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RELIEF VALVE FOR THE SUPPLY PIPES FOR WATER MOTORS.

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Fig. 1.

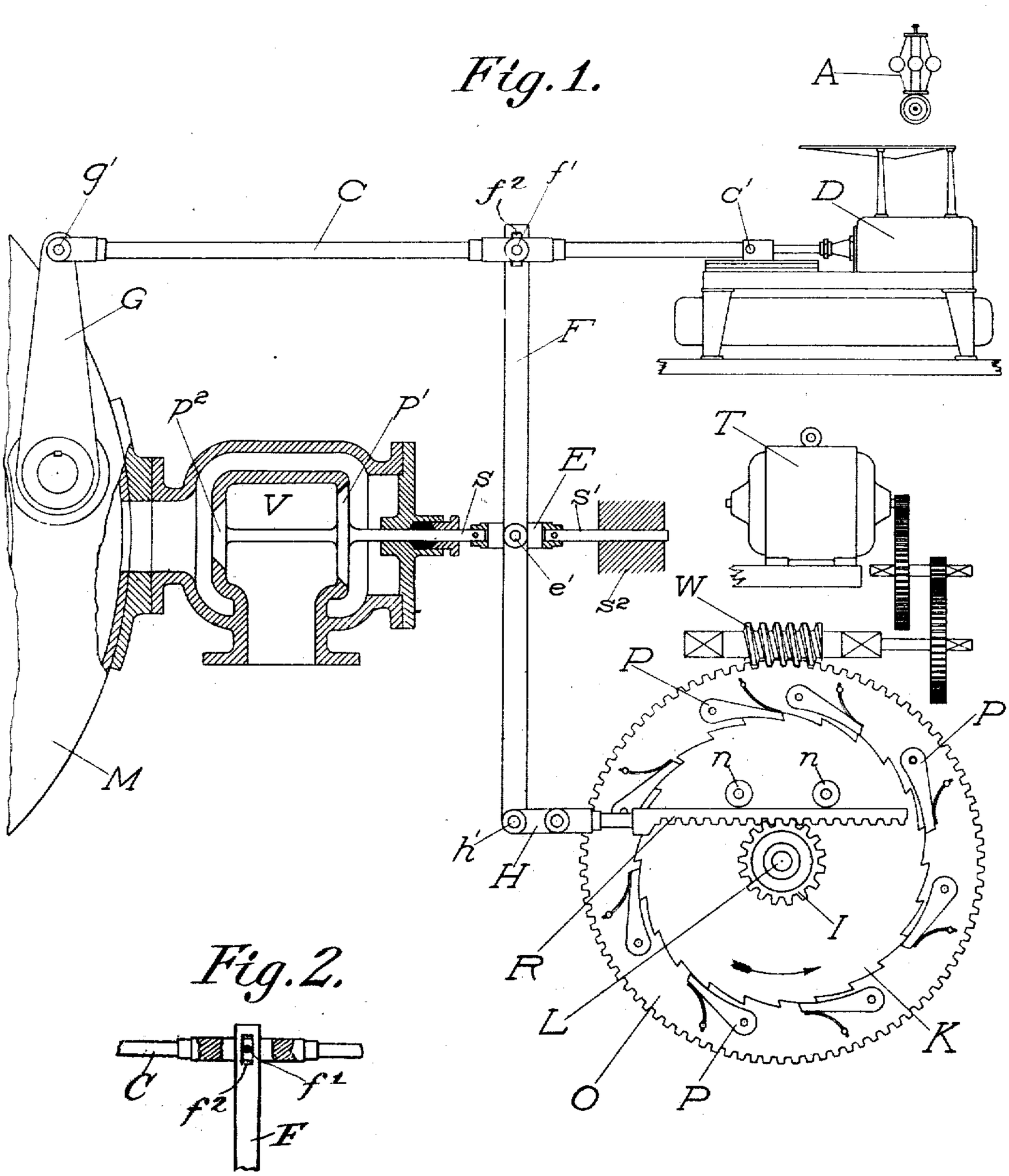

Fig. 2.

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RELIEF-VALVE FOR THE SUPPLY-PIPES FOR WATER-MOTORS.

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To all whom it may concern:

Be it known that I, HENRY E. WARREN, a citizen of the United States of America, and a resident of Ashland, in the county of Middlesex and Commonwealth of Massachusetts, have invented certain Improvements in Relief-Valves for the Supply-Pipes for Water-Motors, of which the following is a specification.

This invention relates to relief valves for the water supply pipes for water-motors, more particularly where the pipe line is long, and it consists of a valve which is constructed so as to be self-closing and is applied to the supply-pipe or penstock of the water-motor. This valve is connected directly with the means by which the governor or controller operates the water-supply gate and in such manner as to cause the relief valve to be opened in proportion to the amount that the water gate is closed, and the closing of the valve is then controlled by its connection with mechanical means which have a constant speed in the proper direction to permit the valve to close only very slowly, thus obviating all sudden strain upon the supply pipe and preventing the injurious "hammer" due to the effect of quickly arresting the movement of the column of water therein.

My improved construction obviates the waste of water which occurs in constructions where such valve is normally partly open; and also by the direct connection of the relief valve with the gate controller mechanism, the valve is quickly and immediately opened in proportion to every closing movement of the water-motor gate, however slight, and the valve is then controlled in its closing movement by mechanism which acts at a constant speed and independently of the movement of the water gate.

In the drawings Figure 1 shows the improved mechanism for operating the relief-valve, all assembled and connected with the motor casing and controller for the motor; Fig. 2, is a detail showing the connection between the rod which extends from the controller to the water-gate lever, and a floating lever through which the relief-valve is operated.

Referring to the drawings, M represents a part of a motor casing or end of the supply-pipe, G the lever of the water-gate for the motor, and by means of a rod C the respective ends of which are pivotally connected at g' and c' to the lever G and a controller D, the water-gate is operated by the latter. The movement of the controller D is regulated by the speed of the centrifugal governor A which is driven by the prime motor. To the water supply pipe penstock or casing of the motor, a valve V is applied. This is of the balanced valve type with one puppet p' larger than the other p^2, and arranged so that the pressure of the water upon the larger puppet p' constantly tends to close the valve. The stem s of the valve extends out of the casing and is pivoted to one end of a slotted link E. To the other end of this link a guide rod s' is pivoted, the end of this rod sliding in a fixed support s^2.

A floating lever F passes through the slot in the link E and is pivoted thereto at e'. The upper end of the lever F is connected to the rod C by a pin f' which passes through a vertically elongated hole f^2 in said lever and the lower end of the lever F is pivoted at h' to a link H, which link is pivoted to a rack-bar R. In operation, the movement of the rod C in a vertical plane is very small, so that a short slot only, at f^2, need be made in the lever F. This rack engages a pinion I secured to a ratchet disk K, both of which turn freely on a shaft L. The rack R is held in contact with the pinion I by means of bearing rolls n supported in the frame of the apparatus, not shown.

Secured upon the shaft L is a gear O of greater diameter than the ratchet K, and located closely beside it. Upon the face of the gear O next to the ratchet K, a series of spring controlled pawls P are pivoted, in proper position to bear upon the teeth of the ratchet K, and by varying the distances between these pawls it will be possible to turn the ratchet K in a direction toward the points of the pawls, but a very small amount independently of the gear O. This gear is driven by a worm W, which may be turned by gear connection with an independent motor T, as illustrated, or by other convenient means.

As an illustration of the operation of the apparatus, assume that the valve V is closed and the water-wheel gate is open for normal speed with the normal load on the wheel; if a sudden diminution of the load occurs the controller D will immediately move the

rod C and gate lever G to the right, and tend to close the water-motor gate, thus reducing the amount of water supplied to the motor to meet the change in load. This movement of the rod C will at the same time give a quick movement of the upper end of the floating lever F to the right. During this quick movement of the upper end of the lever F, the pivot h' at its lower end is practically a stationary fulcrum, and consequently the pivot e' with the link E, and puppets p', p^2 of the valve V, will be pulled to the right and open the valve proportionately to the amount that the water-gate is closed, thus affording an outlet for substantially the same amount of water as has been cut off by the closing of the gate and prevent any shock to the pipe line by reason of such closing, for no substantial change in the velocity of the column of water will have occurred.

As heretofore stated, by reason of the greater surface area of the puppet p' over that of puppet p^2, the valve V would quickly close, if unrestrained, but through the connection of the valve stem with the lever F the lower end of which is attached to the rack-bar R, the valve can close or move to the left only as fast as the rack R moves in that direction, provided the rod C remains stationary.

The worm W is turned so as to rotate the gear O slowly to the left, as indicated by the arrow. As soon therefore, as the valve V in its effort to close begins to pull the rack R to the left, its engagement with the pinion I will cause that pinion with its attached ratchet disk K to rotate in the same direction that the gear O is turning and independently of that gear, until a tooth of the ratchet K is brought to bear against one of the pawls P, when the ratchet and pinion I will be constrained to rotate at the same speed as that of the gear O, and the rack-bar R will also be restrained from moving to the left any faster than the rotation of the pinion I will permit, consequently the valve V will be caused to close very slowly and prevent any injurious shock to the water supply pipe.

When the controller D operates to move the rod C to the left and open the water gate because of a decrease in speed due to an increase of load, the lever F will immediately close the valve V, if open, and then turning on the point e' as a fulcrum, the lower end of the lever will push the rack-bar R to the right, the pinion I and ratchet disk K turning freely in a direction opposite to that in which the gear O is turning, the pawls P easily riding over the ratchet teeth.

I claim:—

1. In combination with the penstock or supply pipe of a water wheel, a controller for the water-supply gate, a self-closing outlet valve connected with the supply pipe, interconnecting operating means between the valve and the controller connection with the water-gate, to open the valve in proportion to the closing of the gate, and mechanically operated mechanism to control the valve and cause it to close slowly whenever opened.

2. In combination with a self-closing relief-valve for a water-motor supply pipe, means connecting said valve with the water-gate operating mechanism to open the valve proportionately to the closing of the gate, a positively driven device, and a freely rotating device upon the same shaft, means upon the driven device to engage the freely rotating device and limit its movement in one direction to the speed of the driven device, and mechanism which operatively connects said freely rotating device with the valve operating means, to regulate the closing movement of the valve to the limited movement of such device, but to permit free and unrestricted movement of the valve when opening.

3. In combination with a self-closing relief-valve for a water-motor supply pipe, means connecting said valve with the water-gate operating mechanism to open the valve proportionately to the closing of the gate, a positively driven disk, a freely rotating ratchet disk, pawls upon the driven disk to engage the ratchet disk and limit its speed of rotation to that of the driven disk in one direction, and means which operatively connect the ratchet disk with the relief valve to control its closing movement.

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