July 3, 1951 G. V. ARATA 2,559,336

DRAFT TUBE VALVE

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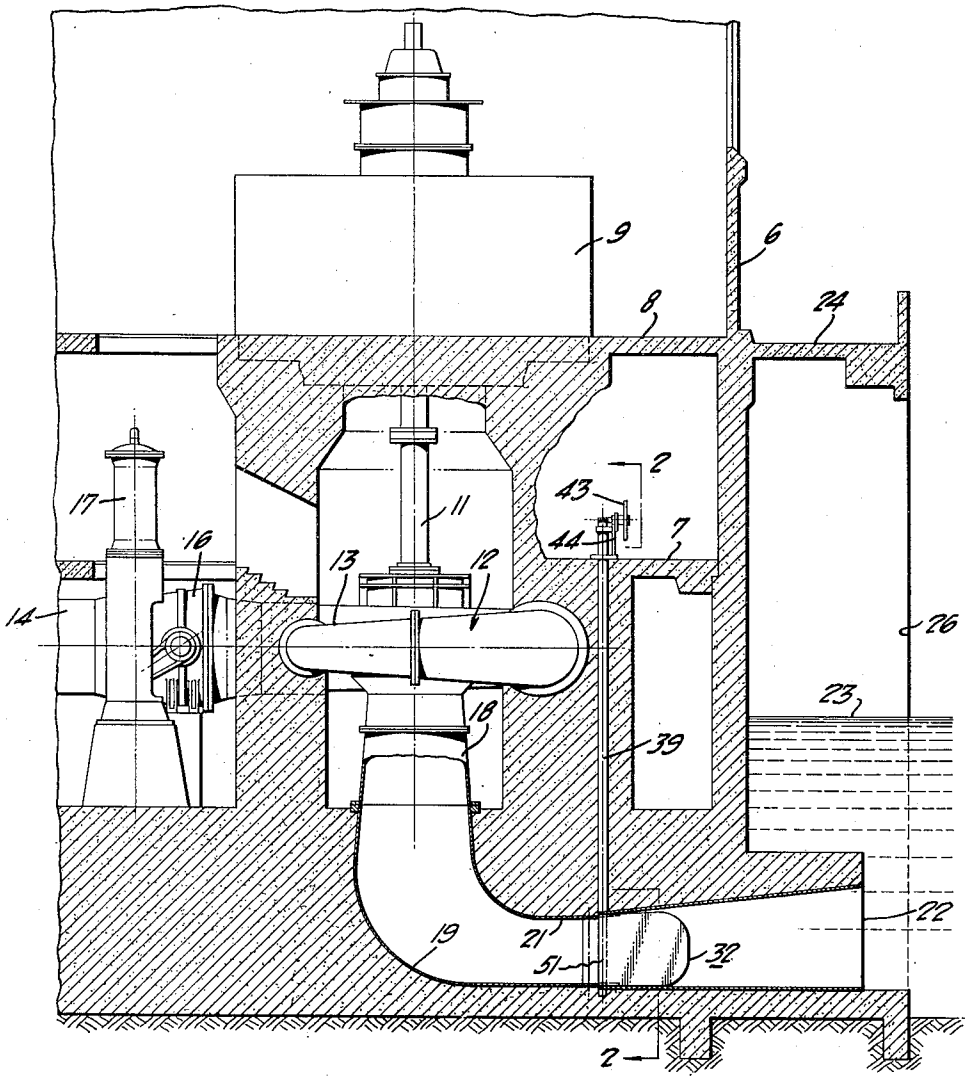


FIG. 1.

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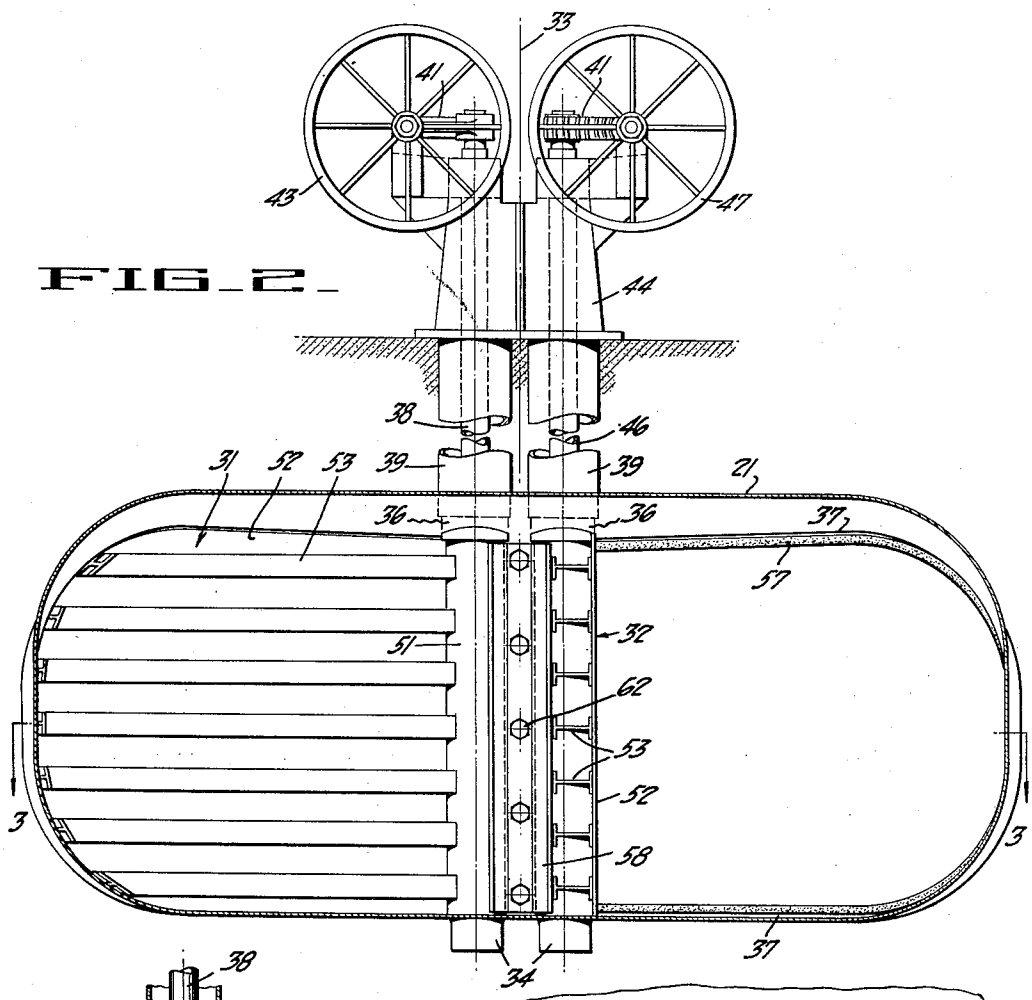


FIG_2_

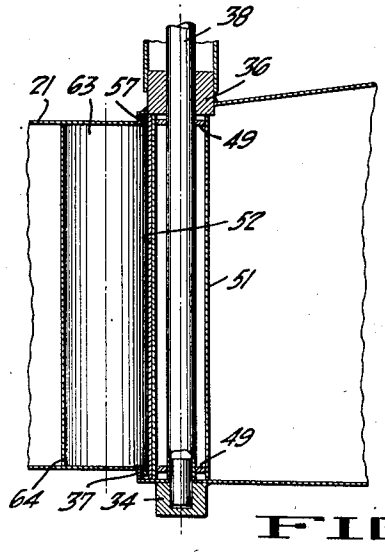


FIG_5_

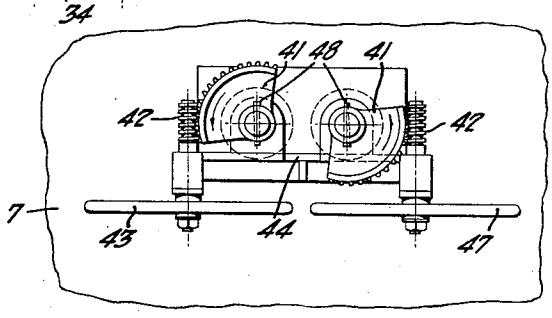


FIG_6_

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FIG_3_

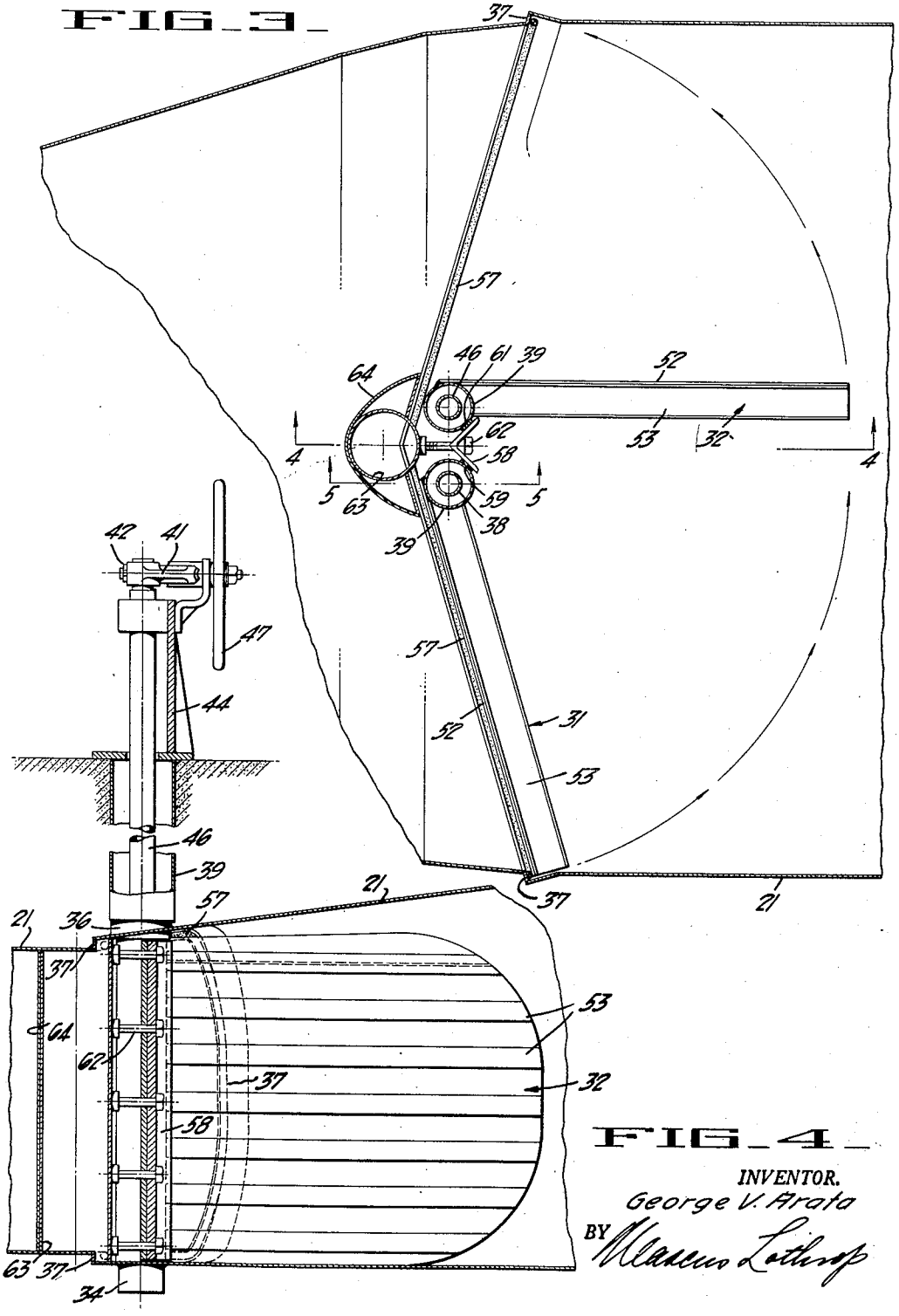


FIG_4_

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UNITED STATES PATENT OFFICE

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DRAFT TUBE VALVE

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Application December 9, 1946, Serial No. 715,049

2 Claims. (Cl. 251—10)

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The invention relates to hydraulic mechanism and particularly to devices for use in connection with hydraulic conduits especially of the type connected to hydraulic turbines, for example as shown in Buehle Patent 1,592,441 issued July 13, 1926. A typical installation of a hydraulic turbine is in a power house wherein the turbine drives an electric generator. The turbine is supplied with hydraulic fluid under a relatively high pressure through a conduit or pipeline extending from a considerable elevation to the inlet to the turbine housing. The water so supplied is directed to impart most of its energy to the rotor of the turbine and is then directed into a hydraulic conduit, referred to as a draft tube, for receiving the spent water and conducting it to a location outside of the power house and open to the atmosphere, usually referred to as an afterbay. The afterbay water level varies under different operating conditions and in different installations. Sometimes it is considerably below the level of the turbine runner and sometimes it is somewhat above the level of the turbine runner.

It is occasionally necessary to effectuate repairs on the turbine and usually it is required that the turbine interior be periodically inspected. This involves an unwatering of the hydraulic mechanism in the immediate vicinity of the turbine. For that reason it is customary practice to provide a shutoff valve at the turbine inlet. At the draft tube outlet to the afterbay, a relatively heavy barrier or gate is provided to cooperate with the power house structure so that it can be lowered from its normal raised position to overlie the draft tube outlet. The use of such a gate entails a provision for its accommodation in the original power house construction and the provision of elevating machinery for raising and lowering the gate. When the gate is in lower position, the interior of the mechanism can be unwatered and the repairs or inspection accomplished. Following this, the closure gate is lifted and retained in an elevated position pending further use. If, by accident, the turbine is again started before the afterbay gate has been raised and without electrical load on the connected generator, the hydraulic forces involved are sufficient to carry away or severely damage the gate.

It is therefore an object of my invention to provide a means for controlling or sealing off the draft tube of a turbine in a more efficacious fashion than heretofore has been the practice.

Another object of the invention is to provide a draft tube construction in which the sealing off means is part of the draft tube construction rather than part of the power house construction

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so that a good deal of power house machinery and capital expenditure can be eliminated, and so that fabrication is a factory rather than a field operation.

An additional object of the invention is to provide a draft tube valve of such a nature that under accidental hydraulic flow, no severe or irreparable damage will be occasioned.

An additional object of the invention is to provide an improved draft tube valve.

Another object of the invention is to provide a draft tube valve which does not deleteriously affect the hydraulic characteristics or efficiency of the draft tube itself.

Other objects together with the foregoing are attained in the embodiment of the invention shown in the accompanying drawings in which

Figure 1 is a cross section on a vertical plane through a power house showing a typical turbine and draft tube installation and with the draft tube valve of my invention incorporated therein.

Figure 2 is a cross section the plane of which is indicated by the line 2—2 of Figure 1 showing one of the gates in closed position and the other of the gates in open position, certain portions being broken away to reduce the size of the figure.

Figure 3 is a cross section the plane of which is indicated by the line 3—3 of Figure 2.

Figure 4 is a cross section the plane of which is indicated by the line 4—4 of Figure 3.

Figure 5 is a cross section the planes of which are indicated by the lines 5—5 of Figure 3.

Figure 6 is a fragmentary plan showing the control wheels for the valve gates with one of the gates in closed position and the other in open position.

In its preferred form the draft tube valve of my invention is for installation in the draft tube of a turbine. The draft tube is a hydraulic conduit usually symmetrical about a vertical axis and is formed with a valve seat. A pair of unbalanced gates are disposed within the tube with their rotational axes parallel to the axis of symmetry of the tube and downstream of a column extending vertically across the tube. The gates are swingable into a closed position abutting the valve seat and into a second open position in the lee of the column. Appropriate sealing means are provided for precluding excessive leakage. The valve gates are moved between the respective extreme positions by controlling mechanisms extending through the wall of the draft tube to a convenient outside location so that the gates can be appropriately positioned from an external point.

While the particular construction of the draft

tube valve of the invention varies with individual installations, a typical arrangement is substantially as shown herein. In this instance there is provided a power house 6 having an operating floor 7 therein at an appropriate elevation below a floor 8 on which a generator 9 is situated. The power shaft 11 extends in a vertical direction to the interior of a turbine 12, the scroll casing 13 of which is connected to a hydraulic inlet pipe 14. At a convenient location in the pipe 14 there is disposed a shutoff valve 16 controlled by a hydraulic actuator 17 so that the scroll casing 13 can be hydraulically isolated from the pipe 14.

From the turbine casing an outlet or draft tube 18 extends at first coaxially with the shaft 11 and then with an elbow 19 into a generally horizontal draft tube portion 21 gradually enlarging and finally having an outlet 22 affording egress for the hydraulic fluid to the afterbay 23. The hydraulic design of the draft tube is very carefully worked out so that the appropriate flow contours are established from the outlet of the turbine to the afterbay. The draft tube is preferably symmetrical about a vertical longitudinal plane.

Normally, and in accordance with previous requirements, the power house 6 is constructed with an extension or platform 24 for the machinery for handling a gate vertically slidable within the confines of end-walls 26 to overlie the outlet 22 or to be lifted above the outlet for further use.

In accordance with the invention, and to avoid the necessity of providing an extension or gallery 24 and the walls 26, I dispose within the draft tube 21 a pair of generally similar gates 31 and 32 which are of an appropriate contour to occupy the entire cross section of the draft tube when the gates are closed and to remain entirely within the draft tube without projecting into the afterbay 23 when the gates are open. The gates are planar, are hydraulically unbalanced and are disposed in mirror symmetry with respect to the vertical, symmetrical axis 33 of the draft tube. Since they are identical, a description of one of them applies equally to the other.

Within the draft tube at a hydraulically suitable location, there is provided a pair of journals 34 and 36 arranged with their common axis parallel to the axis of symmetry 33 and disposed slightly to one side of the central plane of the draft tube but adjacent a transverse valve seat 37 formed in the wall of the draft tube. Adapted to rotate in the journals 34 and 36 is a control shaft 38 extending across the draft tube and through a protecting tube 39 in the structure of the power house 6 to an appropriate location above the floor 7. At its upper end, the control shaft carries a gear segment 41 with which meshes a worm 42 rotatable by a hand wheel 43 suitably mounted in a standard 44 supported on the floor 7. When the hand wheel 43 is rotated the shaft 38 is comparably revolved. In a quite similar fashion a shaft 46 is connected to a controlling hand wheel 47 and is comparably revolved thereby. To provide a weak link in the gate controlling and positioning mechanism, the shafts and gears are joined by shear pins 48 so that in the event of accidental overload, the gates can respond to avoid damage except to the easily renewable pins.

Within the draft tube, the shaft 38 is connected by a pair of discs 49 to a cylinder 51 forming part of the gate 31. Also included in the structure of the gate 31 is a plate or sheet 52 of an appropriate contour to occupy substantially half of the cross section of the draft tube. The sheet is reinforced by a plurality of metal shapes 53 constituting substantially horizontal ribs joined to the plate 52 and also to the cylinder 51. In this fashion an unbalanced, swinging, remotely actuated gate is provided to abut the seat 37. To assist in maintaining a substantially water tight connection when the gate is closed, a packing 57 is provided between the gate and the seat 37.

The cylinders 51 are spaced apart and in order to seal the passage between them, there is provided a closure member 58 preferably comprised of a shape such as an angle spaced slightly from the cylinders and carrying packing strips 59 and 61 to rub against and thereby form a seal with the cylindrical surfaces. The angle 58 is secured in position by removable fasteners 62 extending to a column 63 vertically spanning the draft tube and disposed approximately parallel to the symmetrical axis thereof. In the usual construction, the column 63 is disposed centrally of the great width of the draft tube to assist in carrying the power house structure.

With this arrangement when both of the gates are closed, they, together with the closure plate 58, provide a complete seal across the entire draft tube. When the gates are open they are positioned centrally of the draft tube in back to back relationship and are entirely within the draft tube so that they are not susceptible to impact by debris in the afterbay or other external forces. In order that they will disturb the hydraulic flow as little as possible, in their normally open position, the gates are situated so that they are then both in the lee of fairing 64 encompassing and forming part of the column 63. In effect, the gates form continuations of the fairing and disturb the hydraulic flow an inconsequential amount.

For shut-down operation, after the valve 16 is closed, the gates are closed by manipulation of the hand wheels. Although the gates are unbalanced, this is easily done as there is water on both sides of the gates. The space behind or upstream of the gates is then unwatered. When the shut-down is completed, the valve 16 is carefully opened to relieve the afterbay water pressure on the gates which are then readily opened by operation of the controllers 43 and 47. In the event the turbine should be accidentally energized during shut-down without power being taken from the generator so that a sudden rush of water is imposed upon the gates, they simply open in the manner of check valves breaking the shear pins 48 but without further damage.

I claim:

1. A draft tube valve comprising a turbine draft tube adapted to be disposed below a water level and symmetrical in cross-section about a vertical axis, a column extending across said tube parallel to said axis, a pair of gates including cylinders extending across said tube parallel to said axis, sealing means rubbing against said cylinders and secured to said column, and means extending through the wall of said draft tube and to a point above said water level for operating said gates.

2. A draft tube valve comprising a horizontal hydraulic conduit adapted to extend below the water level from a turbine outlet to an afterbay, a vertical column bisecting said conduit, a pair of gates within said conduit, each of said gates being disposed to one side of said column and including a vertical cylinder in the lee of said column, sealing means secured to said column and

rubbing against said cylinders, and shafts engaging said cylinders and adapted to extend to a point above said water level for swinging said gates about the axes of said cylinders.

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