G. J. HENRY, Jr.

AUTOMATIC CONTROL FOR HYDRAULIC NOZZLES.

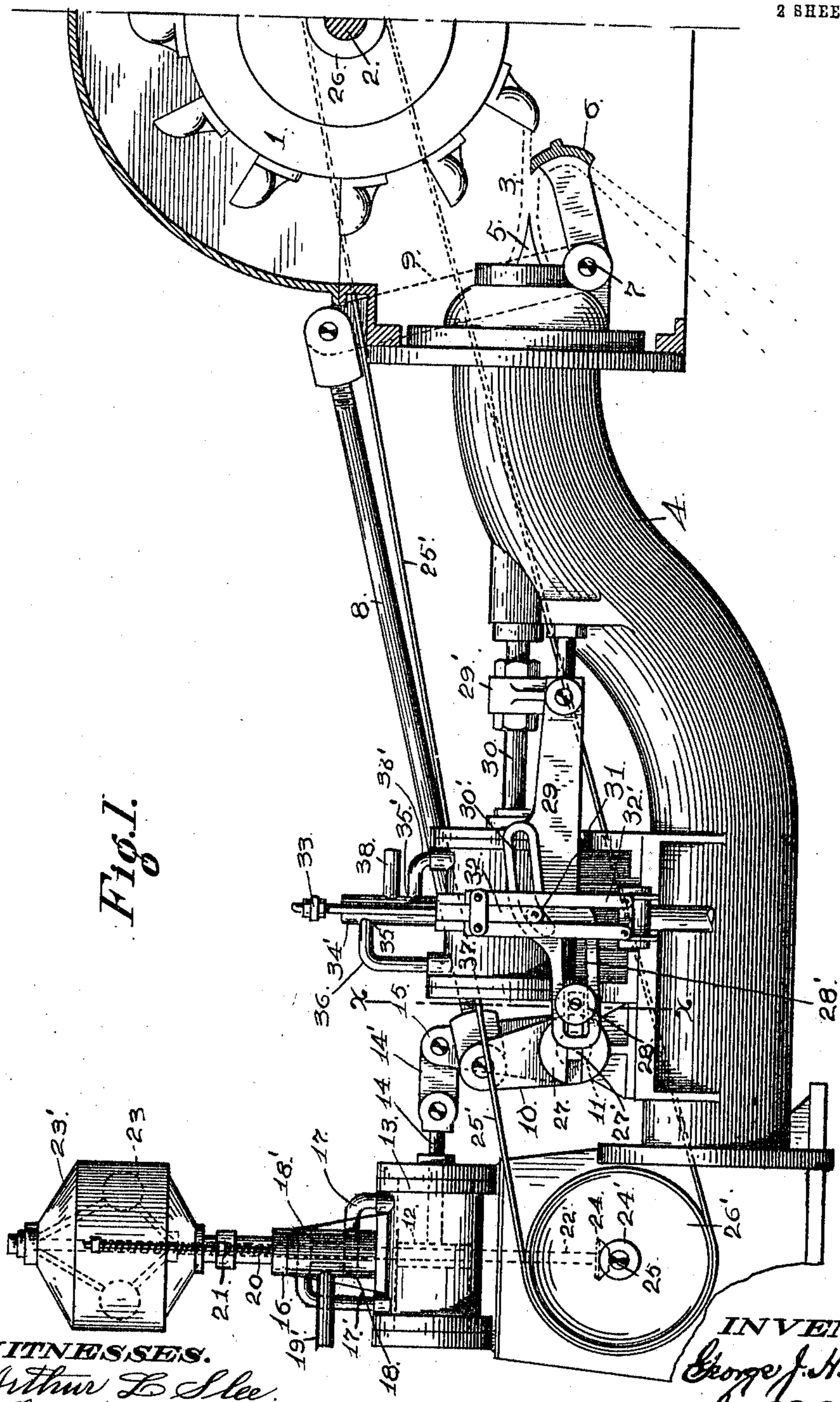
APPLICATION FILED MAR. 22, 1909.

993,064.

Patented May 23, 1911.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

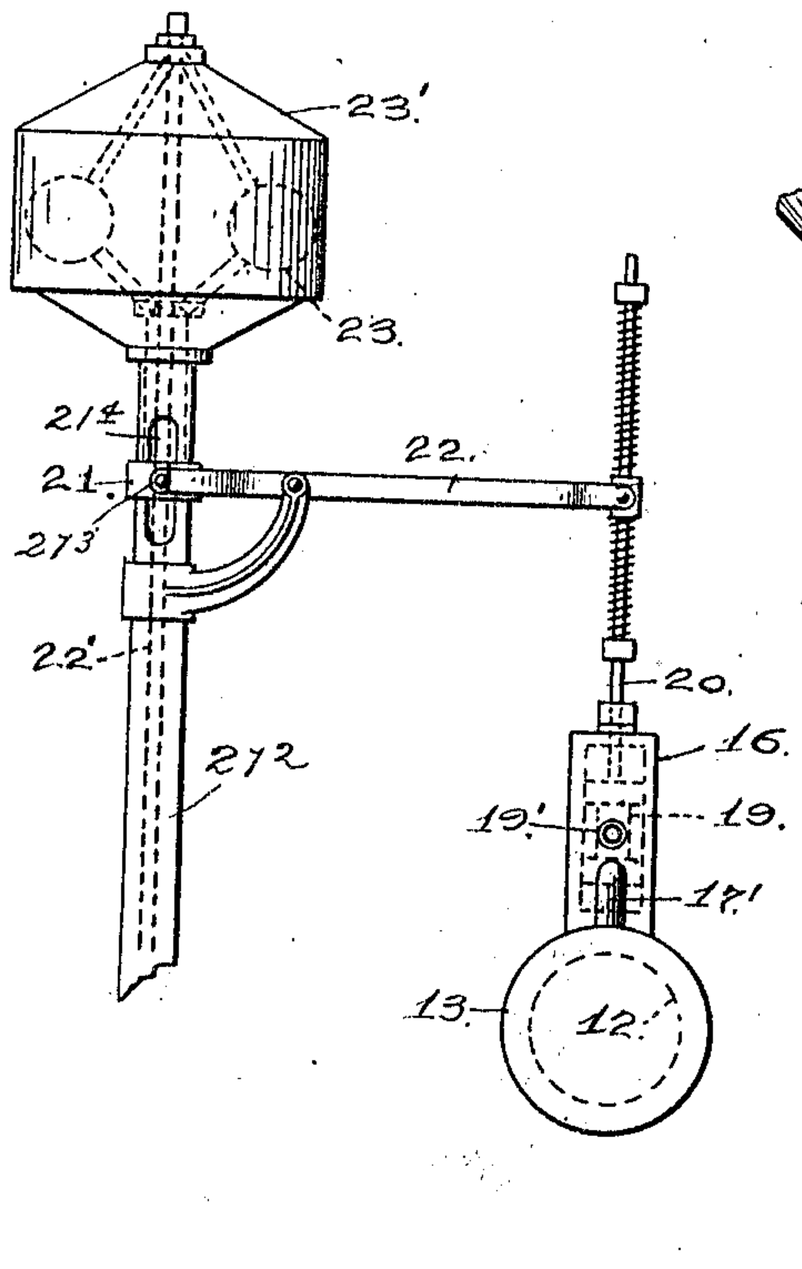


Fig. 5.

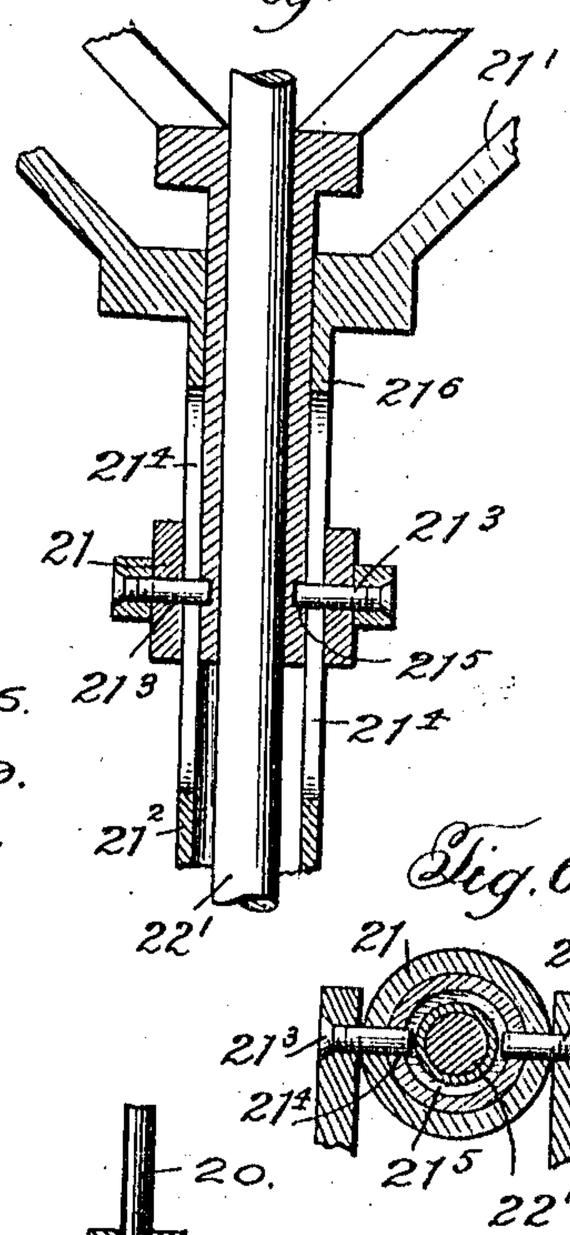


Fig. 6.

Fig. 3.

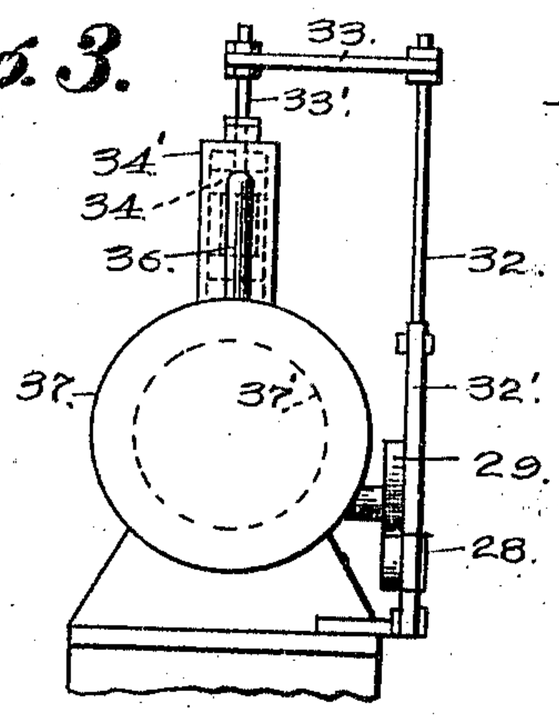
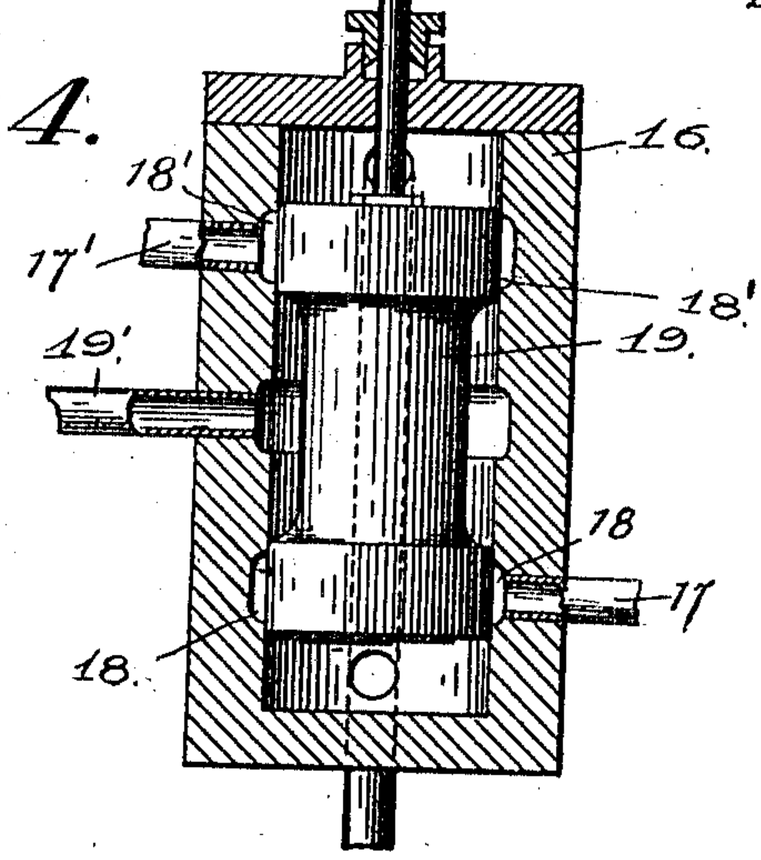


Fig. 4.



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UNITED STATES PATENT OFFICE.

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AUTOMATIC CONTROL FOR HYDRAULIC NOZZLES.

993,064. Specification of Letters Patent. Patented May 23, 1911.

Application filed March 22, 1909. Serial No. 484,993.

To all whom it may concern:

Be it known that I, GEORGE J. HENRY, JR., a citizen of the United States, residing in the city and county of San Francisco and State of California, have invented certain new and useful Improvements in Automatic Control for Hydraulic Nozzles, of which the following is a specification.

The present invention relates to governor actuated means for automatically controlling the water quantity of an impact stream issuing from a fixed or stationary hydraulic nozzle of the needle valve type onto the buckets of a tangential water wheel, and varying the direction of the issuing jet stream in whole or in part relative to the buckets of said wheel in accordance with variations in the working load placed onto the said wheel; the object of the invention being to simplify the construction of the means thrown into action by the changing speed of the governing mechanism, due to load variations, for varying the direction of the issuing jet stream relative to the buckets of the water wheel, and controlling the water quantity of the impact stream to conform to changes in the direction of the said stream, the construction of the associated working parts of the actuated controlling means being such that the stream deflector's movement out of the impact stream will be proportionately to and in synchronism with the closing movement of the needle valve within the nozzle, so that the position of the deflector when out of the stream will be such as to just clear the edge of the issuing stream.

To comprehend the invention, reference should be had to the accompanying sheets of drawings, wherein—

Figure 1 is a side view of the apparatus with the deflecting means positioned for deflecting a portion of the stream issuing from the fixed nozzle off of the buckets of the water wheel. Fig. 2 is an end elevation illustrating the governing means and the connection thereof with the stem of the pilot valve working within the valve-controlled cylinder. Fig. 3 is an end elevation taken on line x—x of Fig. 1 of the drawings. Fig. 4 is a vertical sectional view of one of the pilot valved cylinders for admitting fluid under pressure to one of the controlling cylinders. Fig. 5 is a detail view of a section of the apparatus broken away. Fig. 6 is a horizontal section of a portion of the apparatus in the plane of the pins 21^3 of Fig. 5.

In the drawings, the numeral 1 is used to designate a water wheel mounted on the drive shaft 2, the said wheel being driven by an impact stream 3 issuing from the nozzle 4, which nozzle is rigidly secured to a pipe line for supplying water thereto. Within the said nozzle 4 is located a longitudinally movable needle valve 5, for regulating the outlet orifice of the said nozzle to proportion the stream issuing therefrom in accordance with the working requirements of the water wheel.

The direction of the impact stream 3 issuing from the fixed nozzle 4 is controlled by the deflecting hood 6, which is arranged to swing into and out of the said stream in advance of the outlet orifice of the nozzle. The said deflecting hood is mounted on the rock-shaft 7, secured to the forward end portion of the fixed nozzle, which rock-shaft is operated by the connecting rod 8, united at its forward end to the crank arm 9, secured to and projecting from the said rock-shaft 7. At its inner end, the connecting rod 8 is united to a crank-arm 10, upwardly projecting from the rock-shaft 11, which rock-shaft is actuated by the fluid controlled piston 12, working within the cylinder 13, the stem 14 of which piston 12 is connected by a link 14′ to a crank arm 15, secured to and projecting from one end of the rock-shaft 11.

The movement of the piston 12 is controlled by fluid under pressure admitted into the cylinder 13, by the connections 17—17′, which connections lead respectively from the outlet ports 18—18′, of the valved cylinder 16. The said outlet ports 18—18′ are controlled by the pilot valve 19, working within the cylinder 16. Into the said cylinder 16, fluid under pressure is admitted through the feed pipe 19′, which pipe leads from any suitable source of fluid supply.

The stem 20 of the pilot valve 19 extends a distance beyond the valve cylinder 16, and is connected to the vertically movable sleeve 21, by the arm 22. The said sleeve 21 is slidable on a fixed sleeve 21^2 and carries pins 21^3 guided in longitudinal slots 21^4 in the fixed sleeve 21^2 and engaging a circumferential recess 21^5 in a slidable sleeve 21^6 within the fixed sleeve. The slidable sleeve 21^6 is in turn connected to the lower arms of the fly balls 23 situated within the casing 23′, the upper arms of the said fly balls 23 being secured to the drive rod 22′.

To the lower end of the drive rod 22′ is carried a pinion 24, which meshes with a gear 24′ on the shaft 25, driven from the drive shaft 2 of the water wheel 1, by means of the drive belt 25′, which works over the belt wheels 26—26′, secured respectively to the drive shaft 2, and the operating shaft 25 for the governing mechanism.

On the end of the rock-shaft 11, opposite to that carrying the upwardly projecting crank 15, is a slotted disk 27, within which is adjustably mounted the block 27′, carrying the roll 28. This roll works within the slotted portion 28′ of a lever arm 29, pivoted at its outer end to a collar 29′ secured to and carried by the stem 30 of the needle valve 5 working within the nozzle 1. The said lever arm 29 is also provided with a cam slot 30′, within which works a roll 31, carried by the vertically movable rod 32, the said rod moving within the guide frame 32′, and having its upper end portion connected by the plate 33 to the stem 33′ of the pilot valve 34, located and working within the valve cylinder 34′ for controlling the outlet ports 35—35′ of the said cylinder 34′, which ports are connected respectively by the pipes 36—36′ to the inlet ports of the cylinder 37, for admitting fluid under pressure thereto to actuate the piston 37′, working therein. This piston 37′, is carried by the valve stem 30, extended into the said cylinder, and the movement of said piston actuates the valve stem 30 to operate the needle valve 5. Fluid under pressure is supplied to the valve cylinder 34′, through the feed pipe 38, which leads from any suitable source of supply.

In case the load on the water wheel be reduced, the following operation of the working parts is occasioned to actuate the deflector hood to divert a portion of the issuing impact stream from off the buckets of the water wheel, and to actuate the needle valve in order to proportion the water quantity of the impact stream relative to such change in the working load. As the working load reduces, the wheel is driven at a higher speed by the impact stream bearing onto the buckets thereof, which speed being transmitted to the shaft 25, through the described connection, imparts greater rotation to the drive rod 22′, causing the fly-balls 23 to swing outwardly and raise the sleeve 21, which, through its connection, lowers the valve stem 20 to lower the pilot valve 19 within the valved cylinder 16 to uncover the outlet port 18. Fluid under pressure escapes through said port from within the valved cylinder 16 and escapes through the pipe connection 17 into the cylinder 13 in advance of the piston 12, the pressure of the admitted fluid forcing the said piston outwardly relative to the water wheel and, through its connection with the rock-shaft 11 operating the same to throw the crank-arm 10 outwardly relatively to the water wheel. This movement of the rock-shaft 11 exerts a pulling strain onto the connecting rod 8, which turns the rock-shaft 7, to quickly place the deflecting hood into the impact stream 3, to divert a portion thereof from off the buckets of the water wheel, the inward or upward movement of the deflecting hood continuing until the stream impacting onto the buckets of the water wheel has been regulated to the changed load placed onto the water wheel. At the same time, the part rotation given to the rock-shaft 11, turns the slotted disk 27 carrying the slide block 27′ and the roll 28, turning the same to swing the lever arm 29 upwardly on its pivoted point, the movement of which arm acts against the roll 31 working in the cam slot 30′ to lift the same. As the said roll 31 is moved upwardly it carries therewith the rod 32, which, through its connection, lifts the valve stem 33′ of the pilot valve 34, and raises the said valve within the cylinder 34′ to uncover the port 35, and allow of fluid under pressure passing from said cylinder through the connection 36 into the cylinder 37, back of the piston 37′. The pressure thus admitted into the said cylinder 37, forces inwardly relative to the water wheel the piston 37′ and the valve stem 30 to which it is connected, causing the valve 5 to slowly advance or gradually move into and reduce the outlet orifice of the fixed nozzle 4, until the stream issuing therefrom is proportioned to the working requirements of the water wheel under the change in the load placed thereon. During the outward movement of the valve stem 30, the lever arm 29 travels therewith through its pivoted connection with the collar 29′ on said stem, the said lever arm being temporarily held during such longitudinal movement in its adjusted position by means of governor controlled roll 28 located within the extended slotted portion of such lever arm. As the lever arm 29 is moved outwardly, the roll 31 carried by the vertically movable rod 32 will ride on the downwardly inclined portion of the cam slot 30′ of the lever arm 29, and draw-

ing downward the vertically movable rod 32, will, through its connection, lower the valve stem 33′ and the pilot valve 34 carried thereby, causing the said valve to gradually close the port 35 of the cylinder 34′ and cut off the supply of fluid under pressure into the cylinder 37 back of the piston 37′, thereby bringing the needle valve 5 to a state of rest the moment the outlet orifice of the nozzle 4 is controlled to proportion the impact stream to the changed working load on the water wheel. The moment the supply of fluid under pressure to the cylinder 37 has been cut-off, the vertically movable rod 32 will have been restored to its neutral or zero position. As the needle valve 5 is moved into the outlet orifice of the nozzle 4, the water quantity of the issuing stream is gradually reduced and consequently less power is placed onto the buckets of the water wheel, resulting in a gradual reduction or lowering as to the speed of the fly balls 23 to restore the governing means to normal speed. At the same time, as the speed of the said fly balls lower, the valve stem 20, through the described connection with the vertically movable sleeve 21, will be gradually raised, carrying therewith the pilot valve 19 to close the port 18 of the cylinder 16 and gradually open the port 18′ to admit fluid under pressure through the pipe connections 17′ into the cylinder 13 in back of the piston 12, forcing the same inward relative to the water wheel and through its connection with the rock-shaft 11 turning the said shaft to actuate the crank arm 10 for shifting outwardly the connecting rod 8 to move the deflecting hood 6 out of the impact stream proportionately to the closing movement of the needle valve 5, so that when the said valve is brought to a state of rest, the upper edge of the deflecting hood will just clear the surface of the issuing jet. Under this arrangement, the slightest variation in the speed of the fly balls of the governing means will act to shift the position of the deflecting hood relatively to the issuing impact stream.

It will be noted that the governing mechanism when placed into action moves the rock-shaft 11 to throw the connecting means for actuating the deflecting hood, and shift the position of the lever 11 in order to swing the lever arm 29 on its pivoted point, which movement of the said lever arm operates the vertical rod 32 to move the pilot valve 34, to admit fluid under pressure into the cylinder 37, say back of the piston 37′ therein to force outwardly the valve stem 30 and the valve 5 carried thereby. The governing mechanism then stands at rest, and the pilot valve 34 is moved within its cylinder to gradually cut off the fluid pressure to the cylinder 37, during the longitudinal movement of the lever arm 29, the movement of which is transmitted by means of the roll 31, working in the cam slot 30′ of the lever arm 29, to impart vertical motion to the rod 32 which is connected to the stem 33′ of the pilot valve 34. The pivoted lever arm 29 thus performs two functions, the first being through its described connections to actuate the pilot valve 34 to admit fluid under pressure into the cylinder 37 on a shifting in the governing means, and secondly to gradually restore the pilot valve 34 and its connections to a neutral or zero position, simultaneously with the movement of the valve 5 within the nozzle 4, in order to cut off the supply of fluid under pressure into the cylinder 37. The said lever arm 29 thus imparts a primary and secondary adjustment to the pilot valve 34, the first being in response to the action of the governing means, and the second in response to the movement of the needle valve 5 within the nozzle 4. The secondary adjustment imparted to the pilot valve 34 is accomplished without disturbing the adjusted position of the governing mechanism, which remains stationary until a change therein is called for in response to a variation of the load placed onto the water wheel. Should a greater working load be placed onto the water wheel calling for an increase as to the water of the impact stream to be placed onto the buckets of the water wheel, the operation of the working parts will be the reverse of that just described.

Having thus described the invention, what is claimed as new and desired to be protected by Letters Patent is:—

1. In combination with a water wheel, a rigid nozzle, a needle valve therein for controlling the outlet orifice thereof, and a deflecting hood arranged to swing in advance of the nozzle for the purpose set forth, of a motor for the hood, a governor actuated valve for controlling the motor, connections between the motor and hood, a motor for the needle valve, a valve for the motor, means actuated by the aforesaid connections for shifting said motor valve, said means being connected to the needle valve and comprising provision for restoring said valve to normal position and bringing the needle valve to rest, as set forth.

2. In an apparatus of the described character, the combination with a fixed nozzle, a needle valve longitudinally movable therein, a fluid receiving cylinder, a piston therein connected with the needle valve, means for admitting fluid under pressure into said cylinder, an operating lever, connection between said lever and the means for admitting fluid under pressure to the cylinder, a deflecting hood for controlling the direction of the jet issuing from the nozzle, gov-

erning means, and connections between said means and the deflecting hood, said connections actuating the deflecting hood and placing into operation the fluid controlled means for shifting the needle valve in accordance with the movement of the deflecting hood.

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

GEORGE J. HENRY, JR.

Witnesses:
N. A. ACKER,
D. B. RICHARDS.