

Sept. 2, 1924.

1,507,356

A. A. HORTON

HYDROELECTRIC UNIT FLYWHEEL GOVERNOR

Filed Jan. 27, 1922

3 Sheets-Sheet 2

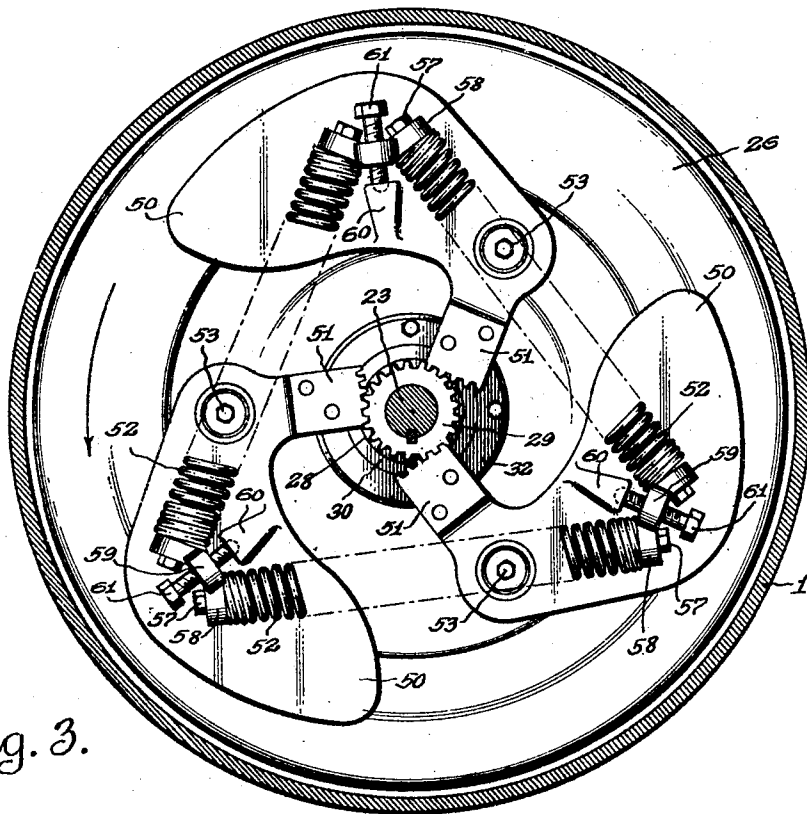


Fig. 3.

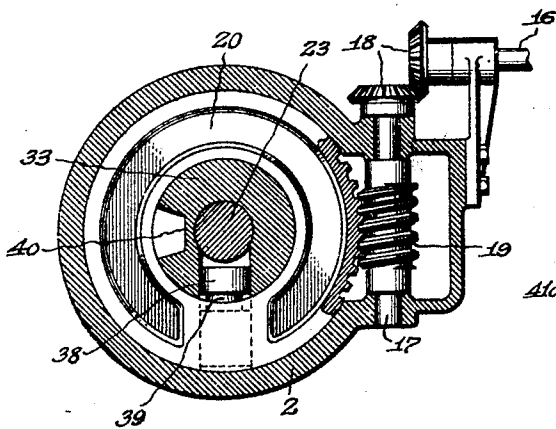


Fig. 5.

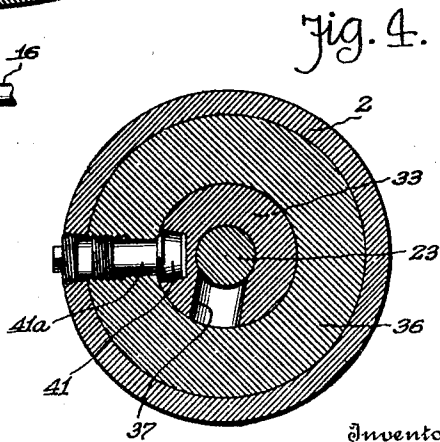


Fig. 4.

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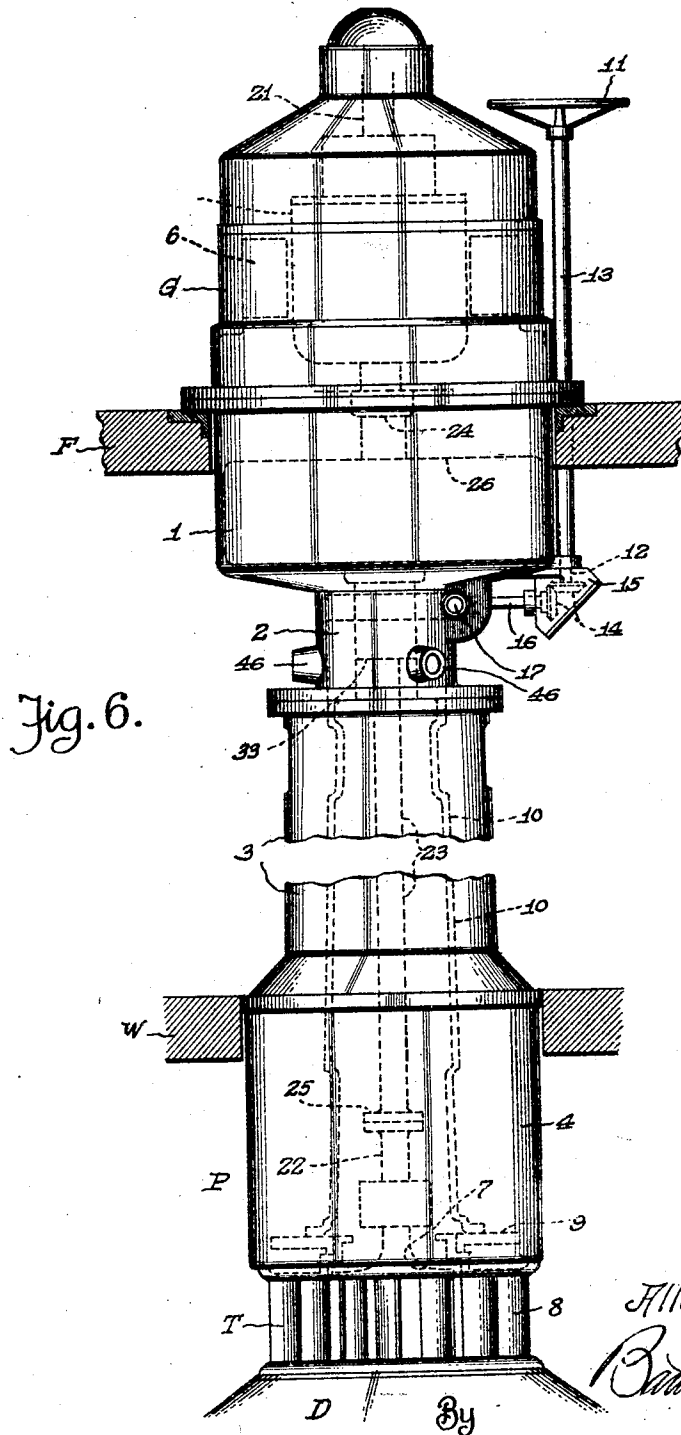
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

ALLEN A. HORTON, OF HIGHLAND PARK, MICHIGAN, ASSIGNOR TO HENRY FORD, OF DEARBORN, MICHIGAN.

HYDROELECTRIC-UNIT FLYWHEEL GOVERNOR.

Application filed January 27, 1922. Serial No. 532,122.

To all whom it may concern:

Be it known that I, ALLEN A. HORTON, a citizen of the United States of America, residing at Highland Park, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Hydroelectric-Unit Flywheel Governors, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to power plants and more particularly relates to speed regulating and stabilizing systems therefor.

Uniformity of speed, in spite of variations in the power supply or load is a universal requirement in the prime mover in the majority of power plant installations. Speed regulation must therefore be provided, and it is the purpose of such speed regulating systems as governors, to automatically provide this regulation. Stabilizing systems although they may include a governor, usually provide also for the dampening of the frequency and amplitude of the residual speed fluctuations, namely those which a governor mechanism unaided is unable to eliminate.

The variation of the energy supplied to the prime mover is a characteristic example of the manner whereby the power plant speed is regulated and thus it is usually in connection with some means for controlling the energy supply that a speed regulating governor operates. A stabilizing system may also operate on the energy supply to smooth out the effect of the governor action and to prevent hunting, but a stabilizer may also virtually or actually function as a flywheel. Its action in the latter case may then be more or less kinetic.

The inherent characteristics of a successful speed stabilizing and regulating system of the type embodied in a governor and governor gear for operating the gates of a hydraulic turbine to regulate its runner speed are: Sensitiveness; powerful operation; rapid gate operation; ability to avoid over-running and under-running speeds of the runner during regulation by accomplishing the regulation in a plurality of opposed similar steps, and such gen-

eral requirements as strength, durability, reliability, and freedom from necessary attention. Although sensitiveness, rapidity of operation, and the general requirements above noted are desirable in any governor; powerful operation and ability to prevent over-running and under-running speeds during operation are especially critical requirements in governors for hydraulic machinery, especially if the governors are direct acting. The first of these, namely governor power is desired to insure positive movement in the action of the governor in spite of the considerable resistance usually offered by the valve or gate mechanism to movement; whereas the latter, constituting the "anti-racing" and "anti-hammering" properties of the governor system is a critical requirement in view of the powerful effect of both the inertia and the kinetic energy of the energizing fluid, which is likely to cause an instantaneous effect opposite to that normally corresponding to the valve or gate position change.

These conditions may also apply in the case of secondary mover installations, and in cases where a governor is employed merely to insure safety to the machine or apparatus wherein it is embodied.

The general object of this invention is to provide a simple and efficient regulating, stabilizing or governing device characterized by its competency under certain or all of the conditions above set forth. Further objects of the invention are: to provide an improved inertia governor; to provide a speed stabilizing system adapted to stabilize and govern the speed of the machine to which it is applied and to augment the flywheel system thereof; to provide a governor system especially suited to the requirements of hydraulic machinery; to provide a governor system adapted to be embodied in a hydro-electric unit; and to provide a new and improved governor gear.

To these and other ends my invention may consist in a speed stabilizing and regulating system organized, constructed, embodied and applied as shown in the drawings, wherein:

Figure 1 is a fragmentary view of a hydro-electric unit, showing in vertical section, a speed regulator and governor incorporated in this machine and embodying features of my invention;

Fig. 2 is a horizontal section taken in the plane of the line II—II of Fig. 1;

Fig. 3 is a plan view of the mechanism shown in Fig. 1 within the governor chamber;

Figs. 4 and 5 are horizontal sections taken in the planes of the lines IV—IV and V—V, respectively, of Fig. 1; and

Fig. 6 is a contracted elevation of the hydro-electric unit embodying my invention, the installation of the unit being also indicated.

A hydro-electric unit of the same general character as that shown in Fig. 6, and an installation of the apparatus is set forth in detail in a co-pending application, Serial No. 499,690, filed September 10, 1921. It is a vertical installation comprising: a hydro-electric turbo-generator apparatus embodying in a single completely self contained and enclosed unit, the major organs, such as the prime mover and generator and their auxiliaries, such as the speed regulating mechanism, transmission and certain lubricating means.

The unit is built up in three principal sections, to wit: a turbine, a generator and an interconnecting section including the speed regulating system.

This interconnecting section is a tubular column comprising: a head or regulator chamber 1, a neck or torsion gear chamber 2, an elongated cylindrical trunk 3, and a pedestal or base 4. This section may, of course be made in one piece or in as many parts as desired. At its upper end the tubular column is mounted on and secured to the floor slab or other supporting structure F and in the vicinity of its lower end the column may be steadied by the cover wall W of the penstock P which it enters. A vertical turbine T of the Francis type may have its crown plate centered on and bolted to the lower end of the pedestal 4, while its turbine or discharge tube is suitably connected to the orifice of the draft tube structure D. Surmounting the unit is a vertical electric generator G, the base of which is centered on and secured to the upper end of the regulator chamber 1. This generator is set forth in detail in a co-pending application, Serial No. 421,858, filed November 5, 1920.

The armature 5 rotative within the field 6 of the generator is direct connected to the runner 7 rotating within the peripherally disposed system of wicket gates 8 of the turbine.

These gates are adapted to be opened and closed by an oscillatable gate ring 9. Counter-clockwise rotational movement of the ring 9 through a small angle as viewed from above will be regarded herein as causing the gates 8 to close; whereas movement of the gate ring in the opposite direction is presumed to open the gates.

The gate ring, in turn, may be operated either manually or automatically and accordingly the gate operating and controlling mechanism embodies both a manually operable branch and a branch adapted to be operated by the automatic regulating mechanism. Thus the unit may be started, set and stopped at the will of the attendant or operator, whereas regulation while running will be obtained by the speed regulator or governor. In the present embodiment of my invention, both the manual and automatic control systems operate the gate ring through the gate ring column 10 secured at its lower end to the gate ring and having a double torsion gear or head at its upper end. This gear is enclosed within the chamber 2 as best shown in Fig. 1. From this section of the gate control gear, the manually and automatically operated mechanisms branch off individually.

The mechanism for manually operating the gate ring column 10 embodies a pilot or hand wheel 11 mounted on and adapted to rotate the hand wheel shaft 12 enclosed within the hand wheel column 13 and driving, through the miter gears 14 enclosed within the casing 15, the hand control shaft 16 which is connected in turn to the worm shaft 17 through a pair of miter gears 18. Thus the gate column worm 19 is compelled to rotate in unison with the hand wheel 11, and since this worm is enmeshed with the segmental worm wheel 20 that is mounted at the head of the gate ring column 10 and connected thereto to communicate its rotative movement to said column, the angular movement of this worm wheel correspondingly shifts or twists the column 10. The latter being centered on and rigidly secured to the gate ring, communicates its movement thereto, thereby opening, holding, or closing the gates 8 which correspondingly affect the flow of penstock water into the turbine.

Automatic regulation is provided independently of the manual control during the operation of the machine by the governor gear which, under the influence of the governor, twists the gate ring column to adjust the gates. The governor is incorporated with the speed regulating and stabilizing system included in the regulator chamber 1. This regulating and stabilizing system is designed to maintain a substantially constant rotational speed in the machine to

which it is applied, even though the load or energy applied may vary,

spring loaded centrifugal mechanism is incorporated with the balance wheel and its shaft, whereby a torsional connection therebetween is provided and a criterion speed established.

The inherent characteristics of a successful governor and governor gear for operating the gates of a hydraulic turbine to regulate its runner speed have been previously stated. The speed stabilizing system shown in the drawings, embodies a governor that is characterized not only by the foregoing qualifications, but possesses also a "dead beat" action, operates through a powerful mechanical governor gear and is supplemented by one or more flywheel mass elements that stabilize and stimulate the governor action and steady the rotative movement and speed of the unit.

Accordingly, the mechanism of the stabilizing system embodies, organically, a flywheel, a governor and a governor gear. This mechanism is mounted upon a shaft which may be the main shaft of the machine as in its present embodiment.

Referring to Fig. 6, the main shaft of the machine includes three sections, one individual to each section of the rotating system of the unit. The generator armature shaft 21 constitutes the upper shaft section; the turbine runner shaft 22 constitutes the lower section of the shaft system; and the shaft 23, direct connecting the upper and lower sections is the intermediate section upon or about which the stabilizing system is mounted. The couplings 24 and 25 assemble the three main shaft sections into a substantially continuous and rigid shaft system having a rectilinear axis; they may both be identical to the coupling 24 shown in detail, or of any type that will hold the various shaft sections coaxial and torsionally rigid. Suitable bearings are provided for supporting the main shaft system and its sections axially and transversely.

The balance wheel 26 is a floating dynamic mass, the inherent inertia and stored kinetic energy of which is utilized to stabilize and to regulate the rotative movement of the unit or machine. These forces and their functions may influence the system mechanically as in the case of a conventional flywheel and also reactively or extraneously by their influence on the governor. Thus the balance wheel may be regarded, organically, as both an element of the rotating system of the machine and as an element of the governor.

The balance wheel 26 is mounted on the shaft section 23 to be helically movable to a limited extent about the axis thereof. This helical movement is bi-directional. If the shaft 23 be rotating and is retarded, the wheel 26 is urged by its kinetic energy to overrun the shaft and climb its helix, whereas if the shaft is accelerated the balance wheel is urged by its inertia to lag behind the rotating shaft and descend its helix. A

Accordingly a sliding helix connection is provided between the balance wheel and the shaft upon which it is mounted, whereas the centrifugal mechanism is connected to said shaft through a planetary system of gearing. To this end a concentric sleeve 27, having formed at its lower end a helix or spiral slide such as the externally formed thrust screw 28, and at its upper end a toothed sector or spur pinion such as the sun gear 29; is rigidly and immovably mounted on the shaft 23. A follower or nut 30 having an internally formed helix or thread 31 freely engaging and embracing the screw 28 is concentrically and rigidly incorporated with the balance wheel. This nut may be formed integral with the hub 32 or may be inserted and rigidly secured thereto. The nut and screw operate as a helical slide and slider when the wheel 26 is oscillated about the shaft 23. The wheel thus climbs the screw 28 as it rotates or moves angularly in one direction about its shaft and descends the screw when its movement relatively to the shaft is reversed.

It is the vertical movement of the balance wheel that causes the governor gear to adjust the energy supply, in the present instance the turbine gates. It is to this end that the cylindrical torsion sleeve 33 is swivel connected to the wheel hub or its nut 30 through the annular ball bearing 34. An oil well 34^a may be provided for retaining lubricant for this bearing. The sleeve 33 freely surrounds the shaft 23 and passes freely through the lower wall of the chamber 1, through the bore in the worm wheel sector 20 and into the bore 35 of the head 36 of the gate ring column 10.

Since the necessary movement of the gate ring column is purely torsional, the vertical movement or axial reciprocation of the balance wheel must be converted into torsional movement in applying it to the gate ring column. The torsion sleeve 33 which is swivel connected to the wheel, is accordingly so constrained and connected to the gate ring column that axial movement of the balance wheel causes a corresponding torsional movement of the gate ring column. The sleeve 33 may also be utilized to communicate the angular or torsional movement of the worm wheel 20 to the torsional gate ring column 10.

To this end the torsion sleeve 33 is provided exteriorly with a helical cam groove 37 engaged by a follower roller 38 journaled on the inwardly projecting end of a stud 39 rigidly secured in the worm wheel 20, and is also provided exteriorly with an axially

extending spline groove 40 engaged by a roller 41 journalled on the inwardly projecting end of a stud 41^a rigidly secured in the head 36 of the column 10. It will be obvious that the disposition of the grooves 37 and 40 might be reversed or that the inclination or lead might be applied in part to both of these elements. A bore through the sleeve 33 accommodates the shaft 23 which passes through the sleeve and rotates freely therein. In order to enhance the free torsional movement of the column 10 a roller suspension therefor is provided, comprising: the conical track or race plate 42 inserted in the peripheral annulus 43 of the head 36, and the conical rollers 44 journalled on the inwardly projecting ends of the studs 45 rigidly secured in the bosses 46 of the torsion gear chamber 2 of the casing. The surfaces of this casing chamber engaging with the sleeve 33, the worm wheel 20 and the column head 36 and the surfaces of the latter three members that are in engagement, should, of course, slide with sufficient freedom to permit the free functional movement of these members.

The centrifugal mechanism for establishing a criterion speed is mounted on the balance wheel 26 and engages with the shaft 23 after the fashion of a planetary system. This mechanism also provides a torsional connection between the shaft 23 and the balance wheel. The mechanism may embody a plurality of identical interconnected sets uniformly disposed with respect to a common center of gravity about which the system is adapted to revolve and this condition may maintain in their various positions of operative movement. Mechanical balance is thus enhanced. As best shown in Fig. 3, each of these sets embodies a pivoted rigid planetary member including a fly-weight 50 and a sector 51, and a loading spring 52. These members are each pivotally mounted on a pintle 53 rigidly secured in a boss 54 formed in the web of the balance wheel 26. To insure sensitiveness in the movement of the fly-weight or planetary members, the ball bearings 55 are interposed between each of the bearing hubs 56 and the pintle shaft. The teeth of the sectors 51 mesh with the sun gear 29 as shown in the drawings, the face of the sun gear being wider than that of the sectors and of sufficient length to permit the latter sliding longitudinally along the former as the balance wheel climbs or descends its helix.

The loading springs 52 are conveniently applied to the fly-weights as best shown in Fig. 3. The adjacent pairing ends of each of the helical tension springs 52 is secured by means of a bolt 57 and a clamp or nut to one of a pair of angularly disposed seats 58 which, together with the intermediate boss 59 are united into a yoke. Each of these

yokes engages with an abutment 60 through the medium of a ball pointed adjusting screw 61 seating in a corresponding recess in the outer upstanding face of the abutment 60. The springs 52 are thus united in a closed triangular spring system, divergently elastic. At its angles it is universally connected to the abutments 60 through the yokes which function as equalizers. The adjusting screws permit of suitable adjustment and centering.

The spring system described, exerts a centripetal force upon a moment arm of each of the fly-weights 50. This draws them together and also shifts the balance wheel 26 relatively to the shaft 23, e. g. rotates the wheel in a counter-clockwise direction and also causes it to move axially downward by virtue of its helical mounting. This assumes that the helix or screw 27 is left hand and that the tension of the governor spring system and the weight of the balance wheel exert corresponding forces on the regulator mechanism. It assumes, further, that the rotation of the shaft 23 is left handed, i. e. counter-clockwise as viewed from above. Still further it is assumed that the depressed position of the torsion sleeve 33 corresponds to the "open" position of the governor gear. It has been previously stated that clockwise movement of the gate ring column 10 would be regarded as its "gate opening" movement and the reverse movement as "gate closing." These conditions may be changed in part or completely, provided that the resulting mechanism and machine and its elements are properly co-ordinated and designed.

The angle of inclination of the cam groove 37 being small, the action between this groove and its roller may be regarded in this mechanism as irreversible. Thus when the worm wheel 20 is rotated, the roller and groove connecting it to the torsion sleeve 33 rotates the latter accordingly and the spline and roller connection between the sleeve and the column head 36 likewise rotates the column 10. Thus as long as the sleeve 33 remains immovable vertically, or in other words does not slide, the worm wheel 20 and the column 10 are, rotatably, rigidly connected. However, the governor mechanism shifts the torsion sleeve axially; and when this occurs, the inclination of the cam groove 37 along which the roller 38 rolls, causes a torsional reaction between the worm wheel 20 and the column head 36, twisting or oscillating the latter, consequently shifting the turbine gates.

The centrifugal mechanism of the governor is relied upon to correct and maintain the absolute speed of the shaft 23, and thus the machine to which it is rigidly connected, the efforts of the centrifugal mechanism being applied to the energy supply control through the governor gear. The inertia

mechanism of the governor, of which the balance wheel is an organic part, on the other hand, is relied upon to instantaneously correct and compensate for variation in machine speed, and to stabilize the action of the centrifugal and inertia systems of the governor mechanism cooperating to produce those characteristics above specified as inherent requirements in a governor ideally meeting the service demands of a unit such as herein illustrated, and in fact the systems intermingling.

In starting, the machine is usually put into operation and brought up to normal running speed under no load. To this end the operator manipulates the hand wheel 11 to apply the energy to the prime mover, in the present instance to shift the gates, opening them from the full closed position through the starting position to the running position. The governor meanwhile comes into action, its mechanism assuming a position intermediate the "full open" position shown in Figs. 1 and 3, and a "full closed" position which is its other extreme position of movement, and raising the torsion sleeve correspondingly in order that the gates may be adjusted to the inherent load of the machine and obtain and maintain normal running speed. Under these conditions of operation, presuming the conditions of head and tail water or other energy supply to remain unchanged, the operation of the governor has been mainly through its centrifugal system, the centrifugal action of the fly-weights overcoming the load opposing their outward movement and thus partially closing the gates and holding them in an appropriate position. The action of the inertia mechanism under these conditions may have been merely to stimulate and steady the governor action.

If, however, an external load be applied, or the potency of the energy supply falls off, the speed of the machine will drop, and the equilibrium of the governor will be disturbed. If this occurs gradually, the action of the centrifugal mechanism of the governor will be rapid enough, but if the load results in a sudden speed drop, the inertia mechanism of the governor may effect a compensating gate adjustment before the centrifugal mechanism has had time to act, although of course the latter will co-operate in this respect. The balance wheel 26, then will oscillate relatively to the shaft 23 and its sun gear 29, first advancing and then lagging, thus providing the much desired over and under setting of the gates or other valve gear, and again enable the governor and machine speed to obtain equilibrium. The action due to an increasing external load is obviously similar.

If, on the other hand, the speed of the machine increases, whether due to change

in load or in potency of energy supply, the governor operation is similar but its effect is converse. If the change be gradual, the centrifugal mechanism may correct for the change as when starting the unit from rest without the assistance of the inertia mechanism. However, if the speed change be abrupt, the balance wheel 26 will again oscillate, first lagging and then advancing, until normal speed and equilibrium is again established. These fluctuations and the consequent governor action are commonly incessant in power plant apparatus, but their magnitude and frequency are considerably dampened by the features of the regulator herein described.

Having thus described a single embodiment of my invention, what I claim is:—

1. In a speed regulator, the combination of a rotatable shaft, a regulating gear through which said shaft extends, means to facilitate manual adjustment of said regulating gear, a balance wheel mounted to be helically movable relatively to said shaft, a planetary centrifugal mechanism connected to the balance wheel and to the rotatable shaft, said connection being such that the movement of the balance wheel and the centrifugal mechanism relatively to the rotatable shaft is co-ordinated, and means for applying said movement to the regulating gear independent of the first mentioned means to cause the latter to be operated and controlled.

2. In a speed regulator, the combination of a rotatable shaft, a regulating gear through which said shaft extends, means to facilitate manual adjustment of said regulating gear, an inertia member having a portion thereof helically movable relatively to said shaft, a fly-weight mounted to be revolvable about an axis and to permit the shifting of its mass center relatively to its axis of revolution, means for co-ordinating the helical movement of the inertia member and the shifting movement of the fly-weight, and means for utilizing the co-ordinated movement of the inertia and fly-weight mechanism independent of the first mentioned means to cause the regulating gear to be operated and controlled.

3. In a speed regulator, the combination of a rotatable shaft, a regulating gear through which said shaft extends, means to facilitate manual adjustment of said regulating gear, a balance wheel mounted to be rotatably movable relatively to said shaft, a pinion rotatably rigid with said shaft, a fly-weight pivotally mounted on said balance wheel with its mass center eccentric of said pivotal axis, an arm rigid with said fly-weight, means for connecting the last mentioned arm to the pinion of said shaft to interconnect the pivotal movement of the fly-weight and the rotative movement of the

balance wheel and to establish a torsional connection between the shaft and balance wheel, and means for utilizing the balance wheel and fly-weight movement to cause the operation and control of the regulating gear.

4. In a speed regulator, the combination of a rotatable shaft, a regulating gear through which said shaft extends, means to facilitate manual adjustment of said regulating gear, a helical slideway rigid with said shaft, a balance wheel mounted to be helically slidable on said slideway, a crank pintle mounted on said balance wheel, a centripetally loaded fly-weight eccentrically journaled on said pintle, a toothed gear rigid with the rotatable shaft, a toothed sector rigid with the fly-weight and concentric with the pivotal axis thereof, said sector meshing with said toothed gear, and means for utilizing the movement of said balance wheel and fly-weights relatively to the rotatable shaft for causing the operation and control of the regulating gear independent of the first mentioned means.

5. In a speed regulator, the combination of a rotatable shaft, a regulating gear through which said shaft extends, means to facilitate manual adjustment of said regulating gear, a helical slideway rigid with said shaft, a balance wheel mounted to be helically slidable on said slideway, a crank pintle mounted on said balance wheel, a centripetally loaded fly-weight eccentrically journaled on said pintle, a toothed gear rigid with the rotatable shaft, a toothed sector rigid with the fly-weight and concentric with the pivotal axis thereof, said sector meshing with said toothed gear, and means, swivel connected to the balance wheel, adapted to apply the axial movement of the same to the regulating gear independent of the first mentioned means.

6. In a speed regulator, the combination of a rotatable shaft, a regulating gear through which said shaft extends, means to facilitate manual adjustment of said regulating gear, a balance wheel mounted concentrically of said shaft to be rotatable relatively thereto, a plurality of crank pintles mounted on said balance wheel in angularly spaced relation, a fly-weight eccentrically journaled on each of the pintles, means for connecting the fly-weights to said rotatable shaft to impart a planetary movement to the former as the balance wheel rotates relatively to the latter, a spring reacting between a pair of the fly-weights to load them against movement in one direction, and means for applying the movement of the balance wheel and fly-weights to the regulating gear independent of the first mentioned means.

7. In a speed regulator, the combination of a rotatable shaft, a regulating gear through which said shaft extends, means to

facilitate manual adjustment of said regulating gear, a balance wheel mounted concentrically of said shaft to be rotatable relatively thereto, a plurality of crank pintles mounted on said balance wheel in angularly spaced relation, a fly-weight concentrically journaled on each of the pintles, means for connecting the fly-weights as a planetary system to said rotatable shaft, a tension spring extending from a moment arm of one of the fly-weights toward the next succeeding fly-weight and reacting between its anchorages to yieldingly load the fly-weight system, and means for applying the movement of the balance wheel and fly-weight system to the regulating gear independent of the first mentioned means.

8. In a speed regulator, the combination of a rotatable shaft, a regulating gear through which said shaft extends, means to facilitate manual adjustment of said regulating gear, a balance wheel rotatably mounted on said shaft, a plurality of crank pintles mounted on said balance wheel in angularly spaced relation, a fly-weight eccentrically journaled on each of the pintles, means for connecting the fly-weights as a planetary system to said rotatable shaft, a two armed equalizer pivotally connected to a moment arm of each of the fly-weights, a tension spring extending from each of the arms of each of the equalizers to the adjacent arm of the equalizer of the next succeeding fly-weight, and means for applying the energy of the functional movement of the fly-weights and balance wheel to the regulating gear independent of the first mentioned means.

9. The combination of a gate adjusting column, a regulating gear adapted for rotating said column, manually actuated means adapted for rotating said regulating gear, means including a reciprocable sleeve for establishing an operative connection between said column and said regulating gear for manual adjustment of said column and an operative connection adapted for column adjustment by power, power means, and a governor actuated by said power means adapted to reciprocate said sleeve and cause said sleeve to rotate said column.

10. The combination of a rotary head, power means coaxially of said head adapted to rotate said head, manually actuated means at the side of said head adapted to rotate said head, a regulating gear and sleeve adjacent said head and establishing a driving relation between said head and its manually actuating means, said sleeve being interposed between said head and said power means and actuated by the latter and adapted to establish an operative connection between said power means and said regulating gear, and governor means adapted to be actuated by said power means to move said sleeve inde-

pendently of said manually actuated means.

11. The combination of a gate adjusting head, a gear at said head, manual means to facilitate adjusting said gear, a sleeve slidable axially of said head and gear and having a constant driving relation with said head and gear, the driving relation between said gear and sleeve being such that sliding of said sleeve causes partial rotation of said

sleeve and said head, and means adapted for sliding said sleeve. 10

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

ALLEN A. HORTON.

Witnesses:

J. E. HALL,

M. H. HOLMES.