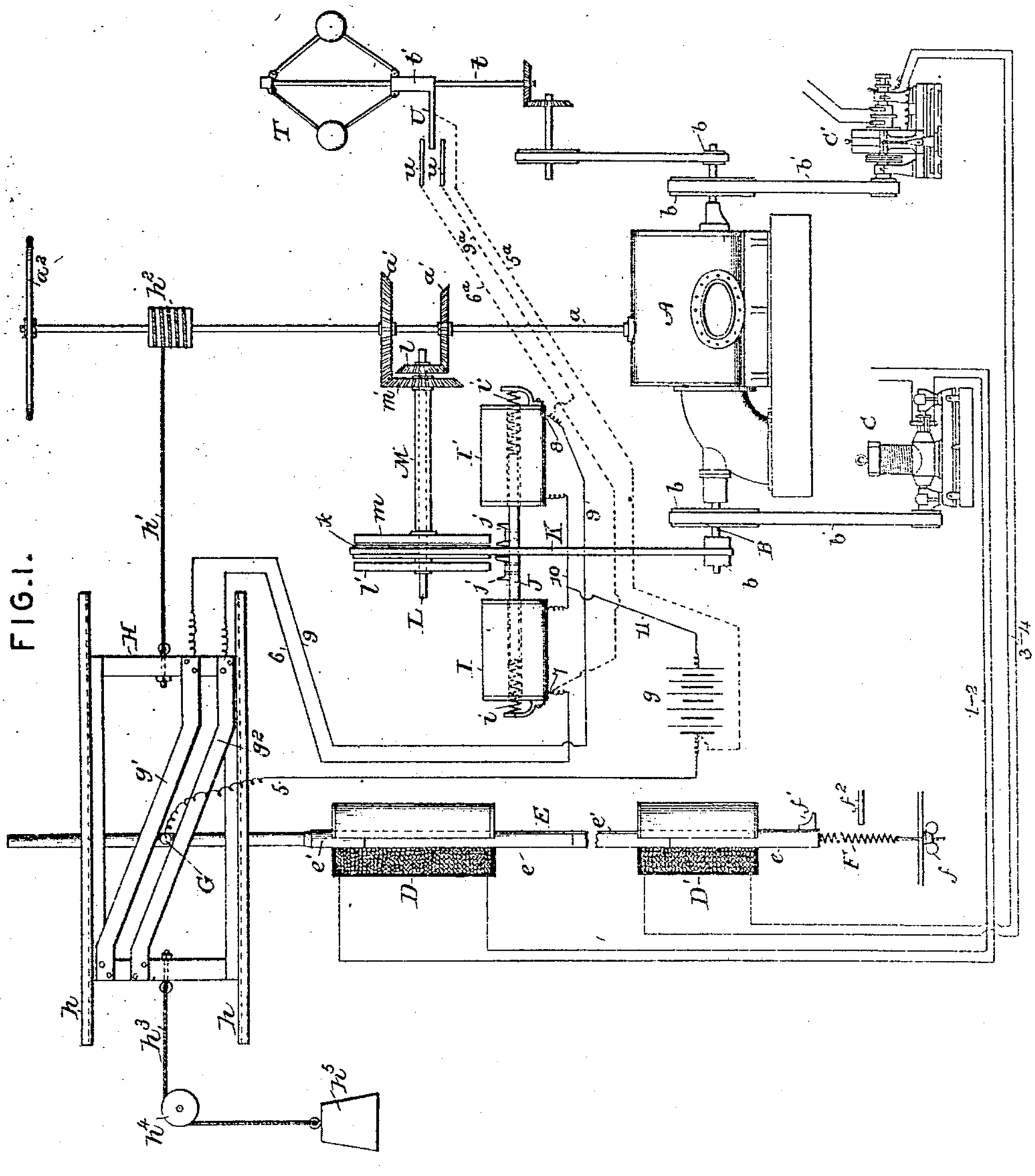
(No Model.) 2 Sheets—Sheet 1.

E. P. WETMORE.

ELECTRICAL WATER WHEEL GOVERNOR.

No. 519,597. Patented May 8, 1894.

FIG. 1.



Witnesses
Jas. K. McCathran
D. C. Hollaugher

Inventor
Earl P. Wetmore

By his Attorneys.
C. A. Snow & Co.

(No Model.) 2 Sheets—Sheet 2.

E. P. WETMORE.

ELECTRICAL WATER WHEEL GOVERNOR.

No. 519,597. Patented May 8, 1894.

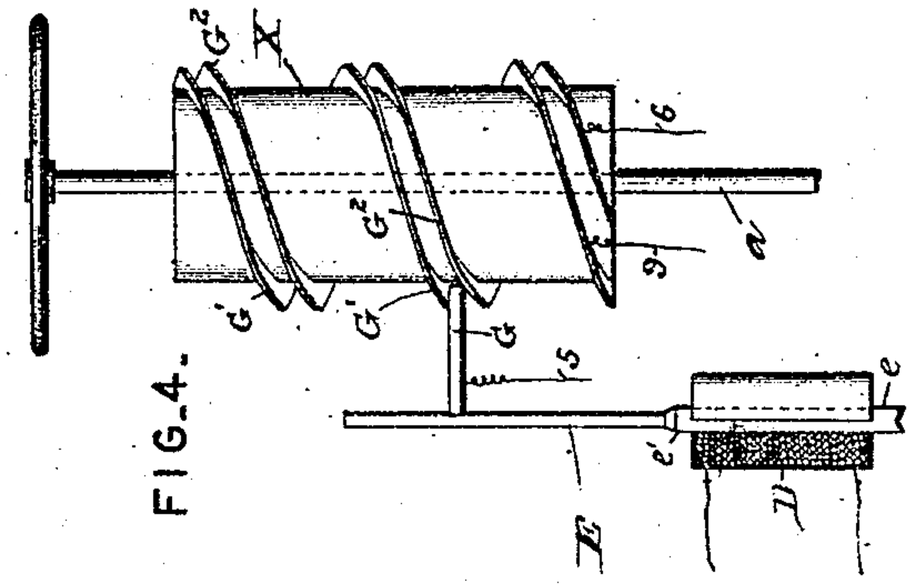


FIG. 4.

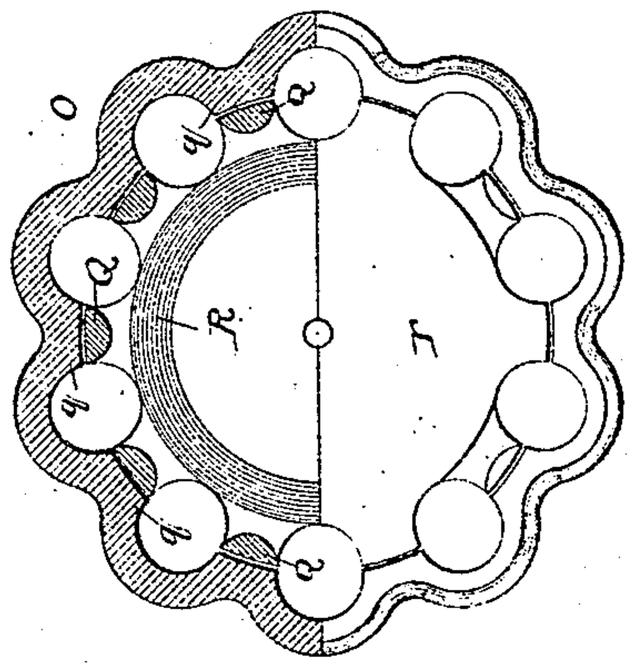


FIG. 3.

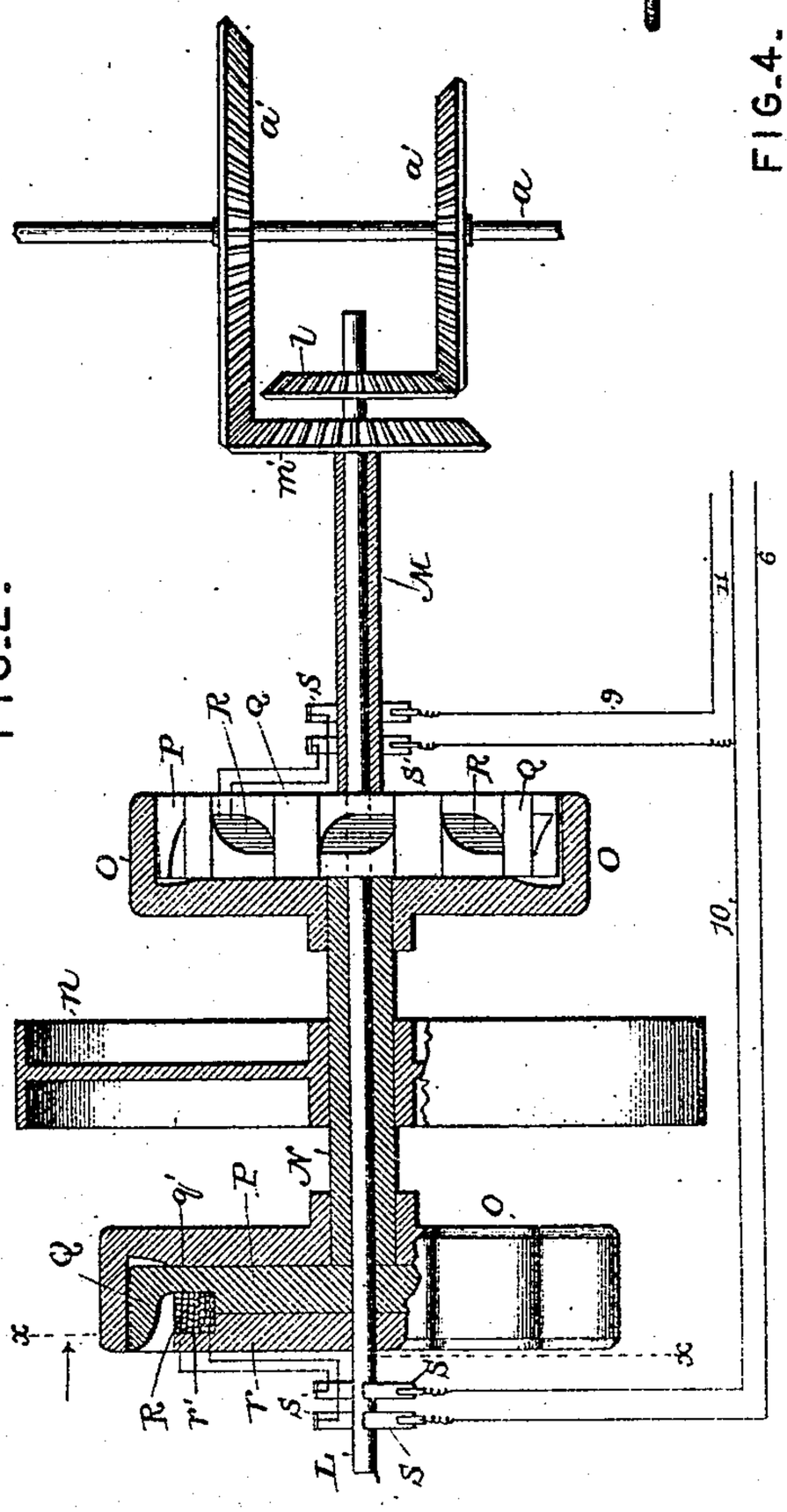


FIG. 2.

Witnesses
Jas. K. McCathran
D. A. Wallhaupter.

Inventor
Earl P. Wetmore
By his Attorneys.
C. A. Snow & Co.

UNITED STATES PATENT OFFICE.

EARL PORTER WETMORE, OF HELENA, MONTANA.

ELECTRICAL WATER-WHEEL GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 519,597, dated May 8, 1894.

Application filed January 16, 1894. Serial No. 497,083. (No model.)

To all whom it may concern:

Be it known that I, EARL PORTER WETMORE, a citizen of the United States, residing at Helena, in the county of Lewis and Clarke and State of Montana, have invented a new and useful Electrical Water-Wheel Governor, of which the following is a specification.

This invention relates to electrical water wheel governors; and it has for its object to provide improved governing devices of this character which shall automatically operate to control the speed of a water wheel according to the load upon the dynamo or dynamos in circuit with the governor, or more technically speaking, according to the variations in current strength or in the output of such dynamos.

The main object of the present invention, therefore, is to regulate the effective supply of water to the water wheel or wheels through means of valves, gates or deflecting nozzles, which are directly controlled by the change in the output of electric energy from the dynamos which are operated by the water wheel or wheels, in order to admit or cut off the supply of water in direct proportion to the increasement or decreasement of the load upon the electric generators.

It is well known, that where the fly ball or centrifugal governors, or differential speed governors, are used in connection with water wheels of the governor does not become effective until the speed of the water wheels is changed. This change of speed in the water wheels is directly caused by the change of load upon the dynamos, and this invention therefore prevents loss of time in effecting the regulation, inasmuch as the change of load upon the dynamos puts the governing devices herein described into practical operation.

With these and other objects in view which will readily appear as the nature of the invention is better understood, the same consists in the novel construction, combination and arrangement of parts hereinafter more fully described, illustrated and claimed.

In the accompanying drawings:—Figure 1 is a diagrammatic plan view of an electrical water wheel governor constructed in accordance with this invention. Fig. 2 is a detail elevation partly in section of electric clutches preferably used in connection with the apparatus shown in Fig. 1. Fig. 3 is a detail sectional view on the line x—x of Fig. 2. Fig. 4 is a detail view showing a preferred construction of contact device.

Referring to the accompanying drawings, A represents a single or double turbine water wheel, or reacting wheel of the Pelton or other type. This water wheel, as stated, is of any preferred construction, and the valve or gate mechanism thereof is controlled by means of the vertical valve rod or shaft a, which is provided at an intermediate point with reversely disposed beveled gear wheels a', and carries at its upper end a hand wheel a^2, which is ordinarily employed for controlling the flow of water through the wheel by hand, but in the present invention such rod is controlled automatically by the devices to be hereinafter described.

The shaft B, of the water wheel A, carries outside of the water wheel casing, any number of belt pulleys b, depending upon the number of electrical generators or dynamos driven by such water wheel, but as illustrated in Fig. 1. of the drawings, two of said belt pulleys receive the dynamo belts b', which are belted to dynamos C and C', of any type or construction, the dynamo C, being illustrated as a direct current dynamo, while the dynamo C', is of the alternating type, and it is to be understood that any number of dynamos of any type may be employed. The direct current dynamo C, is connected in series, by the series circuit 1—2 with a suitably arranged solenoid D, while the alternating dynamo C', has the compound field winding thereof connected in series with the solenoid D', by the series circuit 3—4.

The solenoid D, is illustrated as being arranged directly above and in line with the solenoid D', and it will of course be understood that the specific character of the winding of said solenoids depends upon the fact whether each is connected with one or more dynamos and of the character of such dynamos. Should one or more of the dynamos operated by the water wheel be of the polyphase type, then the magnet D, would be included in series with the field circuit of the polyphase current dynamo, that is, the entire exciting current would pass through the magnet

D, and regulation would be effected since the exciting current of a polyphase generator varies in a certain ratio to the load upon the dynamos. In case one or more of the dynamos operated by the water wheels is of an arc or constant current type, then the magnets D or D′, would be made up of one or more sections of fine wire of proper resistance to enable the same to be connected directly across the terminals of the arc or constant current dynamo. These changes in the windings will of course be varied to accommodate the apparatus to the different dynamos, but only to secure the same result in connection with such dynamos as those illustrated in the drawings, and the aligned solenoids or magnets D, and D′, accommodate therein the sectional core plunger E. The sectional core plunger E, is made up of connecting magnetic metallic sections *e*, and non-magnetic metallic sections *e′*, which form together a single continuous core plunger, but it will of course be understood that the magnetic metallic portions *e*, of the core, are adapted to move within the solenoids, so that motion will be given to the core plunger in either direction, as such solenoids become energized or de-energized. The core plunger E, has connected with the lower end thereof the adjusting spring F, adjustably connected at *f*, to a suitable point of attachment, so that the core plunger will always be returned to its normal inactive position after either or both of the solenoids have become inactive, and said core plunger is further provided at its lower extremity with an off-standing stop arm *f′*, which is adapted to come in contact with an off-standing stop projection f^2, which provides a limit to the downward movement of the plunger. As the said core plunger E, is moved in either direction according to the variation in the strength of either or both of the solenoids, as the load upon the dynamos connected therewith increases or decreases, such core plunger is adapted to act as a circuit closer for the valve or gate operating devices to be described, and is provided at a suitable point above the upper solenoid D, with a contact pin or roller G, which is electrically connected by the wire 5, with one pole of a convenient source of electrical energy *g*, which may be a suitable series of batteries or a dynamo. The contact point or roller G, carried by the solenoid-controlled core plunger E, is adapted to play between the approximately parallel contact plates *g′*, and g^2, respectively. The contact plates *g′* and g^2, are mounted in substantially parallel planes and at an angle on the sliding contact frame H. The sliding contact frame H, is mounted to slide between the parallel guides or ways *h*, and has attached to one end the adjusting rope *h′*, which winds and unwinds on the grooved rope drum h^2, secured on the valve rod *a*, while to the other end of the sliding frame H, is attached one end of the weight rope h^3, which passes over a suitably arranged guide pulley h^4, and has attached to the free end a weight h^5, which serves to slide the contact frame in one direction. The movement of the core plunger E, is adapted to bring the contact pin or roller G, in contact with either of the plates *g′* or g^2, and complete a circuit through the external source of electrical energy *g*, and to provide for this, the contact plate g^2, is electrically connected by the wire 6, to one terminal 7, of a suitably arranged solenoid I, directly in a line with which, and opposite to, is arranged a duplicate solenoid I′, one terminal 8, of which is connected by the wire 9, to the other contact plate *g′*, while the adjacent terminals of these two solenoids I and I′, are joined by the bridge wire 10, which has connected thereto the circuit return wire 11, leading to the other pole of the external source of electrical energy *g*, and thereby providing for a completion of the external circuit through either of the magnets I and I′, according as the contact pin or roller G, is moved in contact with either of the contact plates *g′*, or g^2, mounted on the sliding frame H. The aligned solenoids I and I′, are adapted to control, in either direction, the movement of a horizontally moving core J, the ends of which slide in the opposite solenoids, and within the open outer ends of the solenoids I, and I′, are arranged the core adjusting springs *i* and *i′*, which have one end thereof bearing on the extremities of the core J, and are of a tension which holds the said core to a normal inactive position. The horizontally moving core J, carries at a point between the inner adjacent ends of the solenoids I and I′, the parallel shifting lugs or tappets *j*, which embrace a belt K, driven from one of the pulleys *b*, of the water wheel shaft, and passing over a loose pulley *k*, mounted loosely on a suitably supported and arranged regulating shaft L, which carries at one end a pinion *l*, meshing with the lower one of the wheels *a′*, and adapted to turn such wheel in a direction to close or cut off the supply of water controlled by the rod *a*. The shaft L, carries at a point alongside of the intermediate loose pulley *k*, a fast pulley *l′*, onto which the belt is adapted to be moved by the magnet shifting devices when the core J, is shifted in one direction. At the opposite side of the pulley *k*, and loosely mounted on the shaft L, is the sleeve M, carrying at one end alongside of the loose pulley a belt wheel *m*, and at its opposite extremity a beveled gear wheel *m′*, which meshes with the upper one of the beveled gear wheels *a′*, and is adapted to turn the valve or gate regulating rod *a*, in a direction to open the valve or gate of the water wheel.

The operation of the apparatus set up as just described is as follows:—Assuming direct current and alternating dynamos C and C′, are in operation from the water wheel A; a sudden increase of current load on the direct current dynamo C will energize the solenoid D, sufficiently, so as to move the core plunger E, upward, against the tension of the

spring F, and cause the contact pin or roller G to contact with the upper metallic contact plate g', on the sliding frame. The circuit is then completed through the wire 5, from the external source of generation g, the contact plate g', wire 9, solenoid I, and the return wire 11, which circuit energizes the solenoid I', and moves the shifting core J, in a direction which shifts the belt K, from the loose pulley, k—, onto the sleeve pulley m, which immediately operates the gear m', and the upper one of the rod gears a', so as to immediately increase the supply of water. As soon as the valve rod or shaft a, commences to turn, the adjusting rope h' winds on the drum h^2, and draws the frame H, in one direction until such frame has moved sufficiently far to relieve the contact G, from the upper contact plate g'. The current is thus automatically broken so as to de-energize the magnet I', and then the spring i', immediately moves the core J, into a normal position and shifts the belt K, back onto the loose pulley. The two contact strips or plates g' and g^2, and the drum h^2, are so adjusted that the valves or gates are opened a proper amount to admit the required water for the operation of the wheels when the contact G touches neither of such plates, and therefore the distance or space between such contact plates determines the sensitiveness of the governor or regulator. It will be obvious that similar increases on the load of the alternator C', would have a similar effect on the solenoid or magnet D', to secure the same regulation just described; while, conversely, a decrease in the load of either dynamo would have the opposite effect, that is, to decrease the supply of water to the water wheel, in such case the sliding frame H, being moved properly in one direction by the weighted rope h^3.

While I have illustrated and described a belt shifting device which controls the separate gears engaging the gears on the valve rod or shaft, I preferably substitute these devices by the clutch devices or clutch wheels shown in Figs. 2 and 3 of the drawings. In Fig. 2, the shaft L, carries the gear l, at one end, and the shaft sleeve M, carries the gear m', at one end in the same arrangement as described in connection with the belt shifting devices, but in the preferred arrangement, the shaft L, accommodates thereon a drive sleeve N, to which is keyed a belt wheel n, driven by the belt K, and to the opposite extremities of this sleeve are secured the metallic cup disks O, inside of which are adapted to turn the magnet wheels P. One of the magnet wheels P, is fastened to the shaft L, and the other of such wheels is fastened to one end of the sleeve M, in a similar manner to the mounting of the pulleys l' and m. Both of said magnet wheels P, are sectional and each is provided with a circumferential series of projecting pole pieces Q, adapted to align with similar inwardly projecting pole projections q, formed on the inner periphery of the cup disks. At one side of each magnet wheel and inside of the circle of the pole pieces such magnet wheels are provided with the coil recesses q' in which are placed the magnet coils R, secured in position by the cap plates r, having inner recessed edges r', forming a portion of the coil recesses. The terminals of the magnet coils R, lead respectively to collecting and discharging rings S, S, arranged at one side of the said magnet wheels. The same wire connections are employed in connection with the clutch wheels just described as in connection with the solenoids I and I', the wire 6 from the plate g^2, leading to the collecting ring of one magnet wheel, the wire 9, from the plate g', leading to the collecting ring of the other magnet wheel, the bridge wire 10, connecting the discharging rings of both magnet wheels, and the return wire 11 connected to the bridge wire 10.

When the circuit is closed by the moving contact G, in the manner already described with either one of the contact plates on the sliding frame, either one or the other of the magnet wheels is energized so that the poles thereof are alternately north and south, and necessarily hold the pole projections q, magnetically attracted thereby, so that as the sleeve N, rotates, and turns the cup disks, the energized magnet wheel will be caused to revolve and turn the beveled gear wheel connected therewith, in a similar manner to the belt shifting operation already described.

In connection with the belt shifting or clutch wheel devices just described, I may employ an ordinary centrifugal or fly-ball governor T, the shaft t, of which is geared with and driven from the water wheel shaft B, and the sliding collar t', which is moved up and down by the balls, is provided with a moving contact arm U, corresponding to the contact G and connected by the dotted wire 5^a, with one pole of the generator g. The moving contact U, is arranged to play between the separate contacts u, corresponding to the plates g', and g^2, and are connected by the wires 6^a, and 9^a, with the same connections as the wires 6 and 9. The moving of the contact U, in contact with either one of the contacts u, secures the same operation from the belt shifting devices or clutch wheels as previously described.

Changes in the form, proportion and the minor details of construction may be resorted to without departing from the principle or sacrificing any of the advantages of this invention, and at this point attention is directed to the fact that in the foregoing description I have shown and described the frame H, upon which the contact strips g' and g^2, are located and which is suitably controlled by the drum h^2, rope and counterweight, for simplicity in explaining the operation of the apparatus, but ordinarily and preferably the contact strips g', and g^2, would be arranged in the same relation to each other upon a drum or cylindrical frame X, mounted di-

rectly upon the shaft *a*, of the valve or gate mechanism as clearly shown in Fig. 4, of the drawings, thereby avoiding the use of the connecting devices.

By reference to Fig. 4, it will be seen that the contact plates which are lettered G′ and G², to correspond with those on the sliding frame H, are arranged spirally on the cylindrical frame X, and are disposed parallel with each other so as to correspond in every particular to the relative arrangement of the plates *g′* and *g²*, on the said sliding frame so that the same operation will be effected as the contact pin or roller G, is moved against either of the plates by the core, plunger, or armature E. The same circuit connections are observed in this preferable form of contact device it being shown that the wire 5, is connected to the contact G, the wire 6, to the contact plate G², and the wire 9, to the plate G′, and it is thought that the operation of this construction will be readily apparent without further description.

Having thus described the invention, what is claimed, and desired to be secured by Letters Patent, is—

1. In an electrical water wheel governor, the combination with the water wheel, the water wheel valve rod or shaft, and the dynamo driven by the water wheel; of electrically controlled gear devices connected with the valve rod or shaft, an automatically moving contact frame controlled by the movements of the valve rod or shaft and carrying spaced contact plates in circuit with said gear devices, a solenoid included in the dynamo circuit, a core, plunger, or armature controlled by the solenoid and having a contact arranged to move between said contact plates, and an external source of electrical energy included in a circuit with said contact and said electrically controlled gear devices, substantially as set forth.

2. The combination with a prime mover, its valve or regulating mechanism and the dynamos driven by the prime mover; of electrically controlled gear devices connected with the valve or regulating mechanism and in circuit with an external source of electrical energy, an automatically moving contact frame carrying spaced contact plates in circuit with said gear devices, solenoids circuited with the dynamos, a core, plunger or armature controlled by said solenoids and provided with a contact point or roller playing between the contact plates and also connected with said external source of electrical energy, substantially as set forth.

3. In an electrical water wheel governor, the combination with the water wheel valve rod or shaft; of electric motor device geared to said shaft to turn the same in either direction and included in a circuit with an external source of electrical energy, an automatically turning frame or cylinder carrying spaced contact plates arranged at an angle and separately connected by wires with said motor devices, and an automatically controlled contact point or roller playing between said contact plates and electrically connected with a convenient external source of electrical energy, substantially as set forth.

4. In an apparatus of the class described, the combination with the electrically controlled gearing devices, a similarly controlled moving contact included in the circuit of said devices, and an external source of electrical energy; of a prime mover valve shaft or rod geared to said gear devices, a drum or cylinder mounted on said shaft or rod and turning therewith, and parallel contact plates secured spirally on said drum and adapted to have said moving contact play there-between, substantially as set forth.

5. In an electrical water wheel governor, the combination with the water wheel, its valve mechanism and the dynamo driven by the water wheel; of electrically controlled gear devices connected with the valve mechanism, spaced contact plates suitably arranged and controlled by the movement of the valve mechanism shaft, a solenoid included in the dynamo circuit, a core, plunger, or armature, controlled by said solenoid and having a contact moving between said contact plates, and an external source of electrical energy included in a circuit with said contact and the valve controlling devices, substantially as set forth.

6. In an electrical water wheel governor, the combination with the water wheel, its valve or gate mechanism, electric motor devices geared with said valve or gate mechanism, automatic circuit devices having a moving contact, and controlled by the dynamos driven by the wheels; of suitably arranged solenoids circuited separately with a dynamo and energized and de-energized according to the fluctuations in current strength generated thereby, and a sectional core plunger, having magnetic metallic portions moving in each of the solenoids and connected to and controlling the moving contact of the circuit closing device, substantially as set forth.

7. In an electrical water wheel governor, the combination with the water wheel, its valve or gate mechanism and the dynamos driven thereby; of electric motor devices geared with said valve or gate mechanism and included in the circuit of the external source of electrical energy, a drum or cylindrical frame mounted on the shaft of the valve mechanism, parallel contact plates mounted on said drum or frame and separately connected to reverse operating portions of said electric motor devices, electrically aligned solenoids circuited separately with the dynamos driven by the water wheel, and a core plunger moving in said aligned solenoids and having a contact playing between said contact plates and electrically connected with the external source of electrical energy, substantially as set forth.

8. In an electrical water wheel governor, the combination with the water wheel valve rod

or shaft having reversely disposed gear wheels, separate shafts having gear-wheels meshing respectively with different ones of the gears on the valve rod or shaft, electro-magnetic clutches or clutch wheels mounted on said separate shafts, and electrically controlled circuit closing devices included in separate circuits with said clutches or wheels to energize the same separately, substantially as set forth.

9. In an electric water wheel governor, the water wheel valve rod or shaft having reversely disposed gear wheels, a suitably arranged shaft carrying at one end a gear wheel meshing with one of the wheels on the rod or shaft, a shaft sleeve mounted on one end of said suitably arranged shaft and carrying on one end a gear wheel meshing with the other one of the wheels on the valve rod or shaft, magnet wheels mounted on said suitably arranged shaft and on one end of the shaft sleeve, a drive sleeve mounted on said suitably arranged shaft and driven from the water wheel, metallic cup disks secured on the ends of said drive sleeve and surrounding the magnet wheels, electrically controlled circuit closing devices, and separate circuit connections from the circuit closing devices to each of the magnet wheels to energize the same separately, substantially as set forth.

10. In an apparatus of the class described, the combination with the separate shafts; of a metallic cup disk mounted on one of said shafts, a magnet wheel mounted on the other one of the shafts inside of the cup disk and having a circumferential series of projecting pole pieces and an energizing magnet coil clamped inside of the same and inside of the circle of the pole pieces, and suitable circuit connections with the magnet coil, substantially as set forth.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

EARL PORTER WETMORE.

Witnesses:

H. S. HEPNER,

C. H. ALEXANDER.