J. WILKINSON.

CONTROLLER MECHANISM FOR TURBINES.

APPLICATION FILED OCT. 12, 1911.

1,021,226. Patented Mar. 26, 1912.

Fig. 1.

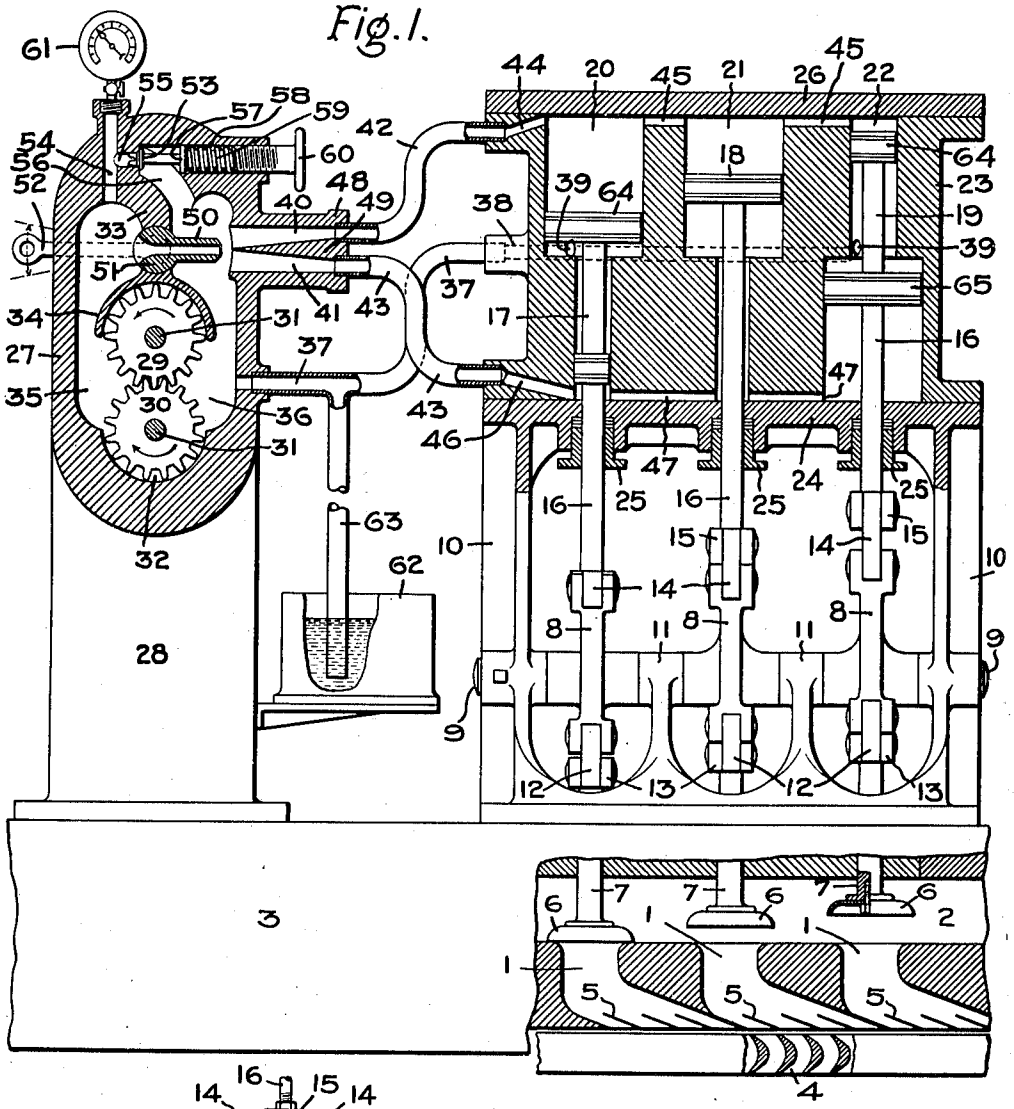


Fig. 3.

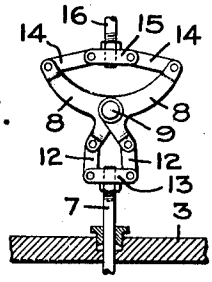
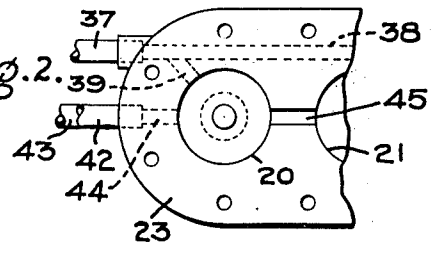


Fig. 2.



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UNITED STATES PATENT OFFICE.

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CONTROLLER MECHANISM FOR TURBINES.

1,021,226. Specification of Letters Patent. Patented Mar. 26, 1912.

Application filed October 12, 1911. Serial No. 654,384.

To all whom it may concern:

Be it known that I, JAMES WILKINSON, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Controller Mechanisms for Turbines, of which the following is a specification.

My invention relates to improvements in controller mechanism for elastic fluid turbines wherein a plurality of separate valves are operated to open and close nozzles by the action of hydraulic pressure under the control of a governor or hand actuated device.

It is one purpose of my invention to utilize hydraulic pressure, preferably that of oil, for actuating a series of small motors, connected to turbine valves through power increasing devices, by means of which but small power is required of the motors to force the valves, with considerable pressure, against their seats or to open them against the pressure when unbalanced. Oil or other liquid, by reason of its inelasticity, responds more directly and positively to the control of the governing devices, than steam or other elastic fluids, thus making the regulating mechanism for the turbine more sensitive and efficient.

It is a further object of my invention to provide a simple and powerful force pump, preferably a gear pump, for forcing the oil or other liquid through a controller device, here shown as a nozzle, which discharges the liquid under pressure into one or the other of two controller conduits which lead to a plurality of independent valve motors.

My present invention constitutes an improvement over the controller mechanism described in Letters Patent No. 753,773, issued to me March 1st, 1904, in that the governing device controls the pressure of the valve actuating fluid on both sides of the differential motor pistons. By this means I dispense with the dead head of pressure under the pistons and maintain a circulation of all the controller fluid which is of particular advantage where steam is used, as it reduces condensation.

My invention further contemplates the provision of a resilient valve adapted to be operated by the use of powerful leverage devices between the fluid motor and valve, which devices will act in a manner to retard the travel of the valve at the point of seating and to hold it under such compression against its seat as to keep the latter properly polished and to prevent wear due to leakage of the motor fluid between the valve and its seat.

My invention further comprises the details of construction and arrangement of parts hereinafter described and illustrated in the accompanying drawings, in which:—

Figure 1, represents a turbine in partial side elevation, the casing being broken away to show a set of nozzle passages with their controlling valves. The controller mechanism for the valves is shown, in vertical sectional view, mounted on the turbine; Fig. 2, is a top plan view broken away of the valve motor casing with its top plate removed, and Fig. 3, is a side view of the toggle mechanism.

Similar reference numerals refer to similar parts throughout.

I have shown my invention applied to an axial flow turbine of the impact type, wherein a series of nozzle passages 1 lead from a supply passage 2 in the head 3, and discharge fluid pressure at an angle against a bucket wheel 4. These nozzles may be provided with director plates 5 in their discharge ends. I provide a separate resilient valve for each nozzle passage comprising a spring cup 6 secured to a valve stem 7 and adapted to completely cover the nozzle entrance when closed. These valve stems 7 project through suitably packed openings in the supply head 3 and are connected each to a separate double toggle, operated by a fluid motor.

The toggle actuating mechanism for each valve comprises a pair of oppositely disposed bell crank levers 8 journaled upon a common axis 9 supported rigidly in a frame 10, that is provided with bearings 11, between which the several bell crank levers are mounted. These levers are connected at their lower ends through toggle links 12 to cross heads 13 connected to each of the valve stems 7. At their upper ends the levers 8 are similarly connected by toggle links 14 to cross heads 15 fixed to the lower ends of stems 16, which are connected to the valve actuating pistons 17, 18 and 19.

The motors for operating the several valves comprise cylinders 20, 21 and 22,

formed in a casing 23 mounted upon and rigidly secured to a plate 24 integral with the frame 10. Through this plate the several stems 16 pass, packing glands 25 being provided to prevent the leakage of fluid from the cylinders above. The plate 24 forms the lower ends of the several motor cylinders, their upper ends being formed by a plate 26 secured to the top of the casing 23. It being the purpose to illustrate my invention in its simplest form, a series of differential cylinders and pistons are shown which, being subjected to a gradually varying controlled pressure will successively open or close the valves. Three cylinders are shown, the first cylinder 20 as representing the extreme at one end of the series, the cylinder 21 as representing the middle cylinder of the series and the cylinder 22 as representing the other extreme of the series. It will be evident that between the cylinders 20 and 22 and the middle cylinder, any desired number of other differential cylinders of gradually varying proportions may be used. According to my present invention therefore the controller mechanism may be elaborated to control any desired number of turbine valves.

The controller mechanism for the series of valve actuating motors comprises a casing 27 mounted as for example upon standards 28 on the supply head of the turbine, and provided with an inner chamber in the lower portion of which are mounted two intermeshing gears 29 and 30 supported on shafts 31 and adapted to be driven in reverse directions by any suitable power means and in any desired manner. The lower portion of the casing is grooved at 32 and provided with a semi-circular chamber struck on an arc from the axis of the gear 30, and the upper part of the casing is divided by a transverse partition 33, which is formed with a concave flaring portion 34 having a curved under face which is struck on an arc from the axis of the upper gear 29. The partition 33 together with the gears divide the interior of the casing into a pressure chamber 35 and a suction chamber 36. The chamber 36 communicates with a conduit 37, that extends to the motor casing 23 and communicates with a longitudinal passage 38 therein. This passage through the short by-passages 39, communicates with each of the two end cylinders 20 and 22 at an intermediate point. The controller casing is provided with two discharge ports 40 and 41 opening into the upper end of the pressure chamber 36, and communicating respectively with conduits 42 and 43 which lead to the motor casing. The conduit 42 communicates through a port 44 in the motor casing with the upper end of cylinder 20, and this cylinder in turn is in communication with the upper ends of the several other cylinders of the series through passages 45. The other conduit 43 communicates through a port 46 with the lower end of the cylinder 20 and passages 47 serve to establish communication between the lower ends of the several cylinders of the series. Ports 40 and 41 are formed in an extension 48 of the controller casing, being separated by a tapering tongue 49, which at its inner end is brought to a sharp point so that it forms practically a knife edge division between the two ports where they open into the chamber 35. The purpose of this construction will be apparent when it is considered that the liquid, with which the controller casing and the several conduits and cylinders are filled, will be forced by the gear pump into the chamber 35 at relatively high pressure, and from this chamber its only normal outlet is through a movable nozzle 50, rotatably mounted in the partition 33 and disposed so as to discharge the liquid flowing therethrough into one or the other or both of said ports 40 and 41 according to its position relative thereto. The nozzle has a circular head 51 which is mounted in curved seats in the partition, and capable of a limited oscillating movement therein. The nozzle is provided at one end with an operating lever 52 which may be connected to a governor of any desired construction or operated by hand. A relief valve 53 is provided to establish communication between the two chambers in the casing through a passage 54, port 55 and passage 56. The purpose of this shunt passage is to prevent the pressure in chamber 35 from becoming too great. The valve 53 is preferably of the puppet type having a collar 57 disposed in a chamber 58 formed in the controller casing. I insert a spring 59 in the chamber 58 between the collar on the valve and an adjusting screw 60, by means of which the valve may be adapted to open at any desired pressure. The passage 54 leading from the pressure chamber 35 continues through the casing and communicates with a pressure gage 61 by means of which the pressure of the liquid in chamber 35 is indicated.

To provide for the displacement of liquid by the action of pistons in the several cylinders I provide a reservoir 62 suitably supported from the standards 28. A pipe 63 communicating with the conduit 37 enters this reservoir and extends to a point near the bottom thereof.

The operation of the mechanism is as follows: Having introduced the desired quantity of oil, alcohol or any other desired liquid into the motor cylinders and controller casing, and assuming the several valves to be closed, upon starting the rotation of the gears in the direction of the arrows, they will operate in the well known

manner as a gear pump to force the liquid under high pressure into the chamber 35. Assuming now that the nozzle is moved to a position opposite the port 40, the liquid flowing through the nozzle under high pressure will be forced into said port and through the conduit 42 and passages 44 and 45 into the upper ends of the several cylinders tending to hold the pistons down and the valves attached thereto closed. The pressure above the several pistons is created and maintained by the impact of the jet of fluid flowing through the adjustable nozzle 50. Since the impact effect of the fluid will not take place in the port 41, the suction effect of the pump will practically draw off fluid from below the pistons causing them to be held in their lowered position by a pressure substantially equivalent to that indicated by the gage 61. As the controller nozzle is lowered the impact effect of the jet of fluid in the port 40 is decreased and that in the port 41 increased until the effective pressure above the head 64 of the piston in cylinder 22 becomes inferior to the pressure existing below the head 65 of said piston, when the latter will move to the position shown in the drawings and open a supply nozzle. The other pistons, however, will remain in their lowered position until the gradually increasing pressure below them will cause them to move upward. It will be clear that any desired number of pistons may be controlled in this successive manner. All leakage between the differential heads of the compound pistons is drawn off through the by-passages 39 and conduit 37, so that it is unnecessary to have the pistons fit pressure tight in their cylinders. The effect upon the total volume of controller fluid due to the displacement of the differential pistons in their different operating positions, is compensated by the reservoir 62 which receives the surplus liquid or gives the same back into circulation as occasion may require.

It will be evident that the use of an incompressible fluid to actuate the several controller pistons will give a more direct and positive action than where steam or other elastic fluid is used. And further, there will be no loss by reason of condensation, nor will there be danger of the motors sticking. In fact the small power required to actuate the gear pump and the absence of any loss or waste in the actuating fluid makes this apparatus much more efficient and economical than those in which steam or other elastic fluid is utilized.

The motor cylinders and pistons may be designed to produce any desired valve action, and, while designed for use with hydraulic pressure obviously, in-so-far as certain features of my invention are concerned, any other kind of pressure fluid may be used. Also there may be as many groups of valves as may be desired.

The operating mechanism for the resilient valves 6 will move the latter toward a closed position with increasing power and decreasing speed as the angles between the links 12 and between the links 14 vanish. These devices act thus to compound the leverage and to increase the power of the fluid motor to hold the valves against their seats over the admission ends of the nozzles. This permits of the use of smaller fluid motors and hence less power is required of the gear pump. The compression exerted on the valves when seated causes them to yield sufficiently to insure a polishing of their seats and to prevent leakage. The combined action of the toggle press and resilient valve will be to reduce the tendency of the valve to hammer its seat and will also reduce the wear and strain on the toggle joints and lever bearings.

In accordance with the provisions of the patent statutes, I have described the principle of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is,

1. In a governing mechanism for turbines, the combination of a plurality of pistons operatively connected to turbine valves, serially connected cylinders therefor, means to conduct fluid under pressure from a controller chamber to both ends of said cylinders, and a controller nozzle for said fluid pressure coöperating with said means and acting to vary the pressure in said cylinders.

2. In a governing mechanism for turbines, the combination of a plurality of pistons operatively connected to turbine valves, cylinders for said pistons, conduits serially connecting the corresponding ends of said cylinders, and a fluid pressure controller means which regulates the pressure in both ends of said cylinders and thereby controls the movements of the pistons therein.

3. In a governing mechanism for turbines, the combination of a plurality of pistons operatively connected to turbine valves, cylinders for said pistons which are serially connected at their corresponding ends by passages, and a fluid pressure controller mechanism which raises the pressure in one end of the cylinders through one series of passages while it lowers the pressure in the opposite end of the cylinders through the other series of passages.

4. In a turbine, the combination of a nozzle acting to direct fluid pressure against a bucket carrying element, a valve for said nozzle, a fluid actuated motor for said valve,

and a controller mechanism utilizing a liquid under pressure to operate said motor which comprises a force pump, a controller nozzle, and means to conduct said liquid under pressure to said motor.

5. A governing mechanism for turbine valves comprising a pressure chamber, a pump to force liquid therein, a movable nozzle to discharge a liquid jet from said chamber, one or more conduits into which said jet may be discharged, and means for operating turbine valves that communicate with said conduit or conduits.

6. In a liquid pressure governing mechanism for turbine valves, the combination of a controller chamber divided into compartments, a gear pump to force the liquid from one compartment into the other, a nozzle to discharge a jet of liquid under pressure into one or more conduits through which the fluid pressure acts to move the turbine valves, and means to return the liquid to said controller chamber.

7. In a governing mechanism utilizing hydraulic pressure, the combination of a plurality of compound cylinders, differential pistons therein operatively connected to valves, ports for admitting fluid under pressure to both ends of said cylinders, means to control and vary the pressure of the fluid admitted through said ports, and a third set of ports through which the liquid leaking past the piston is returned to the main body of fluid.

8. In a governing mechanism for turbines, a plurality of valves, motors for operating said valves, and toggle levers transmitting motion from said motors to said valves, two or more of said levers being mounted on a common axis.

9. A governing mechanism for turbines comprising standards carried by the turbine, motors supported by said standards, turbine valves, and a plurality of devices for transmitting motion from said motors to said valves which are pivotally supported by said standards.

10. A governing mechanism for turbines comprising a fluid containing casing, a pair of intermeshing gears serving as a pump therein, a partition which, with said gears, divides the interior of the casing into two chambers, a device to control the flow of fluid from the chamber into which it is forced by said pump, a relief valve to establish communication between said chambers, and conduits to conduct the fluid pressure under the control of said device to operate turbine valves.

11. In an operating mechanism for a turbine valve, a motor frame connected to the turbine, leverage devices journaled in said frame, a motor supported by said frame and swivelly connected to said leverage devices, and means to operate said valve through the instrumentality of said leverage devices.

12. In an elastic fluid turbine, the combination of a nozzle passage adapted to discharge fluid pressure against a rotatable element, a resilient cup shaped valve adapted to seat over the admission part of said nozzle passage, and toggle means to operate said valve with only full open and closed positions.

13. In an elastic fluid turbine, the combination of a nozzle passage adapted to discharge fluid pressure against a rotatable element, a resilient valve therefor, an actuator, and power transmission means between said actuator and valve which retards the movement of the latter as it seats and increases the power of the former to force the valve against its seat.

14. In an elastic fluid turbine, the combination of a steam chest, a nozzle passage leading therefrom and adapted to discharge motive fluid into the turbine, a valve in the form of an inverted resilient cup adapted to seat over the admission end of said nozzle, a stem for said valve which passes through an opening in said steam chest, and a fluid motor mounted on the turbine and connected to said valve, substantially as described.

15. In an elastic fluid turbine, the combination of a supply head therefor, a steam supply chamber in said head, a nozzle passage leading therefrom into the turbine, a resilient valve adapted to seat over the nozzle entrance, a fluid actuated motor connected to the turbine, a piston therein which reciprocates in line with the movements of said valve, and leverage connections between said piston and valve, whereby the latter is given a variable speed of movement and is placed under powerful compression when seated.

In witness whereof, I have hereunto set my hand this 10th day of October, 1911.

JAMES WILKINSON.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.

BEST AVAILABLE COPY