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G. J. HENRY, JR.

REGULATING MEANS FOR HYDRAULIC NOZZLES.

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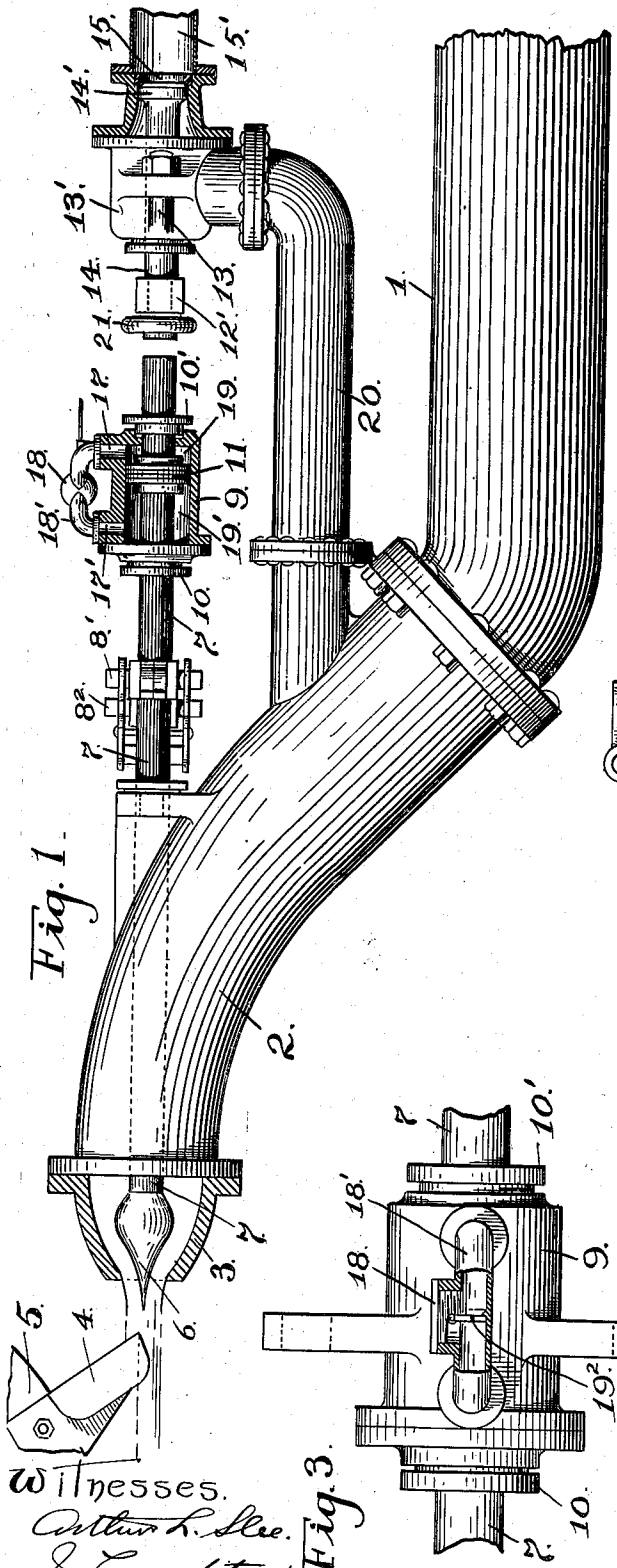


Fig. 1.

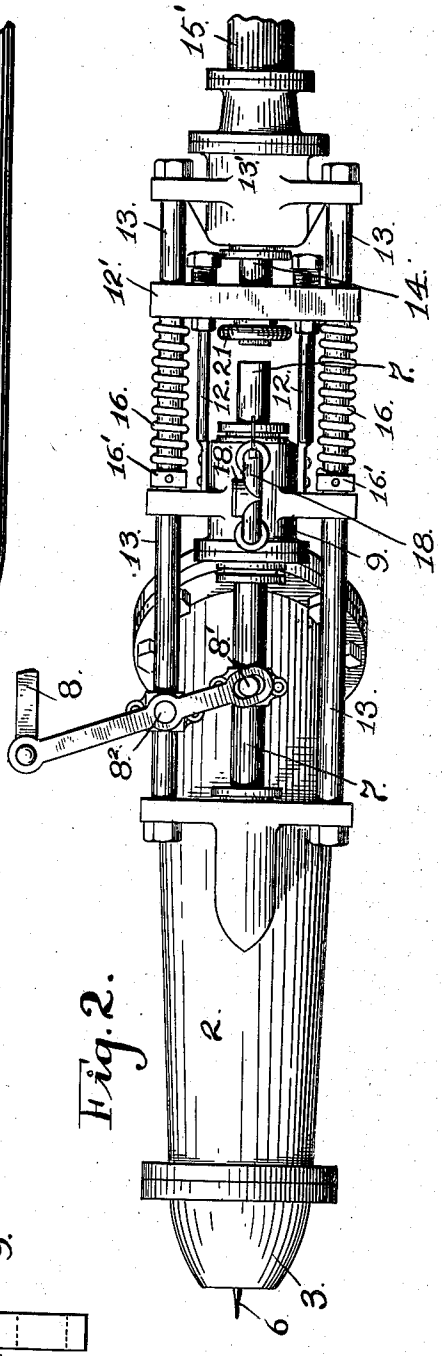


Fig. 2.

Fig. 3.

Witnesses.
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UNITED STATES PATENT OFFICE.

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REGULATING MEANS FOR HYDRAULIC NOZZLES.

No. 853,786. Specification of Letters Patent. Patented May 14, 1907.

Application filed August 29, 1905. Serial No. 276,253.

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, State of California, have invented certain new and useful Improvements in Regulating Means for Hydraulic Nozzles; and I do hereby declare the following to be a full, clear, and exact description of the same.

The present invention relates to that class of hydraulic nozzles designed for directing a jet of water onto the buckets of tangential water wheels, and the object of the invention is to vary the quantity of the impact stream directed toward the buckets of the water wheel, so as to place the same wholly or in part onto or off of the said buckets, in accordance with variations or load changes as to the working of the water wheel or hydraulic motor, the variation as to the impact stream issuing from the nozzle being accomplished without deflection of or change as to the nozzle position relative to the pipe line, while at the same time the shocks to or the water ramming in the pipe line is avoided.

Ordinarily the object accomplished by the hereinafter described mechanism is attained either by the utilization of a deflectable nozzle, the deflection of which nozzle directs the issuing impact stream wholly or in part off of or onto the buckets of the water wheel or the combination of such a nozzle with auxiliary means for actuating the needle valve to vary the outlet area of the nozzle in accordance with the changed position thereof, in order to proportion the stream to variations as to the working load of the water wheel. In either case the nozzle employed is a deflectable one or one that is pivoted to the main line pipe.

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

Figure 1 is a side view in elevation, disclosing the main line water pipe, the discharge nozzle rigidly secured thereto, the by pass connection for preventing an excess of water pressure during sudden changes necessary to reduce the outlet area of the nozzle in accordance with load variations, and the needle valve within the nozzle, the nozzle tip, the dash pot cylinder and the inner end portion of the outlet cylinder being sectioned, the connection between the needle valve stem and the wheel's governor being illustrated; Fig. 2 is a plan view of the mechanism contained in Fig. 1 of the drawings, the wheel's governor and its connection with the stem of the needle valve being removed; and Fig. 3 is a detail broken view of the dash pot cylinder and its by pass valve.

In the drawings, the numeral 1 is used to indicate the main pipe line, and 2 the discharge nozzle rigidly secured thereto for directing the impact stream issuing from the nozzle tip 3 onto the buckets 4 of the water wheel 5.

Within the nozzle 2 works the needle valve or regulating device 6, which serves to regulate the outlet or discharge area of the nozzle to vary the volume or size of the impact stream issuing therefrom in accordance with variations as to the working load of the water wheel or hydraulic motor 5.

The stem 7 of the regulating device 6 extends beyond the nozzle 2 and is connected to the governor 8 by means of the connections $8'$—8^3, which are actuated to operate the stem 7 to move the regulating device 6 into and out of the nozzle's tip 3 to control the outlet area thereof for the purpose of varying the quantity of the issuing impact stream in accordance with variations in the working load of the hydraulic motor.

On the stem 7 is slidably mounted a dash pot cylinder 9, the said stem extending through the stuffing glands 10 and $10'$, to prevent leakage between the said stem and the cylinder 9, which cylinder is filled with oil or other fluid. The stem 7 within the cylinder 9 carries a piston head 11, the oil or fluid within the cylinder 9 providing a fluid cushion against which the said head 11 acts.

The cylinder 9 is rigidly connected through the rods 12 to a cross head $12'$, which slides on the tie rods 13, said rods holding the by pass cylinder $13'$ to the nozzle 2. The said cross head $12'$ is connected through the stem 14 to the valve $14'$ which valve controls the by pass outlet opening or port 15, which connects the by pass cylinder $13'$ with the discharge pipe $15'$. This pipe conveys the discharge from the cylinder $13'$ to the usual wheel pit, not shown.

The cross head $12'$ is normally held in position to maintain the valve $14'$ closed, by the pressure of the springs 16. These springs surround the tie rods 13 for a portion of their length and bear against the said cross head and the set collars $16'$ secured to the said tie rods.

The dash pot cylinder 9 is provided with

opposing outlet ports 17 and 17′, which are connected by the by pass valve 18 interposed within the pipe connection 18′, said ports leading respectively from the chambers 19 and 19′, formed within the cylinder 9 by means of the piston head 11. Through these ports the oil or other liquid within the cylinder 9 is permitted to flow from one end chamber of the said cylinder to the other, said transfer of the oil or other liquid occurring when a difference in pressure exists on one side or the other of the piston head 11, of the stem 7, and thus permitting a relative motion between the stem 7 of the needle valve 6, and the stem 14 of the valve 14′.

Communication between the by-pass cylinder 13′ and the fixed nozzle 2, is established by means of the connecting pipe 20, which acts to relieve the nozzle or pipe line of any excess of water pressure on a sudden reduction in the outlet area of the discharge nozzle, thus preventing any such pressure and by so doing avoiding sudden shocks and pipe ramming which otherwise occur therein, tending to burst the pipe line. Safety means is thus provided to avoid the back water pressure, hence permitting the needle valve to be quickly moved to vary the impact stream issuing from the discharge outlet of the discharge nozzle proportionately to variations in the working load of the motor.

The by-pass valve 18 is hinged to open full in one direction, permitting of a large quantity of oil or fluid to flow quickly from the cylinder chamber 19 into the cylinder chamber 19′, while through a closure of the said valve when the reverse flow takes place, the oil or liquid will flow very slowly from the chamber 19′ into the chamber 19, as the fluid can only escape when the valve is closed through the perforation 19^2, formed in the said valve.

The limit of the stroke permitted the stem 7 of the needle valve or regulating device 6, may be varied by means of the adjusting nut 21, working on the projecting end of the stem 14, of the valve 14′.

The operation of the described mechanism is as follows. The pressure stream is being supplied through the needle nozzle and the load is suddenly thrown off of the water wheel. The governor mechanism, of any approved design, at once, through its connection with the needle valve stem 7, shifts the position of the stem 7 longitudinally, throwing wholly or partially the needle valve 6 into the nozzle's tip, therefore varying the outlet area thereof and reducing the quantity of the impact stream issuing from the nozzle. At the same instance the piston head 11, within the dash pot cylinder 9, is forced against the body of oil in the said cylinder, thus causing the cylinder to move with and in the direction of the stem 7, drawing therewith the rods 12, the cross head 12′, stem 14 and the valve 14′, thus opening or unseating the valve 14′, exactly in proportion to the closing of the valve or regulating device 6 within the fixed nozzle 2. The valve 14′ being thus opened, the water within the nozzle which would cause an excess pressure, is forced to move or is directed into the relief pipe 20, and to flow into the outlet, take off or discharge pipe 15′, through the open port 15. The quantity of water flowing through the main line pipe thus remains for an instant the same as though the needle valve 6 had remained opened.

It will be understood that as the cross head 12′ is moved with the stem 7, the springs 16 are compressed, which exerts a pressure onto the said cross head to force the same in an opposite direction. It is obvious that if the valve 14′ be permitted to remain open while the needle valve is maintained in its closed or partly closed position, the result would be a waste of water. This is desired to save, and to so do the valve 14′ must be closed against the escape of water through the discharge pipe 15′. As soon as the flow of water is established through the pipe 20 into the discharge pipe 15′, preventing shocks to and water ramming of the pipe line, which ordinarily results from a sudden closing of the needle valve of the discharge nozzle, the pressure of the back flowing water onto the valve 14′ tends to close the same. The governor mechanism holds the needle valve and its stem firmly in position while the combined pressure of the water on the valve 14′ and of the compressed springs 16, against the cross-head 12′, acts to move the valve stem 14 to close the said valve 14′. The force thus exerted causes a pressure within the oil compartment or chamber 19′ of the cylinder 9, resulting in the oil or liquid in said compartment or chamber being slowly forced through the by pass valve 18, into the compartment or chamber 19, thus allowing the cylinder 9 to slowly move rearwardly on the needle valve stem and the valve 14′ to gradually seat itself to cut off the flow of water into the discharge pipe 15′, thereby saving the water which otherwise would run to waste.

By the use of the described device the impact stream for the water wheel may be accurately and quickly regulated proportionately to the working load of the hydraulic motor, and this without interfering with the safety of the pipe line, at the same time only such a waste or loss of water is occasioned as is absolutely necessary to relieve the pipe line of the sudden excess of water pressure which otherwise would occur.

The joints rendered necessary by the employment of a deflectable nozzle to vary the impact stream relative to the working load of the hydraulic motor, is avoided by the present invention, while the position of the impact stream relative to the buckets of the

water wheel or hydraulic motor is not varied, as in the case of a deflecting nozzle. This is a feature of importance, inasmuch as the stream at all times bears onto the buckets at relatively the same position, thus securing the maximum efficiency at all times.

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

The combination with a water wheel, of a fixed nozzle for directing an impact stream thereon, a needle valve for controlling the outlet area thereof, a stem extending therefrom outside of the nozzle, an overflow outlet for a portion of the water flowing toward the nozzle when its outlet area is reduced, of connection between said outlet and the fixed nozzle, a dash pot cylinder slidable on the stem of the needle valve, a piston head on said stem within the cylinder, communication between each end of the cylinder for the flow of fluid toward and from the respective ends, means for moving the stem of the needle valve a valve for the overflow outlet, connection between the cylinder and valve for opening the valve of the overflow outlet with the closing of the needle valve, and independent means for closing the said valve of the overflow outlet.

In testimony whereof I have hereunto affixed my signature in the presence of witnesses.

GEORGE J. HENRY, JR.

Witnesses:

N. A. ACKER,

D. B. RICHARDS.