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J. WILKINSON.

TURBINE VALVE MECHANISM.

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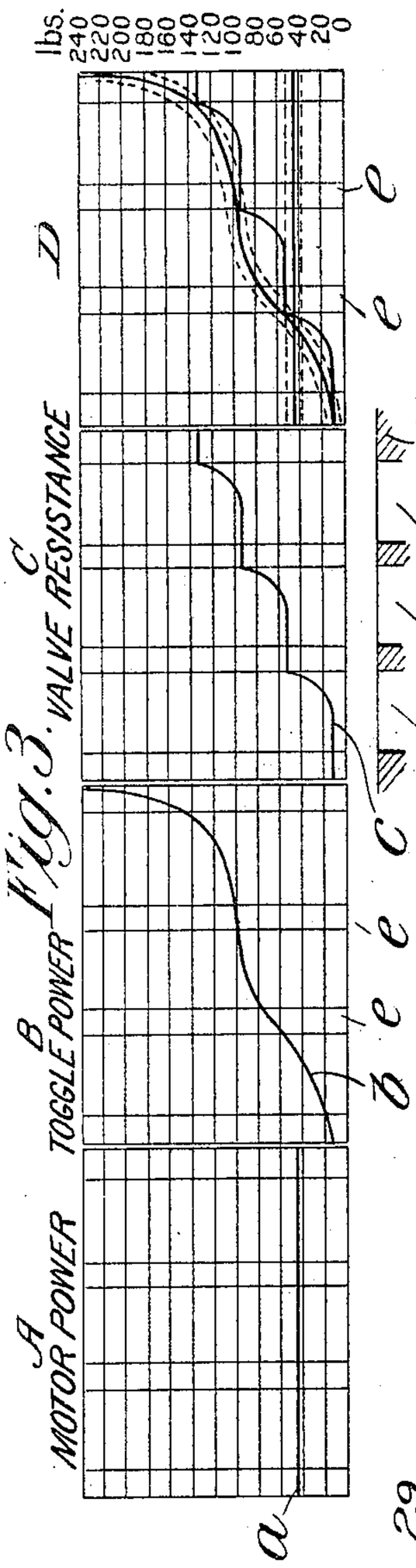

Fig. 3.

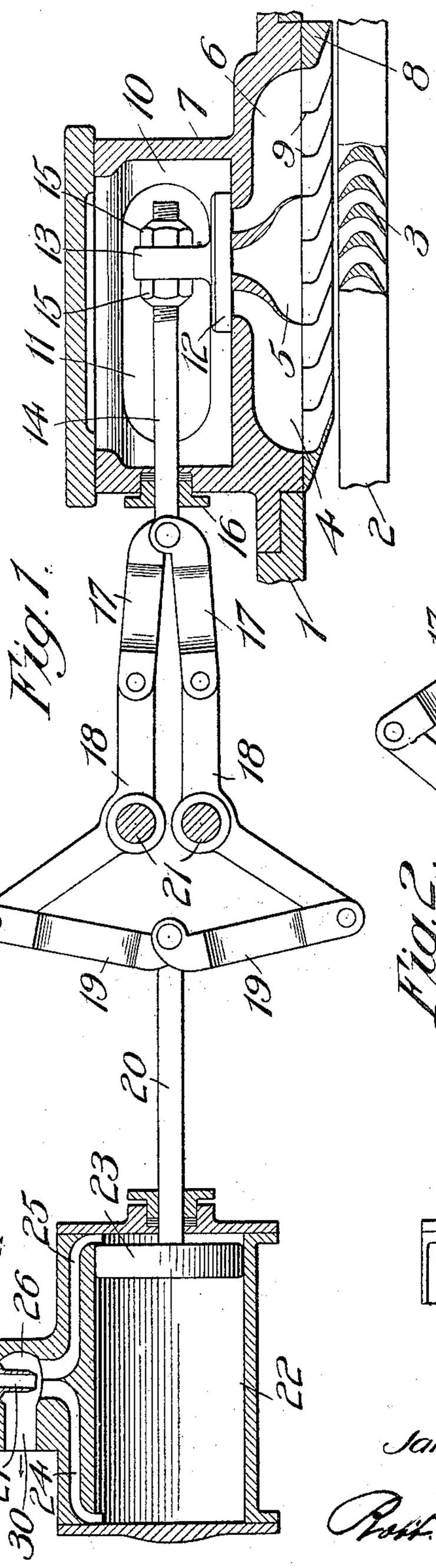

Fig. 1.

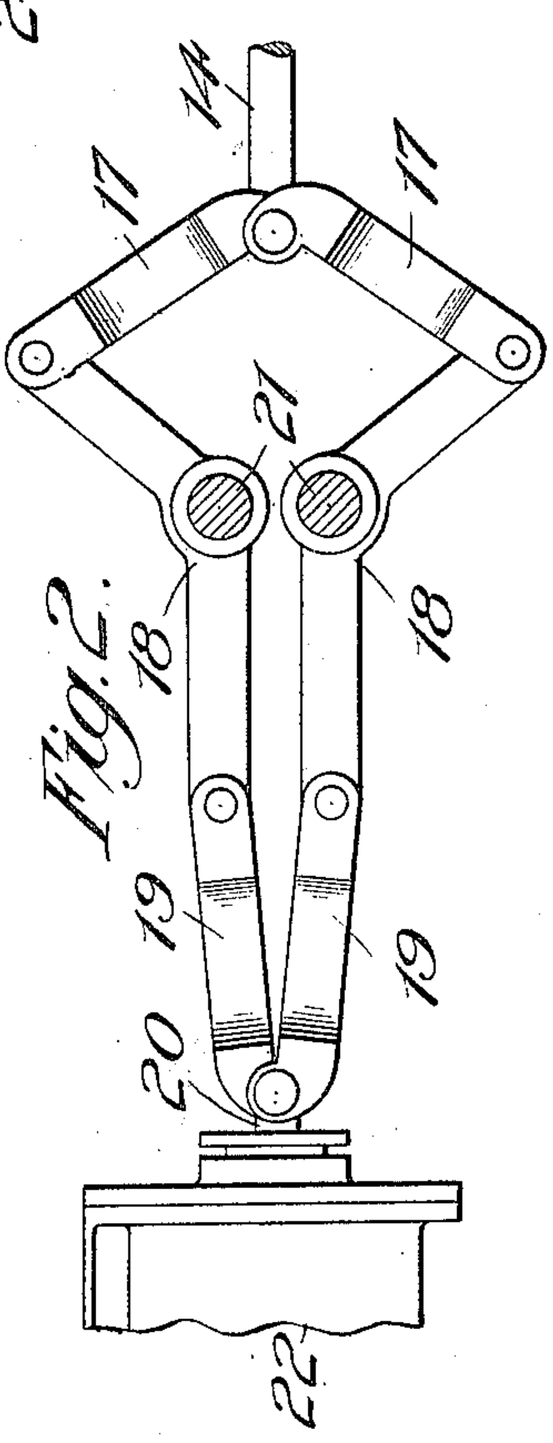

Fig. 2.

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TURBINE VALVE MECHANISM.

No. 803,041. Specification of Letters Patent. Patented Oct. 31, 1905.

Application filed April 8, 1905. Serial No. 254,482.

To all whom it may concern:

Be it known that I, JAMES WILKINSON, a citizen of the United States, residing at Birmingham, in the county of Jefferson and State of Alabama, have invented new and useful Improvements in Turbine Valve Mechanism, of which the following is a specification.

My invention relates to controller mechanism for elastic-fluid turbines.

Where turbines have been provided with a plurality of admission-nozzles, it has been found that a more efficient action of the motor fluid is obtained when a separate valve, designed to have only open and closed positions, is provided for each of the nozzles. The purpose of this is to overcome the objections encountered in the prior practice, where a single valve was adapted to control a number of ports, which objections consisted principally in the wire-drawing action of the valve when partially closing one of the nozzle-ports and in the difficulty of operating the valve in the case of turbines of large power having high initial steam-pressures, so that it would respond relatively to the movement of the governor throughout its travel. The necessity for providing independent motors and valves for each nozzle complicates the controller mechanism and increases the cost of construction. If substantially the same controlling action can be secured by the use of one or more valves, each of which controls a plurality of nozzles, the advantages of such a construction will be obvious. With this object in view I provide an improved valve mechanism illustrative of my present invention adapted to control a plurality of separate nozzles, which will to a large extent avoid the objections encountered in the previous practice above referred to. This mechanism comprises any desired form of valve, preferably a slide-valve and an actuating mechanism therefor, which with a constant initial power is capable of increasing this power as applied to moving the valve over the several ports it controls in a manner to compensate the increasing resistance of the valve as it becomes more and more unbalanced. The actuating mechanism employed in its preferred form consists of a cylinder in which the pressure is varied by the impact action of a fluid-jet under the control of a nozzle and of a toggle-transmission means interposed between the valve and its motor; but inasmuch as the application of a similar fluid-motor and toggle device for actuating valves adapted to control single nozzles has been shown and claimed in a pending application it is my purpose in this application to secure and protect the advantages derived from such an actuating mechanism when applied to moving a valve over a plurality of ports. A further advantage which is gained by this construction is that the tendency of the valve-actuating mechanism will be opposed to holding the valve in wire-drawing positions over any one of the nozzle-ports under its control, for the reason that the valve resistance due to its unbalanced condition and friction is due to equal or slightly exceed the toggle-power at points where more or less of the nozzles are fully closed, whereas when the valve attempts to occupy wire-drawing positions the toggle-power, which increases in a substantially constant ratio, exceeds the valve's resistance, which does not increase materially during its movements in opening or closing a port, thus causing the valve to have a tendency to stop between ports and to move back and forth over the critical port with an action similar to the intermittent operation of the critical valve in the case where a plurality of independent governor-controlled valves are utilized.

According to the drawings, in which I have illustrated a preferred form of my invention, Figure 1 illustrates a partial section through the supply-head of a turbine, showing the nozzles and bucket-wheel in section and the valve and its actuating mechanism in side elevation, the motor and controller device being shown in section. Fig. 2 illustrates the transmission mechanism in a different operating position from that shown in Fig. 1. Fig. 3 is a compound chart illustrating by lines and curves the power of the motor, the variable power exerted by the valve-actuating mechanism, the variable valve resistance, and the combined chart of the several lines and curves.

Similar reference-numerals refer to the same parts throughout.

My invention, which is applicable to any type of multiple-nozzle turbine, is shown applied to an axial-flow impact-turbine having a supply-head 1 and a bucket-wheel 2, provided with buckets 3, against which fluid-pressure is discharged through nozzles 4, 5, and 6, formed in a casing 7, secured to the head. The admission-ports of the several nozzles are arranged closely together, and their discharge ends are formed in a detachable block 8, also secured to the head and provided with direc-

tor-plates 9. The casing 7 is formed with a valve-chest 10, to which the motor-fluid pressure is admitted through a port 11. A slide-valve 12 moves over the several nozzle-ports and is provided with a shoulder 13, to which a valve-stem 14 is connected by nuts 15. The valve-stem 14 projects through one end of the casing, being suitably packed by a gland 16. To the outer end of the stem is pivotally connected a pair of toggle-links 17, which in turn are swivelly connected to a pair of toggle-levers 18. Links 19 connect the outer ends of the levers to the piston-rod 20. The two levers 18 are pivotally mounted upon two fixed journals 21. If desired, they may be mounted upon the same journal.

The motor for actuating the valve comprises a cylinder 22, a piston 23, to which the stem 20 is connected, and two passages 24 and 25, leading from opposite ends of the cylinder to a controller-chamber 26. A controller-nozzle 27 is disposed above the admission ends of the passages 24 and 25 and acts to direct the fluid-pressure entering the controller-casing through the port 28 into one or the other, or both, of said passages. The jet of fluid-pressure acts with impact effect to create and maintain pressures at the opposite ends of said cylinder, and by moving the nozzle 27 by means of a lever 29 so that the impact of the jet takes more effect in one or the other of said passages pressures of different degrees will exist in ends of the cylinder and will unbalance the piston 23, causing the same to be moved by a power equivalent to the differential between the pressures and through the transmission means to move the valve with an increased power to open or close more or less of the nozzle-ports. The controller-fluid pressure is conducted from the controller-chamber through port 30, from whence it may be conducted to any desired point of use.

In describing the operation of my invention reference will be made to Fig. 3, in which line *a* in chart A represents the difference in the pressure on opposite sides of the piston 23, which will be provided by the fluid-jet, as directed by the nozzle in Fig. 1. The position of the controller-nozzle determines this pressure, which may be raised or lowered on either side of the piston to any desired point. The slight movement of the controller-nozzle, due to the action of the governor responsive to small speed variations, will have a tendency to cause the cylinder-pressure to slightly rise and fall. Chart B by the line *b* indicates the curve of the toggle-power applied to move the valve, which power increases and augments the motor's power as the angles between the links 19 and between the links 17 and the toggle-levers vanish. This action is more fully described in a pending application. Chart C by line *c* indicates the valve-resistance curve, it being noted that the resistance of the valve increases by steps, which is due to the fact that its unbalanced condition increases with the number of ports held closed. Below this chart C is shown the several admission-ports for the nozzles 4, 5, and 6 to illustrate their relation to the chart. In chart D the lines *a*, *b*, and *c* are shown combined. The toggle-power will rise and fall in correspondence with variation in the motor-power caused by oscillations of the controller-nozzle. These fluctuations of power represented by the lines *a* and *b* are indicated by dotted lines on the chart D. The valve-resistance curve, however, is constant. In considering chart D it will be noted that the resistance of the valve equals the power exerted on it by the toggle only at the points in its travel where it holds one or more of the nozzles closed. Between these points the toggle-power rises considerably in excess of the valve's resistance, as indicated by the parting of the lines *b* and *c* between the vertical columns *e*, which correspond in width with the division-walls between the nozzles. Slight fluctuations of pressure producing the change in the position of the toggle-power curve (shown in the dotted lines) will alternately bring this valve resistance above and below the toggle-power, and the valve will be moved slightly back and forth across a division-wall between the nozzles without governing effect. Under these conditions the valve will not assume a wire drawing position. If, however, the pressure on one side of the piston increases considerably above that on the other side, the valve will be moved across a nozzle-port; but by reason of the differential between its resistance and its actuating power its tendency while moving over a port will be to oscillate in a manner that will open and close a nozzle rather than to assume stationary positions in which it will wiredraw the nozzle. The controller-nozzle may be used to balance the pressure on both sides of the piston, and thus arrest its movement at any point in its travel.

The toggle-transmission means are designed to produce an increasing power in proportion to the increase of resistance of the valve, which enables the valve to respond with equal accuracy to the governor's regulation at all points in its travel.

The controller-nozzle may be operated by hand or by a governor, and it is my purpose to cover and protect in this application the use of a plurality of sets of nozzles and valve mechanism therefor, passages being employed for conducting the nozzle-controlled pressure to the several valve-cylinders, which being of varying dimension will respond successively thereto.

Having thus described my invention, what I claim as new, and desire to protect by Letters Patent, is—

1. In a turbine, a rotatable bucket element, a plurality of admission-ports discharging fluid-pressure against said element to ro-

tate it, a valve controlling the flow of fluid through said ports, a motor, and a variable-power-transmission means between said motor and valve.

2. In a turbine, a rotatable bucket element, a group of nozzles, a controller-valve therefor, a power device and a toggle for transmitting motion from said device to said valve to successively cut said nozzles into and out of service.

3. In a turbine, motor-fluid nozzles, a valve for successively cutting said nozzles into and out of service, means for operating said valve comprising a power device and a toggle-transmission means for augmenting the power of said device as applied to moving said valve, substantially proportionately with the increase of the valve's resistance.

4. In a turbine, a plurality of nozzles, a valve for successively cutting them out of service, a motor operatively connected to said valve, and fluid-pressure-impact-controller means for arresting the movement of said motor at any point in its travel.

5. In a turbine, a plurality of nozzles, a valve for successively opening or closing them, a motor comprising a cylinder and piston for operating said valve, and a controlling device utilizing the impact action of a fluid-jet to balance said piston at any point in its travel and unbalance it in either direction.

6. In a controller mechanism for turbines, a cylinder, ports leading from each end thereof to a fluid-controller chamber, a piston, a controller-nozzle utilizing the impact action of a fluid-jet to control the pressure in each end of said cylinder, a valve moved by said piston, and a plurality of nozzles which are successively opened or closed by said valve.

7. In combination, a fluid-motor, a piston therefor, controller means for the pressure in said cylinder adapted to balance said piston at any point in its travel, a turbine-valve for controlling a plurality of ports, and a toggle connecting said piston and valve, said toggle being designed to increase the power of the motor as applied to said valve, substantially in proportion to the increase of said valve's resistance at definite points in its travel.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

JAMES WILKINSON.

Witnesses:
A. R. FORSYTH,
WM. H. HURTER.