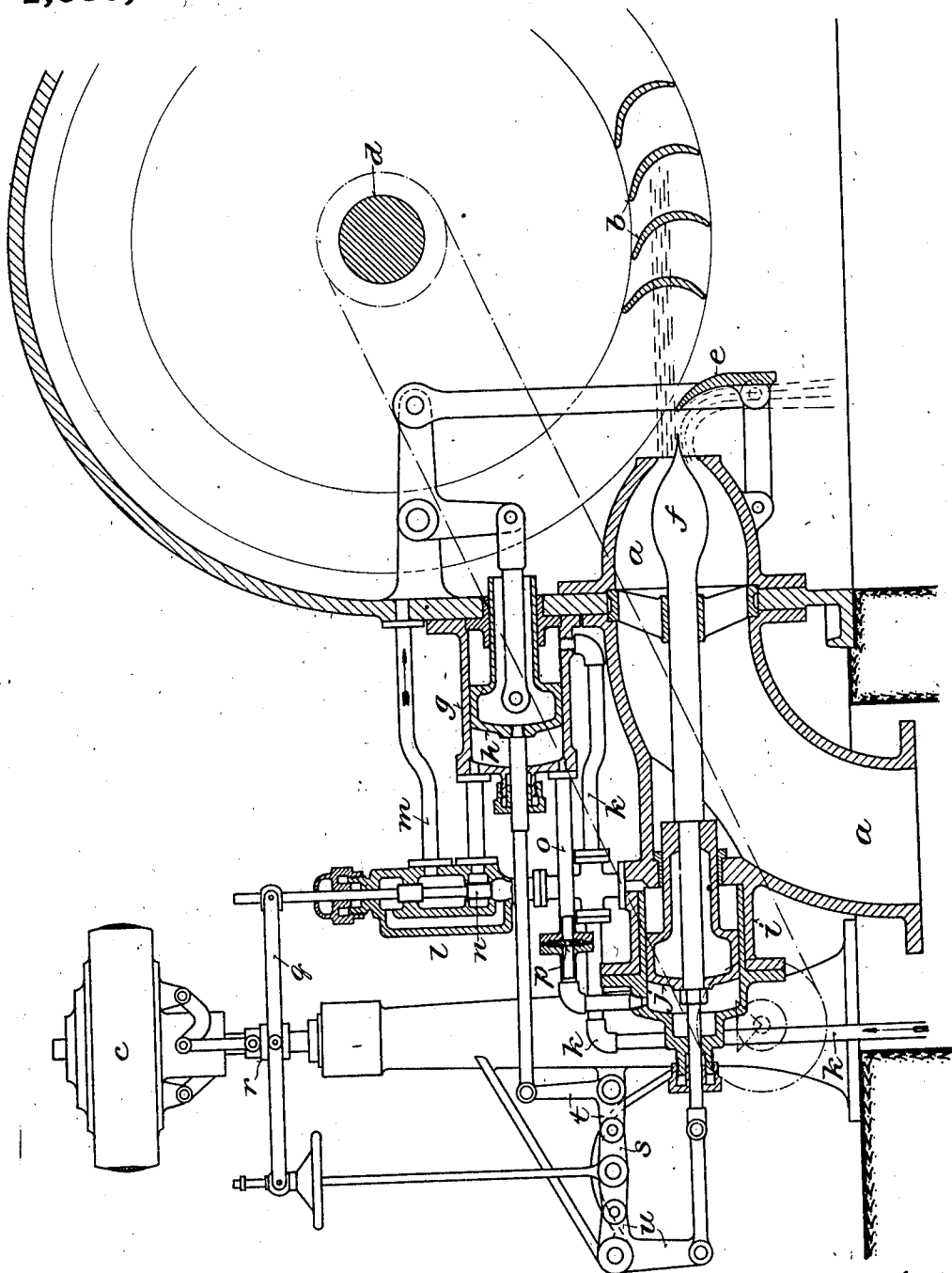


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 AUTOMATIC REGULATOR FOR IMPACT WATER WHEELS.
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AUTOMATIC REGULATOR FOR IMPACT WATER-WHEELS.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, JEAN CACHIN, a citizen of the Republic of Switzerland, residing at Zurich, in the Canton of Zurich and Republic of Switzerland, have invented certain new and useful Improvements in Automatic Regulators for Impact Water-Wheels, of which the following is a specification, reference being had to the accompanying drawing, forming a part thereof.

This invention relates more particularly to high pressure water wheels of the impact type. Its main object is to automatically regulate the power applied to operate the wheel at a substantially constant speed under varying load, without causing sudden and dangerous fluctuations of pressure in the supply pipe or conduit and without waste of water or power.

It consists in certain novel features of construction and in the peculiar arrangement and combinations of parts as hereinafter particularly described and pointed out in the claims.

The accompanying drawing shows in vertical longitudinal section automatic regulating mechanism embodying the invention as applied to an impact water wheel.

a designates the nozzle arranged to direct a jet of water against the vanes or buckets *b* of a water wheel, in the usual or any suitable manner, only a few of the buckets being shown.

c is a centrifugal governor which is driven as indicated, from the shaft *d* of the water wheel.

e is a movable deflector arranged to divert more or less of the jet after it issues from the nozzle and before it strikes the buckets of the wheel, without affecting the size of the jet or the volume of water discharged by the nozzle.

f is a device which may be called a "reducer" for varying the area of the discharge orifice of the nozzle or of the size of the jet issuing therefrom. It may consist as shown, of a needle or tapering valve, movable axially in and out of the discharge orifice.

g is a servo-motor having a differential piston *h* which is connected with the deflector *e* and adapted to move the same more or less into and out of the path of the jet between the nozzle *a* and the path of the wheel buckets. *i* is a similar motor having a differential piston *j*, which may be di-

rectly connected with the needle valve or reducer *f*. The larger ends or working faces of the pistons *h* and *j* are of substantially the same area, while the smaller end or working face of the piston *h* is of greater area than that of the smaller end or working face of the piston *j*.

k is a fluid pressure supply pipe having connections in open communication with the smaller ends of the cylinders of the motors *g* and *i*, or the ends thereof toward which the smaller ends or working faces of the pistons *h* and *j* are presented. It is also connected with a balanced regulating or relay valve *l*, which is in turn connected with the larger end of the motor cylinder *g*, or the end thereof toward which the larger end or working face of the piston *h* is presented. The valve *l* has a discharge or waste connection *m*, and the valve head *n*, which is shown in its normal closed position, controls the admission and release of fluid to and from the larger end of the motor cylinder *g*. A pipe *o* provided with a diaphragm *p* with a restricted opening for the passage of the motive fluid, connects the larger end of the motor cylinder *g* with the corresponding end of the motor cylinder *i*.

The stem of the balanced regulating or relay valve is connected with one arm of a floating lever *q* which is pivotally connected between its ends with the vertically movable collar *r* of the governor *c*. The other arm of this lever is connected by a rod with a floating lever *s*, the ends of which are pivoted to arms of both crank levers *t* and *u*, with the other arms of which the pistons *h* and *j* are connected.

The regulating mechanism thus shown and described operates as follows: Assuming that a considerable and sudden reduction of load takes place, momentarily increasing the speed of the water wheel, the governor acts through the lever *q* to lift the valve head *n* and admit fluid under pressure into the larger end of the motor cylinder *g*, the fluid acting immediately on the larger end of piston *h* before it can pass through the restricted opening in the diaphragm *p* sufficiently to affect the piston *j*, moves said piston *h* to the right, thereby carrying the deflector *e* into the path of the jet and diverting more or less of the jet from the path of the buckets *b*, according to the extent of the reduction in load and the conse-

quent increase of speed. This movement of the piston *h* to the right, operates through the floating levers *s* and *q* and their connections to return the valve head *n* to its normal position, as shown, thereby cutting off communication between the pressure supply pipe *k* and the motor *g*. Immediately following the shifting of the deflector *e* as above stated, the fluid flowing through the pipe *o* and the restricted opening in the diaphragm *p* from the motor *g* into the cylinder of the motor *i*, gradually moves the piston *j* to the right, while the piston *h* is gradually moved back to its original position at the left by the unbalanced pressure on its smaller face, which is greater than the pressure on the smaller face of the piston *j*. The deflector *e* is thus withdrawn from the jet, while the valve or reducer *f* is advanced to a position in which it restricts the jet to an extent corresponding with the portion thereof first diverted by the deflector *e*. The instantaneous or prompt action of the deflector *e* in response to the governor, prevents material variations in the speed of the water wheel, without causing sudden fluctuations of pressure and dangerous shocks in the water supply pipe or conduit leading to the wheel. This means of regulation alone is however wasteful of water and power, but the operation of the deflector being immediately followed by that of the valve or reducer *f*, which by its gradual movement correspondingly reduces the size of the jet without causing a sudden increase of pressure in the supply pipe and nozzle *a*, avoids the waste of water and power which would otherwise occur. If now the load on the water wheel is increased, demanding more power, the resulting reduction of speed causes the governor operating through the lever *q* to move the valve head *n* downward, thereby establishing communication between the motor cylinder *i* through the pipe *o* and motor cylinder *g* with the discharge or waste pipe *m* and releasing the fluid from the larger end of the cylinder *i*. The unbalanced pressure on the smaller end or face of piston *j* then gradually forces said piston to the left, withdrawing the valve or reducer *f* more or less from the orifice of the nozzle *a*, according to the increase in load and demand for power. This movement of the piston *j* operating through the floating levers *s* and *q* and their connections, returns the valve head *n* to its normal position, shutting off communication between the motors and the waste or discharge pipe *m*. The valve or reducer *f* will retain the position to which it is thus adjusted until a further variation in the load occurs.

Whenever a slight or gradual decrease of load occurs, causing a slight opening of the valve head *n* not greater than the opening in the diaphragm *p*, the piston *h* and the de-

flector *e* will remain quiescent, while the fluid under pressure from the supply pipe *k* passing through the larger end of the cylinder *g* and the pipe *o* into the larger end of the cylinder *i*, gradually moves the piston *j* to the right and advances the valve or reducer *f* into a position to reduce the jet as required, without materially affecting the pressure in the water supply pipe or conduit.

Either the deflector or the needle valve or reducer may be used alone to regulate the water wheel temporarily in case one of said devices is out of order or for any reason it becomes inoperative or necessary or desirable to disconnect it.

Various changes in the construction and arrangement of parts may be made without departure from the principle and scope of the invention, which is not intended to be limited to details except such as are expressly included in the claims.

I claim:

1. In an automatic regulator for impact water wheels the combination with a jet nozzle and a governor, of means for diverting more or less of the nozzle jet from the water wheel and means for varying the size of said jet comprising motors, a valve controlling the operation of said motors, and mechanism connecting said valve with the governor and with said motors and adapted to automatically return said valve to its normal position after movement thereof by the governor.

2. In an automatic regulator for impact water wheels, the combination with a jet nozzle and a governor, of means for diverting more or less of the nozzle jet from the water wheel, and means for varying the size of said jet comprising motors, a fluid pressure supply connection with the jet-diverting motor, a valve controlling the admission and release of fluid to and from said motor through said connection, a restricted fluid passage connecting said motors, and mechanism connecting said valve with the governor and with said motors and adapted to return the valve to its normal position after movement thereof by the governor.

3. In an automatic regulator for impact water wheels, the combination with a jet nozzle and a governor, of means for diverting more or less of the nozzle jet from the water wheel and means for varying the size of said jet comprising motors, a fluid pressure supply connection with the jet-diverting motor, a valve controlling the admission and release of fluid through said connection, a restricted fluid connection between said motors, and floating lever mechanism connecting said valve with the governor and with said motors and adapted to return the valve to its normal position after movement thereof by the governor.

4. In an automatic regulator for impact

water wheels the combination with a jet nozzle and a governor actuated by the water wheel, of a movable deflector for diverting more or less of the jet, a reducer for varying the size of the jet, motors each comprising a cylinder and a differential piston, one connected with the deflector and the other with the reducer, the smaller face of the piston connected with the deflector being of greater area than the smaller face of the other piston, a constant fluid pressure supply connection with the smaller ends of said cylinders, a restricted fluid passage connecting the larger ends of said cylinders, and a fluid pressure supply connection with the larger end of the deflector motor provided with a valve which is connected with the governor, substantially as described.

5. In an automatic regulator for impact water wheels the combination with a jet nozzle and a governor actuated by the water wheel, of a movable deflector adapted to divert more or less of the jet from the wheel buckets, a reducer adapted to vary the size of the jet, motors connected with said deflector and reducer, a valve controlling the operation of said motors, and mechanism connecting said valve with the governor and the motors and adapted to automatically return the valve to its normal position after movement thereof by the governor, substantially as described.

6. In an automatic regulator for impact water wheels the combination with a jet nozzle and a governor actuated by the water wheel, of a movable deflector and a reducer arranged to act upon the jet, motors connected with said deflector and reducer, a fluid pressure supply connection with the deflector motor, a valve controlling the admission and release of fluid to and from said motor through said connection, a restricted fluid passage connecting said motors, and mechanism connecting said valve with the governor and the motors and adapted to return the valve to its normal position after movement thereof by the governor, substantially as described.

7. In an automatic regulator for impact water wheels the combination with a jet nozzle and a governor actuated by the water wheel, of a movable deflector and a reducer arranged to act upon the jet, motors having differential pistons connected one with the deflector and the other with the reducer, a fluid pressure supply connection with the larger end of the deflector motor, a valve controlling the admission and release of fluid through said connection, a restricted fluid connection between the larger ends of the motors, constant fluid pressure supply connections with the smaller ends of the motors, the smaller end of the deflector piston being of greater area than the smaller end of the reducer piston, and mechanism connecting

said valve with the governor and the motor pistons and adapted to return the valve to its normal position after movement thereof by the governor, substantially as described.

8. In an automatic regulator for impact water wheels the combination with a jet nozzle and a governor actuated by the water wheel, of a movable deflector and a reducer arranged to act upon the jet, motors connected with said deflector and reducer, a fluid pressure supply connection with the deflector motor, a valve controlling the admission and release of fluid through said connection, a restricted fluid connection between said motors, and floating lever mechanism connecting said valve with said governor and the motors and adapted to return the valve to its normal position after movement thereof by the governor, substantially as described.

9. In an automatic regulator for impact water wheels the combination with a jet nozzle and a governor actuated by the water wheel, of a movable deflector and a reducer arranged to act upon the jet, motors connected with said deflector and reducer, a fluid pressure supply connection with the deflector motor and a restricted fluid connection leading therefrom to the reducer motor, a balanced valve controlling the admission and release of fluid through said connections to and from both motors, and mechanism connecting said valve with the governor and motors and adapted to return the valve to its normal position after movement thereof by the governor, substantially as described.

10. In an automatic regulator for impact water wheels the combination with a jet nozzle and a centrifugal governor actuated by the water wheel, of a movable deflector and a reducer arranged to act upon the jet, motors connected with said deflector and reducer, a fluid pressure supply connection with the deflector motor, a restricted fluid connection leading therefrom to the reducer motor, a balanced valve controlling the admission and release of fluid through said connections to and from both motors, and floating lever mechanism connecting said valve with the governor and with each motor and adapted to return the valve to its normal position after movement thereof by the governor, substantially as described.

11. In an automatic regulator for impact water wheels, the combination with a jet nozzle and a governor actuated by the water wheel, of means controlled by the governor and adapted to promptly divert more or less of the jet when a considerable and sudden increase in the speed of the governor occurs, means also controlled by the governor and adapted to gradually and correspondingly reduce the size of the jet according to reduction in load and demand for

power, and means for returning the jet diverting means to normal position simultaneously with the restriction of the jet, the jet diverting means being adapted to respond only to a considerable and sudden acceleration in the speed of the governor, while the jet reducing means is adapted to respond independently of the jet diverting means, to slight or gradual variations in the speed of the governor.

12. In an automatic regulator for impact water wheels, the combination with a jet nozzle and a governor, of means for diverting more or less of the jet from the water wheel, and means for varying the size of the jet comprising motors, valve mechanism controlling the operation of the motors, means for causing the slow advance of the

jet varying means as the jet diverting means retires to its neutral position after advance movement thereof, and lever mechanism connecting said valve mechanism and motors with the governor and adapted to automatically return said valve mechanism to its neutral position after each movement thereof by the governor and to permit the advance of the jet varying means as the jet diverting means retires without affecting the governor or valve mechanism.

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

JEAN CACHIN.

Witnesses:

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GEO. T. SCHUBELER.