.

GOVERNOR.

APPLICATION FILED MAR. 6, 1906.

Fig. 1.





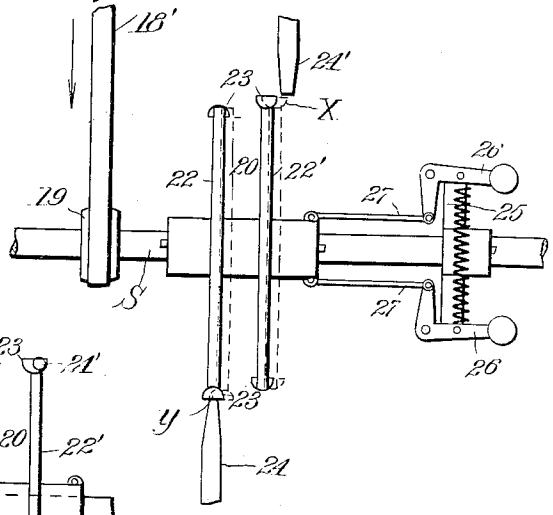
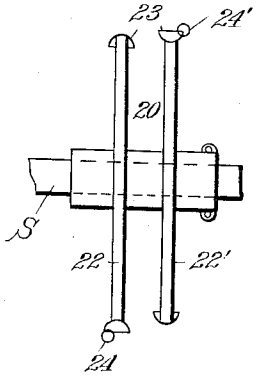


Fig. 2.



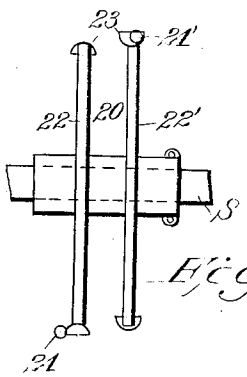


Fig. 3.

Witnesses

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GOVERNOR.

No. 865,082. Specification of Letters Patent. Patented Sept. 3, 1907.

Application filed March 6, 1906. Serial No. 304,562.

To all whom it may concern:

Be it known that I, ELMER F. CASSEL, of Seattle, in the county of King, State of Washington, have invented certain new and useful Improvements in Governors, of which the following is a specification.

This invention contemplates certain new and useful improvements in governors, and relates more particularly to that class of governors which are employed to regulate the power applied to hydraulic motors or water wheels.

Heretofore hydraulic governors have been produced which operate to regulate the speed of the motor by altering the angle of the nozzle or feed, with relation to the motor buckets, whereby a reduced volume of water acts against the latter; or else means have been provided for shutting off or reducing the flow from the nozzle. When however, such governors have been applied to motors working under large quantities of water, it has been found in practice that the pressure is frequently so great that the regulating means is necessarily slow acting. As a consequence, before the column of water can be reduced the mechanism is often racked to such a degree as to cause serious injury. My present invention is designed to overcome these defects by providing a governor which will be extremely sensitive to the slightest variations in speed of the motor and which will at the same time possess sufficient power for promptly and mechanically actuating and efficiently effecting a positive control of the nozzles, gates, or other means for controlling the volume of water acting upon said motor, whereby the speed of the motor is rendered uniform under all conditions.

In carrying out my invention, I provide suitable means for controlling the water supply with respect to a prime mover, which means is operated by a shaft controlled by a planetary gear. One member of said gear is connected to rotate with the motor to be governed, the opposite member of said gear being connected with a supplemental motor constructed to maintain a uniform speed under all conditions, any difference in speed of the two members of the planetary gear thus connected serving to effect a corresponding movement of the shaft controlling the water supply.

The invention will be hereinafter fully set forth and particularly pointed out in the claims.

In the accompanying drawing, Figure 1 is a diagrammatical view illustrating my invention. Figs. 2 and 3 are views of a slightly modified form of auxiliary motor.

Referring to the drawing, 10 designates the main motor, which I shall hereafter term the "prime mover", the form illustrated being of the well known "Pelton" type. On a counter shaft 11 are rotatably mounted two sleeves 12, 12′, the adjacent ends of which are provided with bevel gears 13, 13′, the outer ends of said sleeves being provided with pulleys 14, 14′. The counter shaft 11 is also provided with two oppositely arranged pinions 15, interposed between and meshing with gears 13, 13′, and mounted to move with said counter shaft as the latter rotates. The gears and pinions thus referred to form a well known type of planetary gear. The counter shaft 11 is also provided with a toothed pinion or segment 16 in mesh with a rack 17, which in turn controls the water supply.

The prime mover 10 is connected to the pulley 14 by a suitable belt 18, while pulley 14′ is connected by a belt 18′ to the pulley 19 of a supplemental or auxiliary governing motor 20. This latter may be of any preferred type the speed of which will not be affected by the speed of the prime mover, but I have illustrated a motor which is a slight modification of the hydraulic motor, for which Letters Patent 652,715 and 654,872 were granted to me June 26th 1900, and July 31st 1900 respectively. In the form illustrated, the motor body comprises a slidable hub mounted to rotate with shaft S, and provided with two disks 22, 22′, upon the peripheries of which are secured buckets 23, which are oppositely arranged, *i. e.* arranged in such manner that power applied thereto will tend to rotate the wheel in opposite directions. Said buckets are actuated by fluid, preferably water, discharged from nozzles 24, 24′, the nozzle 24 serving to normally operate the motor and occupying the usual position relative to the buckets of disk 22. The nozzle 24′ is to one side of the normal path of movement of disk 22′. A disk 25 is also rigidly mounted on shaft S and provided with weighted governor arms 26 which are connected by levers 27 with the motor body, whereby any movement of said arms 26 is communicated to said body.

In practice the motor 20 has a tendency to rotate at a uniform speed, whereupon any change in the speed of rotation of the prime mover is reflected upon the planetary gears in the well known manner, thus effecting a rotation of counter shaft 11, and a corresponding movement of rack 17, controlling the water supply. It will be noted, however, that an increase in the load upon the prime mover 10 reduces the speed of the latter and tends to reduce the speed of the auxiliary motor 20 below normal, while a decrease in the load upon the prime mover 10 tends to increase the speed of the auxiliary motor 20 above normal, these tendencies being due to the belt or other connection with the planetary gear. The effect of this condition is such as to render the governing action applied to the prime mover inoperative unless the resistance of the auxiliary motor to acceleration and retardation is equal to the resistance of the governing action applied to the prime mover. To overcome this defect, the auxiliary

motor must not only be governed in the usual sense, *i. e.* so as to control its speed when the load is increased or diminished, but must also regulate its speed when power is applied tending to increase said speed. This result is accomplished by my invention. In the drawing the disk 25 is shown in the position to receive the full power from the jet 24, the parts being illustrated in the position occupied when the planetary gear is operating to cut off the power applied to the prime mover. When this action is completed, no further load being driven by the auxiliary motor, the action of the governor arms 26 will cause the motor body to move laterally on shaft S until the buckets or disk 22 assume the position X, illustrated in dotted lines, where just enough power is applied from jet 24 to keep the auxiliary motor at normal speed. At the same time, buckets of disk 22′ will be in the position indicated by Y, barely coming into the line of the jet 24′. Now, assuming that the opposite governing action for the prime mover takes place, *i. e.* to increase the power applied to the prime mover, the planetary gear will tend to drive the auxiliary motor (already running at normal speed) at a higher rate of speed. As the speed of the auxiliary motor increases the disks 22, 22′ will move further to the right under the influence of the governor arms, whereupon the buckets of disk 22 will move entirely out of the line of jet 24 and the buckets of disk 22′ enter into jet 24′, the latter acting in a direction tending to reverse the rotation of the auxiliary motor thus retarding the same to such an extent as will prevent further increase in the speed of the motor, or in other words keep the same at normal speed. As soon as the speed diminishes, the governor arms 26 and the disks of the auxiliary motor assume their normal positions. In this manner the power governing means is rendered delicate and positive in its operation, and all objections of over-governing or under-governing are obviated.

If it is desired to have a more sensitive auxiliary motor than the one heretofore described, the same can be secured by arranging the jets 24, 24′ as indicated in Fig. 2. By referring to said figure it will be noted that each jet is arranged to slightly impinge against the outer edges of its respective buckets, the reversing action of the jet 24′ serving to hold the speed of rotation down to the desired normal. As soon, however, as any influence is brought to bear upon the auxiliary motor to increase the speed of rotation thereof, the disk 22 is moved out of the line of impact of jet 24 while disk 22′ is moved to the right and in a position to receive the full force of the jet 24′, with the result that the tendency to increase the speed of rotation is at once counteracted by the reversing action of said jet 24′, whereupon the parts immediately resume their normal speed.

I am aware that attempts have been made to govern the speed of hydraulic motors by means of an auxiliary motor and intermediate planetary gear, and that one or more patents have been granted for such devices, but they have not been successful commercially, for the reason that the auxiliary motor was not constructed to maintain an absolutely uniform speed under all conditions, thereby causing fluctuations in the governing efficiency. I believe myself, however, to be the first to produce a governor of this character in which the auxiliary motor is provided with means for positively maintaining a uniform normal speed of rotation under any and all conditions, and I accordingly make broad claim thereto.

The advantages of my improved governor will be at once apparent to those skilled in the art to which the same appertains.

It will be particularly noted that I have produced a governor that is exceedingly sensitive to the slightest variations in speed of the prime mover, and in which the governing action is such that the power applied to the prime mover is uniformly commensurate with the work to be performed. My improved governor is also free from delicate and complicated mechanism and is so constructed as not to readily get out of order or become deranged.

It will also be noted that while I have illustrated and described my improved governor as applied to a hydraulic motor, it is not limited in its application to this class of inventions.

It is readily apparent that the same may be used as the governing element of any other form of prime mover.

It will also be noted that the auxiliary motor illustrated and described is virtually a reversible motor, which is as effectively governed in one direction as in the other, and that by means thereof any tendency of the prime mover to rotate the auxiliary motor is effectively overcome. In this connection, however, I do not desire to limit myself to the specific auxiliary motor shown and described.

I claim as my invention:

1. A governor comprising a reversible reversely governed auxiliary motor, and means for varying the power applied to the element to be governed in proportion to the differences of speed occurring between said governed and said auxiliary motor.

2. A governor comprising an auxiliary motor, means for driving the same, means for varying the power applied to a prime mover in proportion to the differences in speed occurring between the auxiliary motor and the prime mover, and means for counteracting any tendency of the prime mover to drive the auxiliary motor.

3. A governor comprising an auxiliary motor, means for driving the same, means for maintaining said auxiliary motor at a uniform speed under normal conditions, means for varying the power applied to a prime mover in proportion to the differences of speed occurring between the auxiliary motor and the prime mover, and means for counteracting any tendency of the prime mover to drive the auxiliary motor.

4. A governor comprising an auxiliary motor, means for driving the same, means for varying the power applied to a prime mover in proportion to the differences in speed occurring between the auxiliary motor and the prime mover, and means for applying power in opposite directions to said auxiliary motor to counteract any tendency to govern the speed of said auxiliary motor.

5. A governor comprising a reversible auxiliary motor, reversely operated means for maintaining said motor at a uniform speed of rotation, and means for varying the power applied to the element to be governed in proportion to the differences in speed occurring between said governed element and said auxiliary motor.

6. A governor comprising an auxiliary motor provided with reversely operated buckets, means for moving said buckets into and out of their respective lines of impact, and means for varying the power applied to the element to be governed in proportion to the differences in speed between said governed element and said auxiliary motor.

7. A governor comprising an auxiliary motor provided with two members each having buckets arranged to be reversely operated, means for moving said buckets into and out of their respective lines of impact, and means for

varying the power applied to the element to be governed in proportion to the differences in speed between said governed element and said auxiliary motor.

8. A governor comprising an auxiliary motor formed of a pair of disks provided with a common hub, each disk being provided with buckets arranged to be reversely operated, means for moving said buckets into and out of their respective lines of impact, and means for varying the power applied to the element to be governed in proportion to the differences in speed between said governed element and said auxiliary motor.

9. A governor comprising an auxiliary motor, means for driving the same, a planetary gear connected with said auxiliary motor and also with the element to be governed, means controlled by said planetary gear for regulating the power applied to the element to be governed, and means for counteracting any tendency of the governed element to drive the auxiliary motor through said planetary gear.

10. A governor comprising a reversible reversely governed auxiliary motor, a planetary gear connected with said motor and also with the element to be governed, and means controlled by said planetary gear for regulating the power applied to the element to be governed.

11. A governor comprising an auxiliary motor provided with reversely operated buckets, means for moving said buckets into and out of their respective lines of impact, a planetary gear connected with said motor and also with the element to be governed, and means controlled by said planetary gear for regulating the power applied to the element to be governed.

In testimony whereof, I have signed this specification in the presence of two subscribing witnesses.

ELMER F. CASSEL.

Witnesses:
W. H. H. YOUNG,
DAVID REED.