No. 660,789. Patented Oct. 30, 1900.

W. A. DOBLE.

HYDRAULIC REGULATING NOZZLE.

(No Model.) (Application filed Oct. 17, 1899.)

Fig. I.

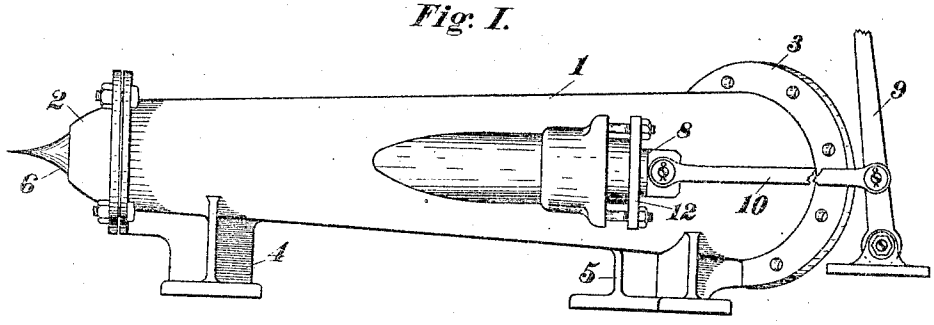


Fig. II.

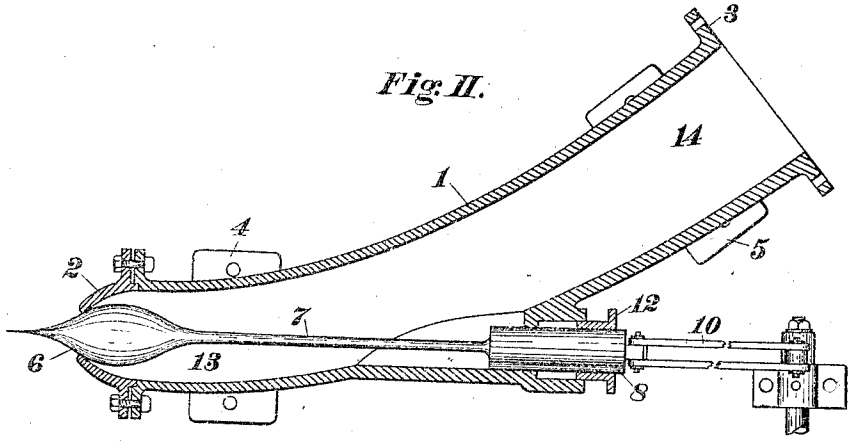
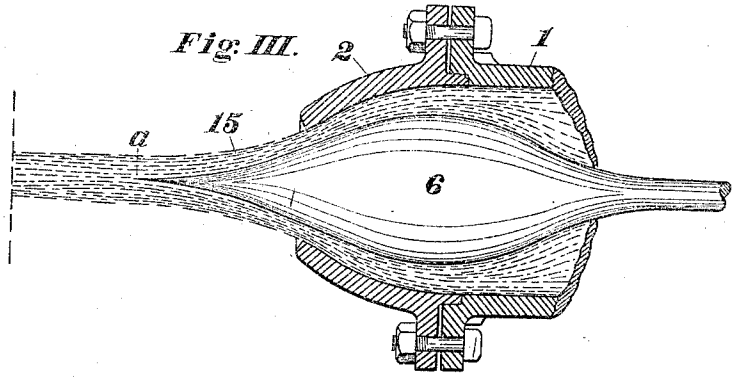


Fig. III.



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HYDRAULIC REGULATING-NOZZLE.

SPECIFICATION forming part of Letters Patent No. 660,738, dated October 30, 1900.

Application filed October 17, 1899. Serial No. 733,854. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. DOBLE, a citizen of the United States, residing at San Francisco, county of San Francisco, and State of California, have invented certain new and useful Improvements in Hydraulic Regulating-Nozzles; and I hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to hydraulic nozzles for discharging a varying amount of water for power and other purposes, commonly called "regulating-nozzles," especially applicable to tangential or jet water-wheels, and to certain improvements in such nozzles that will maintain the solidity of the stream of water discharged irrespective of its size.

My improvements consist in discharging the water through an annulus around a spindle-shaped core that acts also as a valve to open, close the issue, and regulate the amount of water discharged, and in so constructing the nozzle-chamber and spindle-shaped core that the water will approach the point of issue at a gradually-accelerated rate of flow and be discharged by easy curves tangential to the interior curved faces of the nozzle and the anterior curved faces of the central core, so as to follow the latter to the point thereof.

My invention also consists in a means of supporting this central core without guides within the water-passage of the nozzle so it will automatically assume and maintain a concentric position in the nozzle-chamber and in means to quickly withdraw and advance this core-piece as a throttling and regulating valve and to clear the discharge-way when obstructed; also, in balancing hydrostatically, as nearly as possible, the thrust upon the core-piece.

The objects of my invention are to provide a hydraulic nozzle that will discharge a solid stream of water throughout a wide range of volume or capacity and to avoid the disturbance of such jets by friction on their exterior, and consequent greater velocity at the center; also, means of instantly clearing the nozzle in case of obstruction, and other objects, hereinafter more particularly pointed out in the specification to follow and illustrated in the drawings forming a part thereof.

Referring to these drawings, Figure I is an elevation of one of my improved nozzles adapted for use in driving a tangential water-wheel with the nozzle closed by the interior core. Fig. II is a central horizontal section through Fig. I. Fig. III is an enlarged section through the nozzle, showing more clearly the contour of the surfaces over which the water passes, the core being in the position taken when in the medium position for discharge.

Similar characters of reference indicate corresponding parts in the several figures.

It is well known that the effect produced by water issuing from nozzles under pressure, especially in jets applied to water-wheels, is greatly impaired if the speed and volume are changed by altering the initial pressure or by throttling devices for the purpose of regulation; also, that varying the section of such nozzles by the usual devices to regulate the amount of water discharged sets up disturbances that break up the integrity or solidity of the stream. To obviate these objections, I construct regulating-nozzles as illustrated in the drawings, now to be referred to.

The main nozzle 1 when arranged to discharge beneath a tangential water-wheel in the usual manner is preferably tapered and made in a curved form, as shown in section, Fig. II, and is preferably provided with a detachable converging tip 2, that can be renewed in case of wear by scour or otherwise; also, to enable this part to be made of a harder or different metal, if desired. The flange 3 is connected to the main supply-pipe, and the nozzle is supported on the stands 4 and 5, preferably cast integral with the main part 1, or this latter can be held in various ways—for example, by a radial flange to be attached to the side of an inclosing case or frame in which the smaller sizes of tangential water-wheels are commonly mounted.

In the center of the nozzle at its issuing end I place a spindle-formed core 6, held by a flexible rod 7, made integral with or attached to a compensating piston 8, that is moved outward or inward by a lever 9 and links 10, as seen in Figs. I and II. A lever 9 is usually employed to give a quick move-

ment to the piston 8 and the core-point 6 and in case the issue should become clogged by solids carried in the water; also, for suddenly starting and stopping a wheel on which the water is being discharged. The range of the lever 9 each way and also to certain points for regulation of the amount of water discharged can be determined by stops, a sector-scale, or in any other suitable manner, or the lever can be substituted by a screw. Such devices being a matter of common knowledge and use and requiring modification in many cases are not illustrated in the drawings. The piston 8 is provided with a packing-gland 12 and is usually made with a sectional area sufficient to balance the thrust on the core-piece 6 when the latter is at an average working position, or as shown in Fig. III, and thus reduces the thrust on the lever 9 and enables regulation to be performed within the force capable of being exerted by centrifugal or other regulating apparatus of the common kind. The core-piece 6 being held by the rod 7, it will without lateral guides that cause obstruction and disturb the flow automatically assume and retain a concentric position in the nozzle-tip 2 and in the chamber 13, as shown in Fig. II. The chamber 13 14 is without obstruction preferably tapered gradually from the flange 3 to the point of issue around the core-piece 6 to cause a gradually-accelerated movement of the water as it approaches the point of discharge, and the curve of the inner surface of the nozzle-tip 2 and the curve of the outer surface of the core-piece 6 are coincident when in their working positions, as shown in Fig. III, where the water 15 is as it appears in operating. The water is thus discharged in an annulus with nearly equal frictional retardation or resistance on the outer and inner surfaces of this annulus and is gradually directed by easy curves to a solid form at the point *a* and retains that form for a longer distance than if discharged in a solid stream from a common nozzle.

The jet or stream can be increased or diminished in size without disturbing its solidity at *a*, and, as may be seen, the core-piece 6 when thrust forward closes the issue and forms an effective and convenient stop-valve. Also in working if the annular issue is obstructed by any kind of solids that enter with the water these will at once escape by drawing back the core-piece 6 and opening the discharge-orifice, after which the core can be returned to its working position.

The projection of the core-piece 6, the surfaces of which are of a suitable curve, providing a center on which the stream can form without disturbance into a solid jet of the same or a less diameter than the bore of the nozzle end or tip, prevents the entry of air or the formation of a partial vacuum within the jet, and also may have other effect such as viscous adhesion. The results have been arrived at by practical experiments that included various modifications of form and proportion, the one illustrated having thus far proved the most satisfactory.

It will be understood that the main body of the nozzle can be made with a parallel bore or continuation of the supply-pipe and perform the same, except as to some loss of the energy of flow.

It will be observed that the form of the core at both ends conforms to what are called "wave-line" curves that in practice present the least resistance to passage through water, the same shape at the posterior end conforming to the condition of preserving the gradually-diminishing bore of the nozzle and gradually accelerating the water's velocity as it approaches the point of discharge from the nozzle. In this manner it will be seen that the section of the waterway through the nozzle in all working positions of the core-piece 6 is such as to produce a continually-accelerated flow as the water approaches the point of issue and that the course of the water where changed is guided by easy curves and without disturbance, so a large or a small stream can be discharged from the same nozzle and maintain a solid form.

It will be understood that the main functions of my invention, but in a less efficient manner, can be attained by employing frustums of a core or straight tapers instead of the curved surfaces for the core and nozzle without departing from the essential features of my invention, and such construction, if demanded by cheapness, I include therein.

Having thus explained the nature and objects of my invention and manner of applying the same, what I claim as new, and desire to secure by Letters Patent, is—

1. A hydraulic regulating-nozzle gradually tapering from the bore of the main supply-pipe toward its discharge end, convergent at the tip in curved lines, a spindle-shaped core mounted therein, bounded by double reversed curves approximating wave-lines, pointed at its outer end, and projecting at said outer end through said convergent tip, leaving a conical annular space between said convergent tip and said core through which a convergent shell of water is discharged when the core is in position for discharge, substantially as specified.

2. In a hydraulic regulating-nozzle, a main tube having a tapering bore, convergent at the tip in curved lines, a spindle-shaped core centrally mounted therein, bounded by double reversed curves approximating wave-lines, projecting at its outer end through said convergent tip, the outer curves of said core being convergent in lines of similar convergency to the inner lines of the convergent tip, whereby when the core is in the medium position for discharge the inner and outer tangential lines of the cone of discharge between said core and tip are approximately parallel, substantially as specified.

3. In a hydraulic regulating-nozzle, a ta-

pering main tube, a tip thereon converging in curved lines, a spindle-shaped core centrally mounted therein, pointed at its end, and projecting through and beyond the converging tip, said core bounded by double reversed curves approximating wave-lines, of similar convergency to the curved inner lines of the converging tip at the place of emergency from said tip, whereby when the core is in the medium position for discharge a conical shell of discharge is formed having approximately parallel walls at the emergent point, substantially as specified.

4. In a hydraulic regulating-nozzle, a tapering main tube, a tip thereon converging in curved lines, a spindle-shaped core centrally mounted therein, pointed at the end, and projecting through and beyond the converging tip, said core bounded by double reversed curves approximating wave-lines, of similar convergency to the curved inner lines of the converging tip at the place of emergency from said tip, and gradually becoming less convergent beyond the tip up to the terminal point, substantially as specified.

5. In a hydraulic regulating-nozzle, a tapering main tube, a removable tip thereon converging in curved lines, a spindle-shaped core centrally mounted therein, bounded by double reversed curves approximating wave-lines, pointed at the end and projecting through and beyond said tip, with means external to said nozzle for moving said core back and forth to vary the discharge-aperture between said core and tip, substantially as specified.

6. A hydraulic regulating-nozzle converging at its discharge end, a spindle-shaped core bounded by double reversed curves approximating wave-lines mounted therein and projecting beyond said discharge end, a balancing piston connected to said core, and means external to the nozzle for moving both piston and core longitudinally within the nozzle, substantially as specified.

7. A hydraulic nozzle converging at its discharge end, having a spindle-shaped core centrally mounted therein by means of a flexible rod or stem permitting said core to assume a concentric position in said nozzle by the action of the water thereon, substantially as specified.

8. In a hydraulic regulating-nozzle having a discharge end converging on curved lines, a movable spindle-shaped core-piece mounted therein projecting through said discharge end, adapted to open and close the same and permit an annular discharge of water therefrom on lines tangential to the inner curved faces of the nozzle end and the anterior curved faces of the central core, in combination with a hydraulic balancing-piston connected to said core by a flexible rod or stem, and means to operate said piston and core, substantially as specified.

9. In a hydraulic regulating-nozzle, a spindle-shaped core-piece adapted to open and close the issue of the nozzle, or permit a variable annular discharge therefrom, a removable inwardly-converging tip for the nozzle and a spindle-formed core mounted on a flexible rod that permits it to assume automatically by action of the water a concentric position within the removable tip, substantially as specified.

10. In a hydraulic regulating-nozzle, a removable converging nozzle-tip, a movable pointed core-piece therein tapering each way with curved surfaces over which the water flows, a flexible support for the core-piece attached to a piston to balance the thrust of the core piece and external means to move the piston, all combined and operating substantially as described.

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

WILLIAM A. DOBLE.

Witnesses:
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