A. PFAU.

NOZZLE.

APPLICATION FILED FEB. 7, 1906.

915,214. Patented Mar. 16, 1909.

Fig. 1.

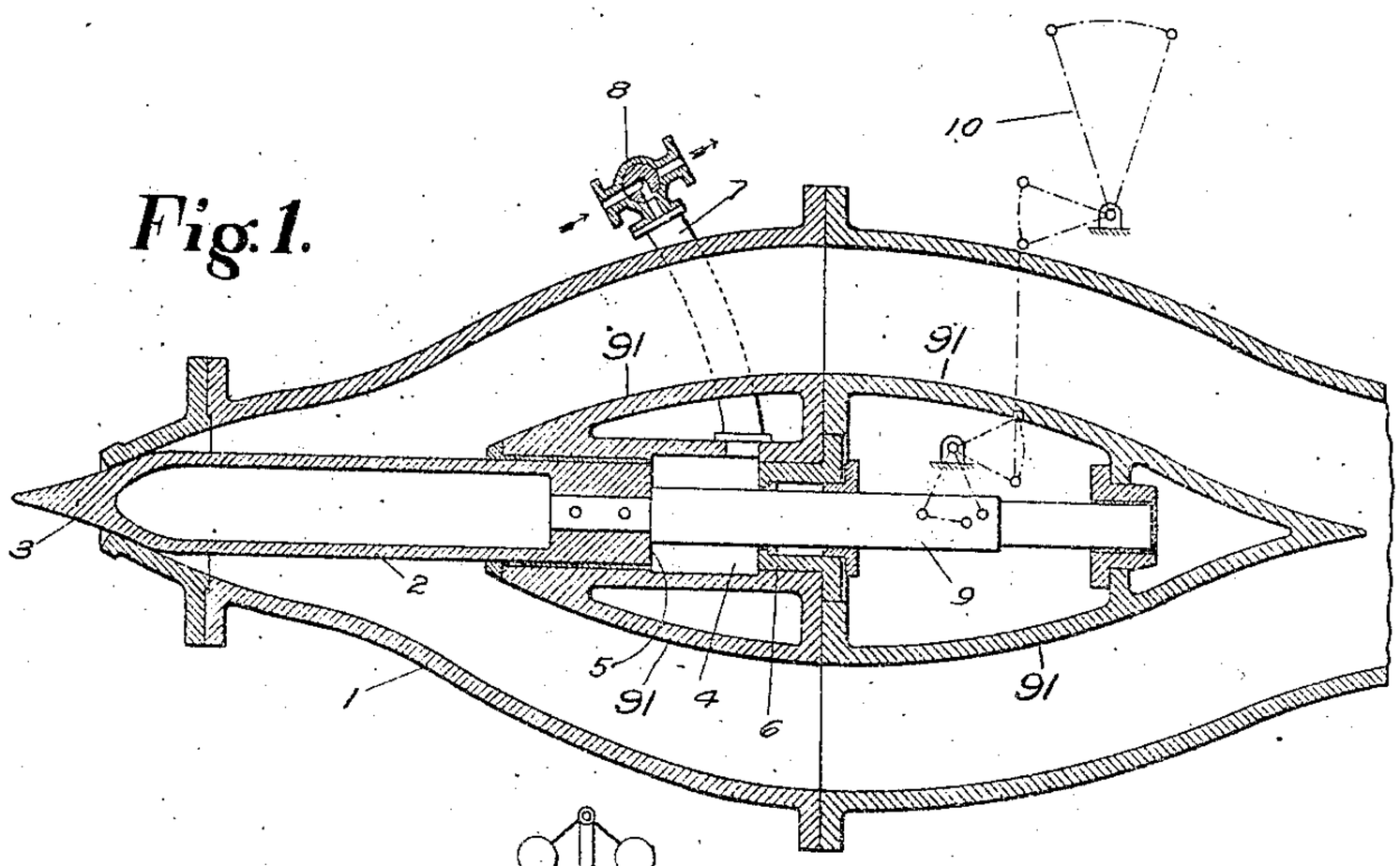

Fig. 2.

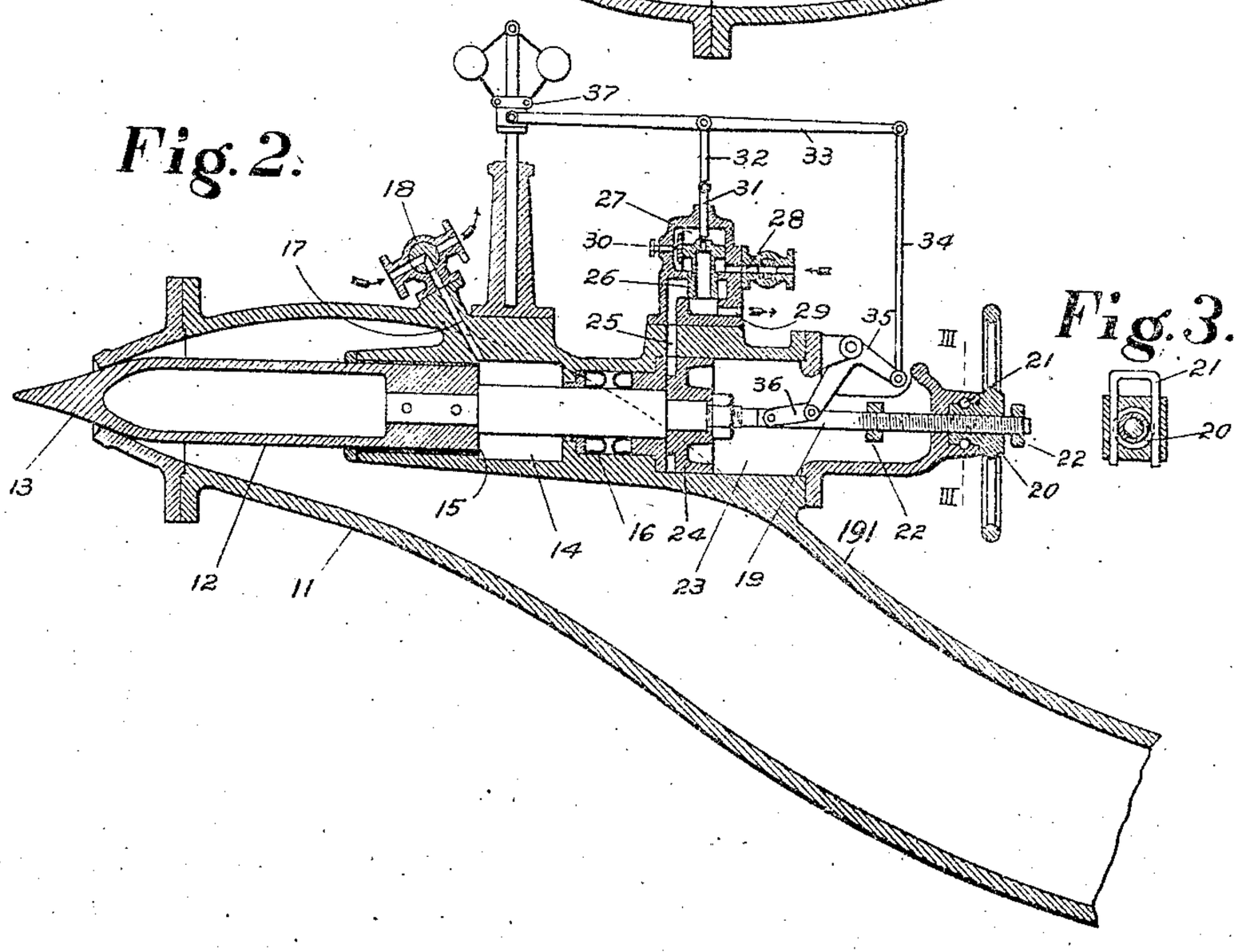

Fig. 3.

WITNESSES:

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NOZZLE.

No. 915,214. Specification of Letters Patent. Patented March 16, 1909.

Application filed February 7, 1906. Serial No. 299,925.

To all whom it may concern:

Be it known that I, ARNOLD PFAU, a citizen of the Republic of Switzerland, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Nozzles, of which the following is a specification.

This invention relates to nozzles and means for controlling the outlet therefrom.

This invention has utility when used to conduct fluid to a driven element, as a water wheel.

This construction is especially valuable owing to the particular form of nozzle opening; owing to the form of the needle tip; owing to the form of the exposed stem of the needle and the mounting of the needle which permits of firmly holding the needle against vibration and delivering the fluid without eddies to the adjustable nozzle opening; owing to the efficient needle control connections.

The great difficulty experienced in the use of a needle valve for controlling the flow of water through nozzles where the water was under a high head, has been to prevent the displacement of the needle with respect to the orifice whereby the issuing jet of water assumed a form other than cylindrical, and also to prevent vibrations of the needle due to such displacement and possibly to other causes not recognized or well understood. Before this invention it has been the common practice to so dispose the needle with respect to the flow of water that the needle was subjected to lateral pressure against one side. In some of the structures of the prior art the valve is provided with a comparatively small and slender stem. This construction was adopted in practice in order to permit a bending of the stem under the action of the water without displacing the valve from the center of the jet and thereby deforming the jet. With this construction, however, a curious effect has been noticed, viz., that the valves of this construction wear or erode very rapidly wherever there is any dirt or grit carried by the water, and even in cases where the water would ordinarily be termed clean or clear. It is supposed that this rapid wear or erosion is permitted by reason of the vibrations occurring within the material or mass of the needle itself, and it was the purpose of the construction disclosed by this specification to provide a rigid valve or needle for this class of devices so mounted and arranged that the material composing the same would be under a state of stress due to the pressure of the water and that the valve would be uninfluenced by the flow of the water past it, and in actual practice the difficulties experienced by the prior types of these valves appear to have been satisfactorily overcome.

Referring to the drawings: Figure 1 is a sectional view of an embodiment of the invention in a two-way deflection nozzle. Fig. 2 is a sectional view of an embodiment of the invention in a rigid nozzle. Fig. 3 is a section on the line III—III of Fig. 2.

The two-way nozzle 1 has a continuous taper adjacent the outlet as is common in this class of devices. Mounted in the nozzle 1 is the needle having the hollow exposed cylindrical stem 2 with the continuous taper tip 3. This tip tapers directly from the stem 2 and the curve of the tip is of a single double reverse form. In the nozzle 1 is a chamber 4 through which the needle extends. The end 5 of the needle stem 2 is exposed to the pressure of the water in chamber 4, and in the construction shown the pressure exerted by the water in said chamber against said end of the needle is utilized for assisting in moving the needle. At the opposite end of the chamber 4 is the packing 6 through which the needle works. Communicating with the passage 4 is the fluid connection 7 having the valve 8 which may be connected at one position with a source of pressure, for instance, the penstock which may be back of the gate. At its other position the valve 8 would open to exhaust. When connected with a source of pressure, the fluid passing through 7 serves to normally keep the needle forced toward nozzle closing position.

Connected to the extension 9 of the needle is a system of linkage 10 provided with means for mechanical control of the position of the needle. The extension 9 of the needle lies opposite the concave or bent-aside portions 91, 91 of the nozzle and is directly accessible from without the nozzle walls without any disassembling of parts. This control may be manually operable.

The one-way nozzle 11 has the continuous taper adjacent the outlet. In the nozzle 11 is the needle having the exposed hollow cylindrical stem 12 with the single double reverse curve tip 13. The configuration of the

chamber between the nozzle and needle is uniform and symmetric for the purpose of equal pressure distribution. This construction also applies to Fig. 1. In the nozzle 11 is the chamber 14 in which the end 15 of the needle stem 12 operates as a piston. The opposite end of the chamber 14 is closed by a packing 16 surrounding the needle. Communicating with the chamber 14 is the fluid connection 17 having a valve 18. This valve may connect the chamber 14 with a source of pressure, as from the penstock back of the gate, or connect the chamber with the exhaust. The extension 19 of the needle has connection with the mechanical needle control 20 which, in this instance, as a hand wheel having threaded connection with the needle. The extension 19 of the needle lies opposite the concave or bent-aside portion 191 of the nozzle and is directly accessible from without the nozzle walls without any disassembling of parts. When operated mechanically the key 21 serves to hold the wheel 20 from longitudinal movement relative to the nozzle. Mounted on the extension 19 of the needle are the stops 22 which are adjustable; the outer one of which may be set so that the needle may not reach full closed position in the nozzle. This precaution will prevent water hammer in the event the needle should suddenly move toward closing position. The inner adjustable stop 22 will serve to limit the maximum opening of the nozzle and thereby prevent excessive use of water when but a limited maximum is available.

Besides the chamber 14 in the nozzle 11 there is the chamber 23 in which is the piston 24 also mounted on the needle. Communicating with the chamber 23 is the fluid connection 25 having the valve 26 in the chamber 27. The chamber 27 has the controllable inlet 28 for fluid under pressure and the exhaust outlet 29. The controllable inlet may receive the fluid under pressure from the penstock back of the gate. The valve 26 is of the poised type and is controlled by a valve stem 31. The fluid under pressure entering at 28 passes around the valve 26 under its flange extension and through the adjustable cataract portion 30 of the chamber 27 above the valve 26. This fluid may seep out through the opening in the valve 26, which opening is controlled by the valve stem 31. Connected to the stem 31 is the link 32 mounted intermediately of the ends of the floating lever 33. One end of the lever 33 is connected by the link 34, bell crank lever 35, and link 36, with the extension 19 of the needle. The opposite end of the floating lever 33 is connected to a governor 37.

Inasmuch as the pistons 15 and 34 are of different effective areas, the fluid under pressure which is admitted to the chambers 14 and 23 may be derived from the same source. Such being the case, the interposed packing 16 is not subjected to material difference in pressures in the regular operation of the device.

When the needle of Fig. 2 is connected up for automatic control or relay governing, the device will operate as follows: Should the speed of the driven element become excessive, the governor 37 will lift the end of the lever 33 connected thereto. This will cause the lever to move about the link 34 as a fulcrum, and through link 32 lift the stem 31 away from valve 26. This will increase the area of the seepage opening in the valve 26, thereby reducing pressure above the valve 26 so that this valve will rise until the pointed stem 31 so fits the seepage opening in the valve 26 that the fluid under pressure passing the adjustable cataract 30 is just taken care of by this seepage opening. This rise of the valve 26 will connect the chamber 23 through the opening 25 with the exhaust outlet 29. The fluid under pressure in the chamber 14 will accordingly actuate the needle piston 15 toward closing position. This movement of the needle will be transmitted through link 36, bell crank 35 and link 34 to move the floating lever 33 about the governor 37 as a fulcrum. This will cause the link 32 to cause the stem 31 to move down to close the seepage opening in the valve 26. This will again cause an unbalancing of the pressures about the valve 26, for the passage of fluid about the adjustable cataract 30 to the upper side of the valve 26 will, on this greater area, cause the pressure to force the valve 26 downward to again give the seepage opening proper area for outlet. This movement of the valve downward closes the fluid connection 25 and thereby holds the needle in the position to which it was forced. Should the speed of the driven element fall below the normal, then the floating lever 33 will move downward about the link 34 as a fulcrum, and through the link 32 and stem 31 close the seepage opening in the valve 26, causing the valve 26 to recede to create proper area of seepage opening to take care of the fluid under pressure passing cataract 30. This movement of the valve 26 downward will permit fluid under pressure entering at opening 28 to pass through fluid connections 25 to force the piston 24 against the resistance of fluid in the chamber 14 and thereby retract the needle. This movement of the needle causes a secondary movement of the valve 26 through the linkages 36, 35, 34, and lever 33 about the governor 37 as a fulcrum. These control devices are such that any one or all may be disconnected. Normally, fluid under pressure is always in the chamber 14 and the needle is accordingly held toward nozzle closing position.

Notwithstanding the governor is connect-

ed to the device, the needle may be controlled by hand by bringing the wheel 20 into position for locking by the key 21, then rotating the wheel as desired.

The two forms of apparatus disclosed by the drawings accompanying this specification show that the nozzle is so arranged that the water is directed against the opposite and opposing sides of the valve, whereby the valve is freed from side thrusts and in consequence a much stiffer needle or valve can be used, this change in construction assisting in overcoming the defects of the prior types of these needles, and by substantially immersing the entire needle or valve in the water, the material composing the same is subjected to the stress of compression, thereby further reducing the liability for said material to experience vibrations.

What is claimed and it is desired to secure by Letters Patent, is:—

1. The combination with a curved-passage nozzle having an aperture, of a needle extended through the curved walls of said nozzle and having the outer portion located adjacent the concave side of the curved portion of the nozzle and directly accessible from without the nozzle walls and adapted to control the thoroughfare through said aperture, the space between the portion of the needle within the nozzle and the opposite walls of the nozzle being symmetrically enveloped about said needle portion.

2. The combination with a curved-passage nozzle having an aperture, of a needle extended through the curved walls of said nozzle and adapted to control the thoroughfare through said aperture, the nozzle having its wall extending inwardly and closely adjacent the needle from the place where the needle extends through the nozzle walls, whereby the space between the portion of the needle within the nozzle and the opposite walls of the nozzle is symmetric about said portion of the needle.

3. The combination with a nozzle having an aperture, of a needle extended through the walls of said nozzle to control the thoroughfare through said aperture, the outer portion of the needle being directly accessible from without the nozzle walls, the space between the portion of the needle within the nozzle and the opposite walls of the nozzle being symmetrically enveloped about said portion of the needle and said needle portion being of decreasing cross-sections proceeding toward the needle point at any place where these sections differ in size.

4. The combination with a nozzle having a portion curved or bent aside to receive a needle valve, of a needle valve extended through the curved walls of the nozzle, the nozzle and valve being constructed and arranged to cause the space between the portion of the needle valve within the nozzle and the surrounding walls of the nozzle to be symmetrically enveloped about said needle portion.

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

ARNOLD PFAU.

Witnesses:
GEO. E. KIRK,
G. F. DE WEIN.