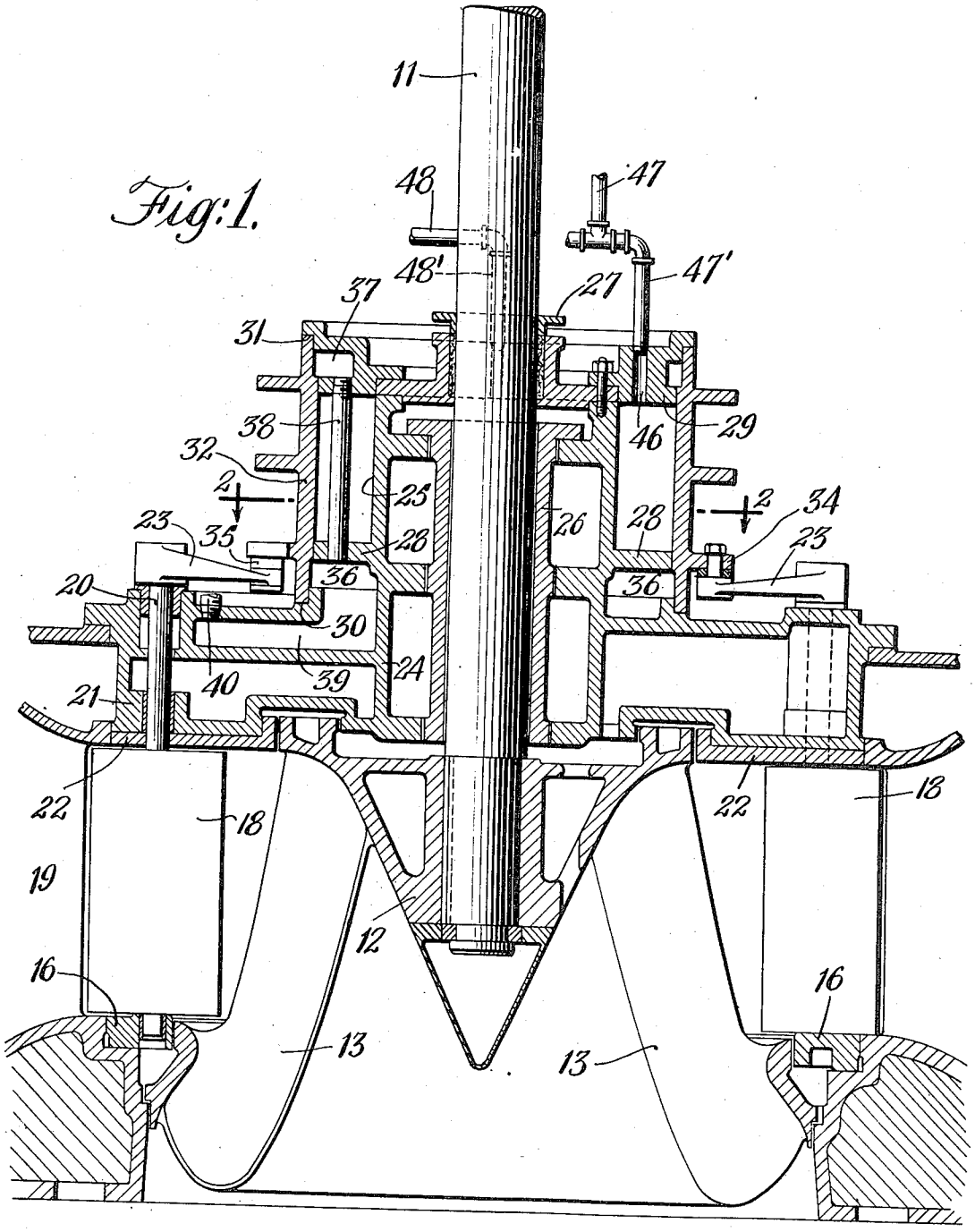
Feb. 5, 1924. 1,482,405

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OPERATING MECHANISM FOR HYDRAULIC TURBINES

Filed Nov. 26, 1920 2 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

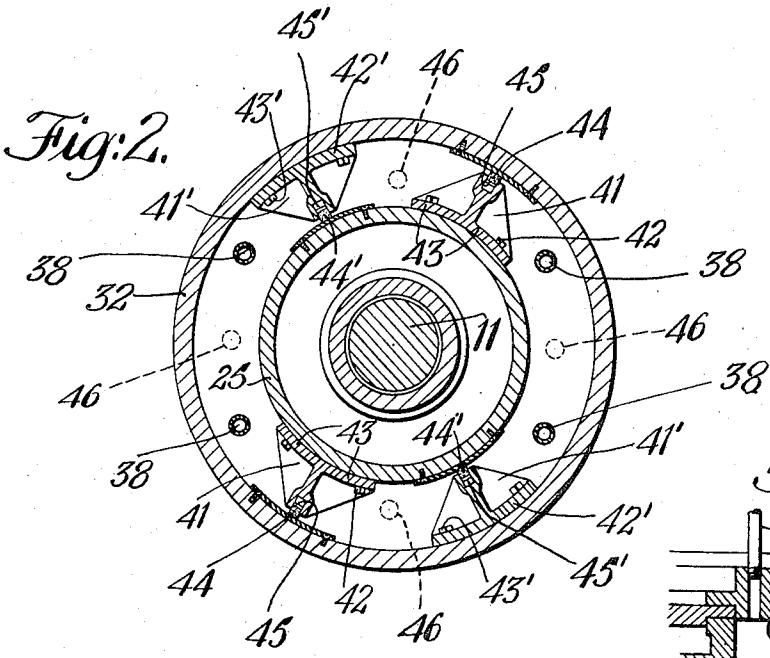


Fig. 4.

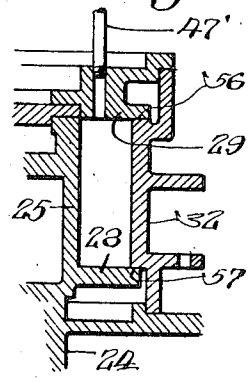
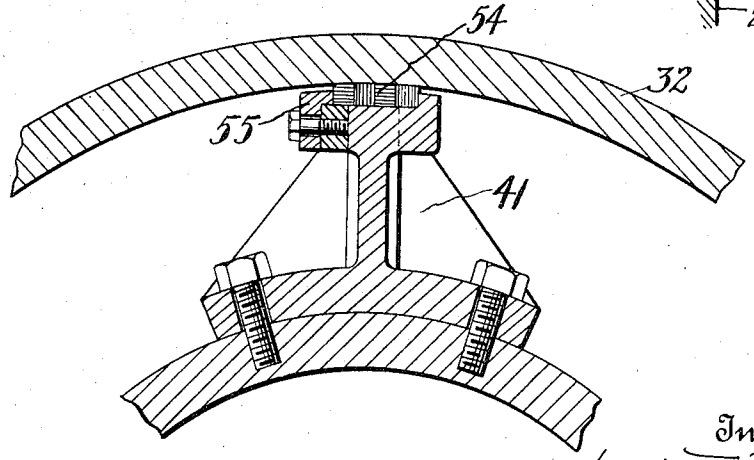


Fig. 3.



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UNITED STATES PATENT OFFICE.

LEWIS FERRY MOODY, OF PHILADELPHIA, PENNSYLVANIA.

OPERATING MECHANISM FOR HYDRAULIC TURBINES.

Application filed November 26, 1920. Serial No. 426,371.

To all whom it may concern:

Be it known that I, LEWIS FERRY MOODY, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Operating Mechanism for Hydraulic Turbines, of which the following is a specification.

The principal object of my invention is to provide a new and improved gear for operating wicket gates for a hydraulic turbine. Another object of my invention is to provide operating mechanism for wicket gates that shall have a minimum of back lash and give directness and certainty of action. Another object relates to disposing the operating mechanism conveniently and compactly around the turbine shaft and making it self-contained with the turbine head cover. These and other objects of my invention will be appreciated upon consideration of the disclosure of a specific example of the invention as set forth in the following specification and claims taken with the accompanying drawings. It will be understood that modifications may be made within the scope of the invention.

Referring to the drawings, Fig. 1 is a vertical section of a hydraulic turbine equipped with operating mechanism for its gates in accordance with my invention, and Fig. 2 is a section on the line 2—2 of Fig. 1, and Figs. 3 and 4 are sectional views of modified details.

The vertical shaft 11 carries the runner 12 with the vanes 13. The stationary parts of the turbine include a distributor plate 16 below and distributor plate 22 above, between which are the wicket gates 18, rigidly connected with the respective shafts 20 above and the pintles below. The water passes to the gates 18 through the inflow conduit 19. Each shaft 20 is mounted to rotate in suitable bearings in the part 21 of the head cover 24, which carries the bearing 26 for the main shaft 11. Each gate shaft 20 has a crank arm 23 on its upper end.

At the top of the head cover 24 is a stuffing box 27 around the shaft 11. The casting 24 carries a cylindrical wall 25 with an annular flange or head 28 around its lower end, and a removable annular head 29 is placed on the upper end opposite to the head 28. Around the chamber between the heads 28 and 29, and spaced from the cylindrical wall 25 is a cylindrical shell 32 adapted to have rotary movement around the head cover 24. At its lower edge the shell 32 projects down and makes a close fit with a seat 30 carried by the head cover 24 so as to enclose an annular chamber 36 below the head 28. From this chamber 36 a conduit 39 goes through the casting 24 to the pipe 40. The shell 32 has a flange 34 around its base to which the links 35 are pivotally connected at one end of each, the other end of each such link 35 being connected to a respective crank 23.

At the upper end of the annular chamber within the walls 25 and 32, the removable head 29 carries an annular chamber 37, the upper edge of the shell 32 enclosing this chamber 37 on the outer face and having a close fit with the seat 31.

Several pipes 38 connect the annular chamber 37 with the annular chamber 36.

The fixed cylindrical wall 25 carries two opposite abutments 41 with flanges 43 fastened by the studs 42. Each such abutment 41 has a packing member 44 along its outer edge in engagement with the inside surface of the rotatable shell 32, this packing member being pushed out by springs 45. Two pistons 41′ alternating with said abutments 41 are fastened on the inside face of movable wall 32 by means of flanges 42′ and studs 43′ and carry springs 45′ holding packing members 44′ in engagement with the outer face of the stationary cylindrical wall 25. There are four ports 46 opening into the annular chamber 25—32 through the upper head 29, respectively, between the abutments 41 and pistons 41′. These ports are indicated by dotted lines in Fig. 2. They are spaced 90° apart and one pair of opposite ports 46 is connected with the pipe 47 through the branches 47′, the other pair of opposite ports 46 being connected with the pipe 48 through the branches 48′.

On referring to Fig. 2, it will be seen that in the annular cylinder 25—32, the fixed

abutments 41 form heads respectively for the pistons 41′ which are movable with the outer cylinder wall. Accordingly, when the pipe 47 is connected with a source of pressure fluid supply and the pipe 48 is connected to exhaust, the pistons 41′ and the wall 32 will move in a clockwise direction. Reciprocally when the pipe 48 receives pressure fluid and pipe 47 is connected to the exhaust, the cylinder 32 will move counterclockwise. Since the wall 32 by means of its flange 34 and the links 35 is connected with the cranks 23, any such movement of the wall 32 as just described will rotate the gates 18 through the corresponding shafts 20.

Accordingly, the gates 18 may be adjusted angularly by means of the motor mechanism described, depending for its operation on the introduction of pressure fluid at 47 or 48.

The packing 44′ and 44 will reduce the leakage past the piston 41′ and abutment 41 to a minimum. The upper and lower ends of piston 41′ may be carefully fitted to the cylinder heads 28 and 29 so that special packing will not be necessary at these places. A little leakage will do no harm, because the quantity of water required to operate the gates is comparatively small.

Any leakage past the outer edges of the heads 29 and 28 will be received in the annular chambers 37 and 36 and the contents of the chamber 37 will drain down through the pipes 38 into the chamber 36 and thence through the conduit 39 to the discharge pipe 40.

Heretofore it has been common to operate turbine gates from a ring around the shaft corresponding to the flange 34, but this ring has been moved from a main cylinder and piston and a tangential connecting rod. By my invention the ring is made a rigid structure with the piston 41′ which receives the pressure to move it, and this reduction in the number of moving parts and in the number of joints reduces the possible lost motion or back lash. The control of the gates will ordinarily be effected by means of a governor and it is very desirable to make the connection as direct and effective as possible, so that any governor effect will give an immediate response in gate adjustment. By my invention the back lash is reduced to a minimum and a very effective control is secured. By my invention the number and extent of the moving parts are reduced and this reduces the inertia that has to be overcome by the governor and thus enables the governor to actuate the gates more promptly and accurately.

The control of wicket gates heretofore by means of an ordinary cylinder and piston acting through a connecting rod upon a ring corresponding to the flange 34 has involved the necessity for a special mounting for the cylinder off at one side. The cylinder has been either carried by the pit liner of the turbine or by the turbine casing or in some instances supported independently of the turbine by the surrounding concrete structure. In any case, the cylinder and connecting mechanism have required considerable space and inconveniently interfered with the walk-way around the turbine head cover within the turbine pit. It has also been necessary to dismantle the connection and sometimes to remove the cylinder before the turbine head cover could be removed for dismantling or repair of the runner and other portions of the turbines, and as frequently arranged the operating cylinder could not be definitely located with respect to the rest of the turbine until final erection at site. By my invention the whole operating mechanism is grouped compactly around the turbine shaft within the space defined by the gate shafts 20. The motor is located within the outer radial limits of the distributor plate 22 that is, if an imaginary vertical cylinder be erected from the outer edge of the distributor plate 22 the motor would be entirely contained within this cylinder. This arrangement leaves a clear space all the way around the turbine head cover, and enables the entire operating mechanism to be self contained with the head cover, so that in dismantling the turbine it can all be removed as a unit.

Although one particular embodiment of the invention has been described in considerable detail above, the invention may be applied in other forms as required by the different types of turbines and settings. For example, it is particularly adapted for use with open flume turbines with submerged operating mechanism, such as may sometimes be used for small units under low heads, the arrangement of this invention being relatively inexpensive and capable of being conveniently installed. The operating fluid used for the pressure supply to the rotary piston may in many cases be water taken from the turbine penstock without the use of pressure pumps, since a large piston area may readily be provided by the use of this invention. When a single pair of pistons is insufficient, multiple pistons can be arranged around the circumference within the operating ring. When penstock pressure is used to supply the piston space, the chamber 36 may conveniently be turned directly into the cored space within the turbine head cover which in turn is drained through the turbine runner into the draft tube. It may frequently be desirable to form all of the running fits between the ring 32 and the heads 28 and 29 by plane surfaces rather than cylindrical surfaces, in order to provide for a slight distortion of

the ring 32. Figure 4 shows such a construction in which the ring 32 is formed with shoulders 56 and 57 adapted to bear against the heads 28 and 29 respectively. Whatever the design, it will in general be desirable to make the upper cylinder head removable so that the piston packing can be readily inspected or renewed. While the design of the parts making up the mechanism of this invention can be considerably varied, the substitution of the rotary piston motion for the longitudinal piston motion heretofore employed for operating the turbine gates will be retained and will permit the large number of moving parts heretofore used in turbine operating mechanisms to be considerably reduced, and the mechanism to be materially simplified.

The packing members 44, 44′ cut down the leakage and may be made of hard packing such as metal or lignum-vitae or of a soft packing 54 as indicated in Fig. 3. In the modification shown in this figure the packing 54 is held in place by the adjustable side clamp 55.

I claim:—

1. A turbine having a shaft, a rotary motor surrounding said shaft and control mechanism for said turbine adapted to be actuated from said motor.

2. In a turbine, controlling means therefor, a ring surrounding the turbine shaft for actuating said controlling means and an actuating motor for said ring located inside the ring.

3. A turbine having an upper distributor plate means for controlling said turbine and a motor adapted to actuate said means, said motor being located within the outer radial limits of said distributor plate.

4. In a hydraulic turbine, a series of wicket gates around the turbine, an annular cylinder around the turbine shaft, one curved wall thereof being fixed and the other movable around the shaft and connected with said gates, a piston across the cylinder carried by the movable wall, an abutment carried by the fixed wall, and means to apply fluid pressure between said abutment and piston to move said movable wall and thereby adjust the gates.

5. In a hydraulic turbine, a series of wicket gates around the turbine and hydraulic operating mechanism therefor placed around the turbine shaft within the outline of said gates.

6. In a hydraulic turbine the combination with a series of wicket gates around the turbine, of operating means therefor comprising an annular cylinder around the turbine shaft and a piston therein, and connections from said operating means to said gates.

7. In a hydraulic turbine the combination with a series of wicket gates around the turbine, of operating means therefor comprising an annular cylinder around the turbine shaft and a plurality of pistons therein, and connections from said operating means to said gates.

8. In a hydraulic turbine, a series of wicket gates around the turbine, respective shafts for said gates, a member extending around the turbine shaft and connected to said gate shafts, and hydraulic means within said member to rotate the same to adjust the gates.

9. In a hydraulic turbine, a series of wicket gates around the turbine, respective shafts for said gates, a member extending around the turbine shaft and connected to said gate shafts, and hydraulic means within said member to rotate the same to adjust the gates comprising an annular cylinder adjacent to said member, and a piston therein rigidly connected to said member.

10. In a hydraulic turbine the combination with a series of wicket gates around the turbine having respective shafts, of a member extending around the turbine shaft and connected to said gate shafts, hydraulic means within said member to rotate the same to adjust the gates comprising a fixed cylindrical shell within said rotatable member, annular heads to complete the enclosure of the space between said member and shell, and a piston and an abutment carried by said member and shell respectively.

11. In a hydraulic turbine, a series of wicket gates around the turbine, a fixed cylindrical shell coaxial with the turbine, outwardly extending annular heads carried by said shell, an outer cylindrical shell fitting against the outer edges of said heads and rotatable around said inner shell, an abutment and a piston carried respectively by said shells between them, and operating connections from said outer shell to said gates.

12. In a hydraulic turbine, a series of wicket gates around the turbine, a fixed cylindrical shell coaxial with the turbine, outwardly extending annular heads carried by said shell, an outer cylindrical shell fitting against the outer edges of said heads and rotatable around said inner shell, an abutment and a piston carried respectively by said shells between them, operating connections from said outer shell to said gates, and annular chambers enclosing the joints between the heads and the outer shell to receive leakage through said joints from within the space between the shells.

13. In a hydraulic turbine, a series of wicket gates around the turbine, a fixed cylindrical shell coaxial with the turbine, outwardly extending annular members carried by said shell, an outer cylindrical shell formed with surfaces adapted to bear against the surfaces of said annular members, said outer shell being rotatable about said first named shell, an abutment and a

piston carried respectively by said shells between them and operating connections from said outer shell to said gates.

14. In a hydraulic turbine, a series of wicket gates around the turbine, a fixed cylindrical shell coaxial with the turbine, outwardly extending annular heads carried by said shell, an outer cylindrical shell fitted against outer cylindrical faces of said heads and rotatable around said first named shell, an abutment and a piston carried respectively by said shells between them and operating means from said outer shell to said gates.

LEWIS FERRY MOODY.