No. 775,106. PATENTED NOV. 15, 1904.

W. S. ELLIOTT.

ELASTIC FLUID TURBINE.

APPLICATION FILED MAR. 2, 1904.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

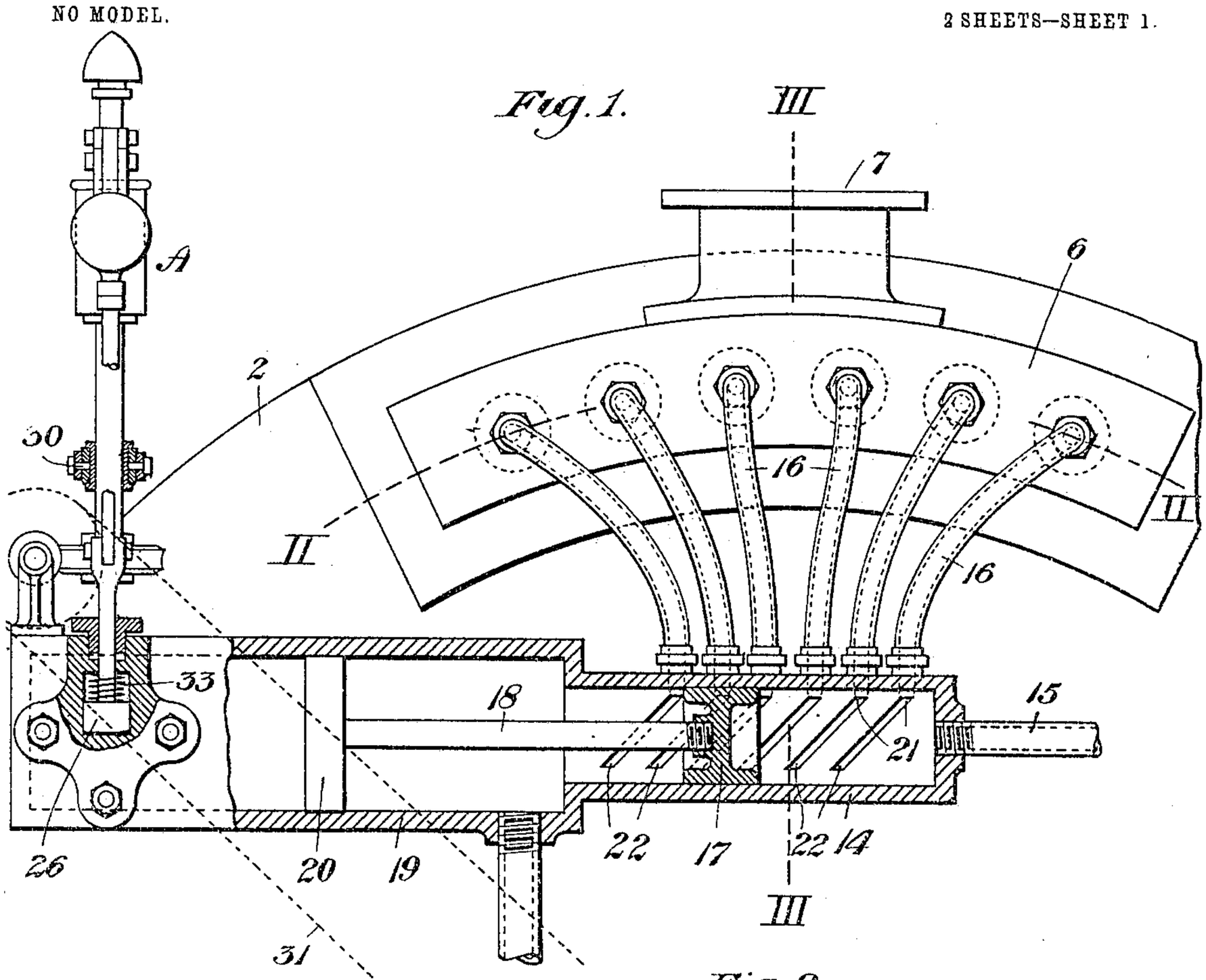
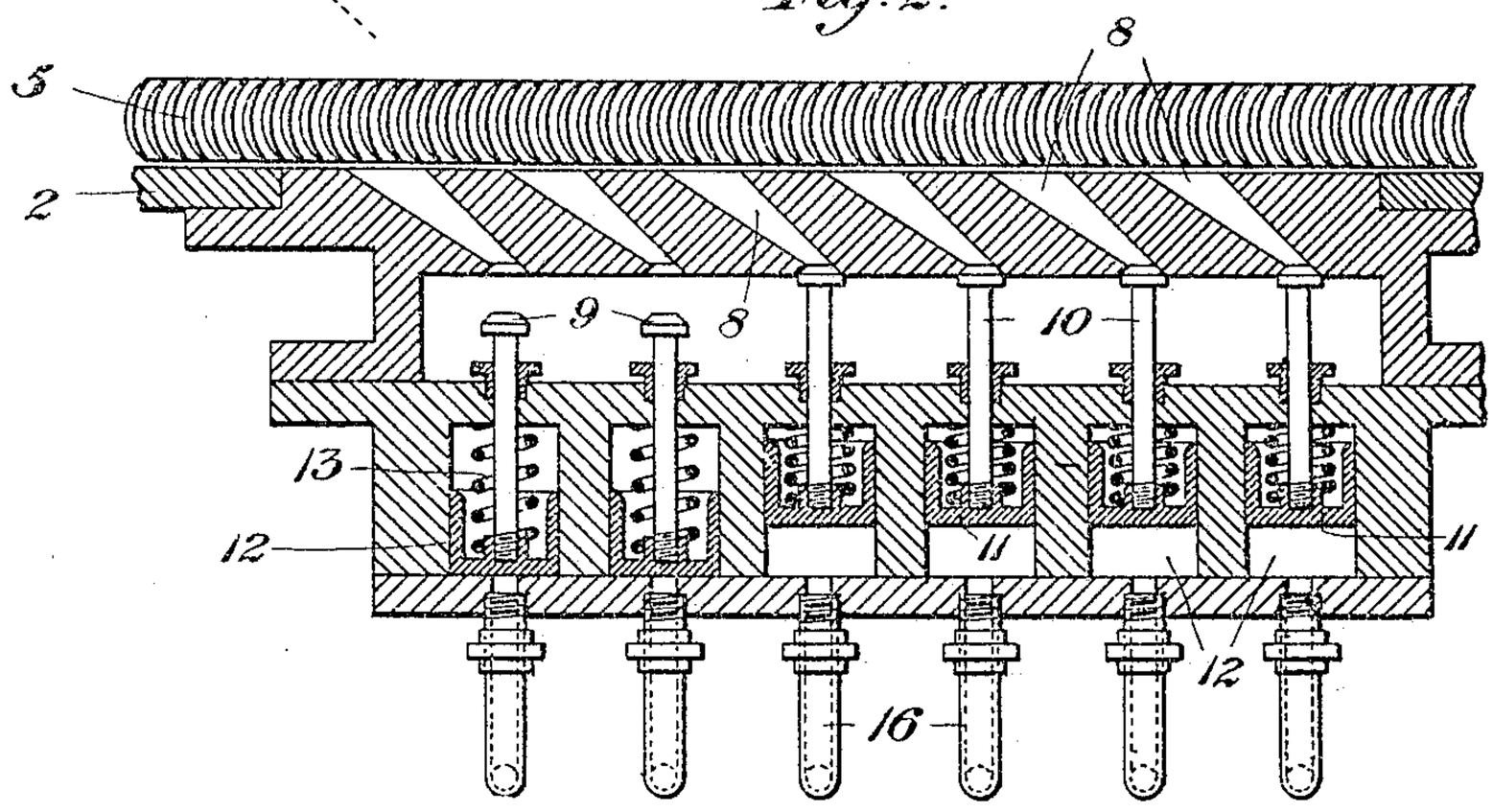


Fig. 2.



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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3

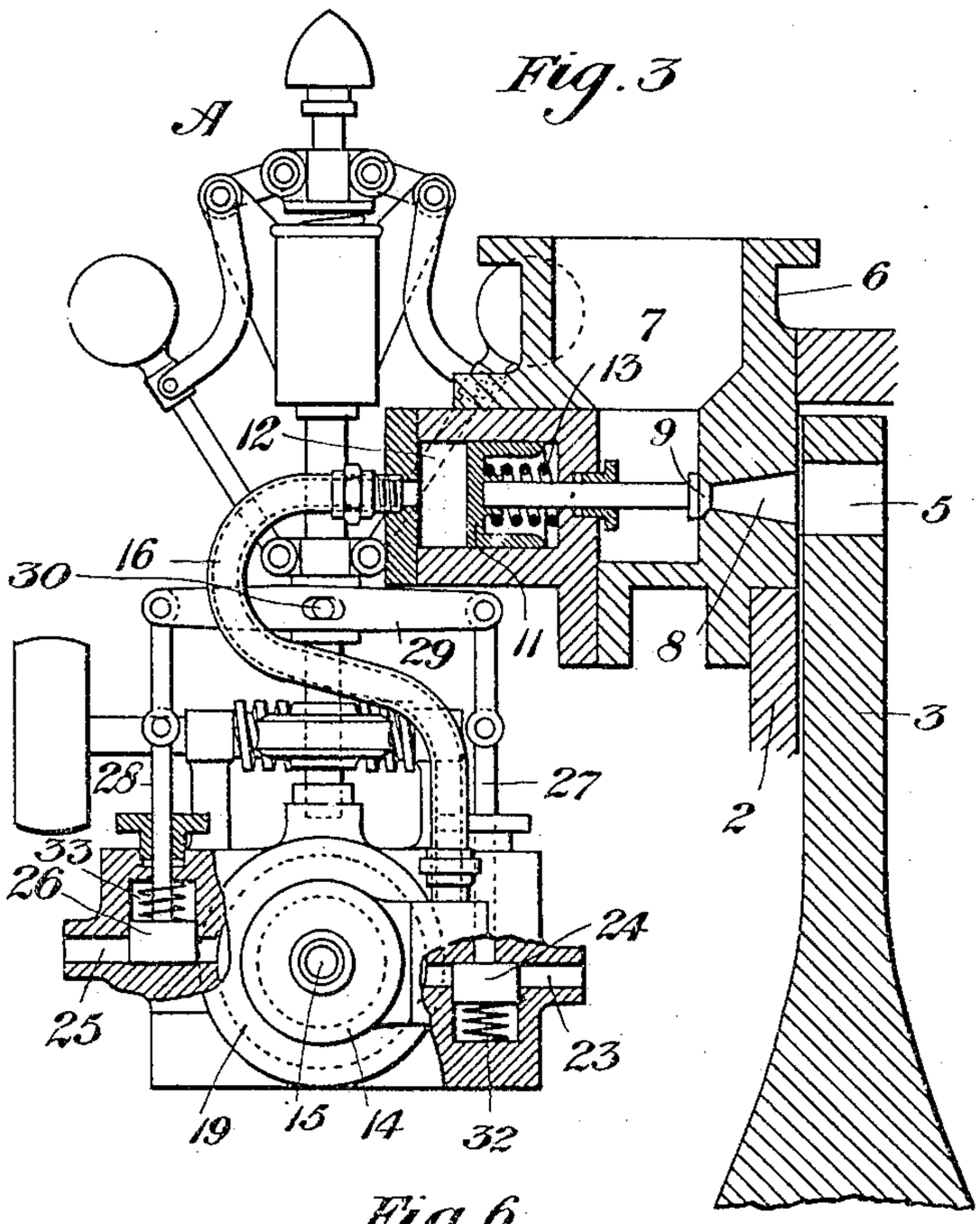


Fig. 6.

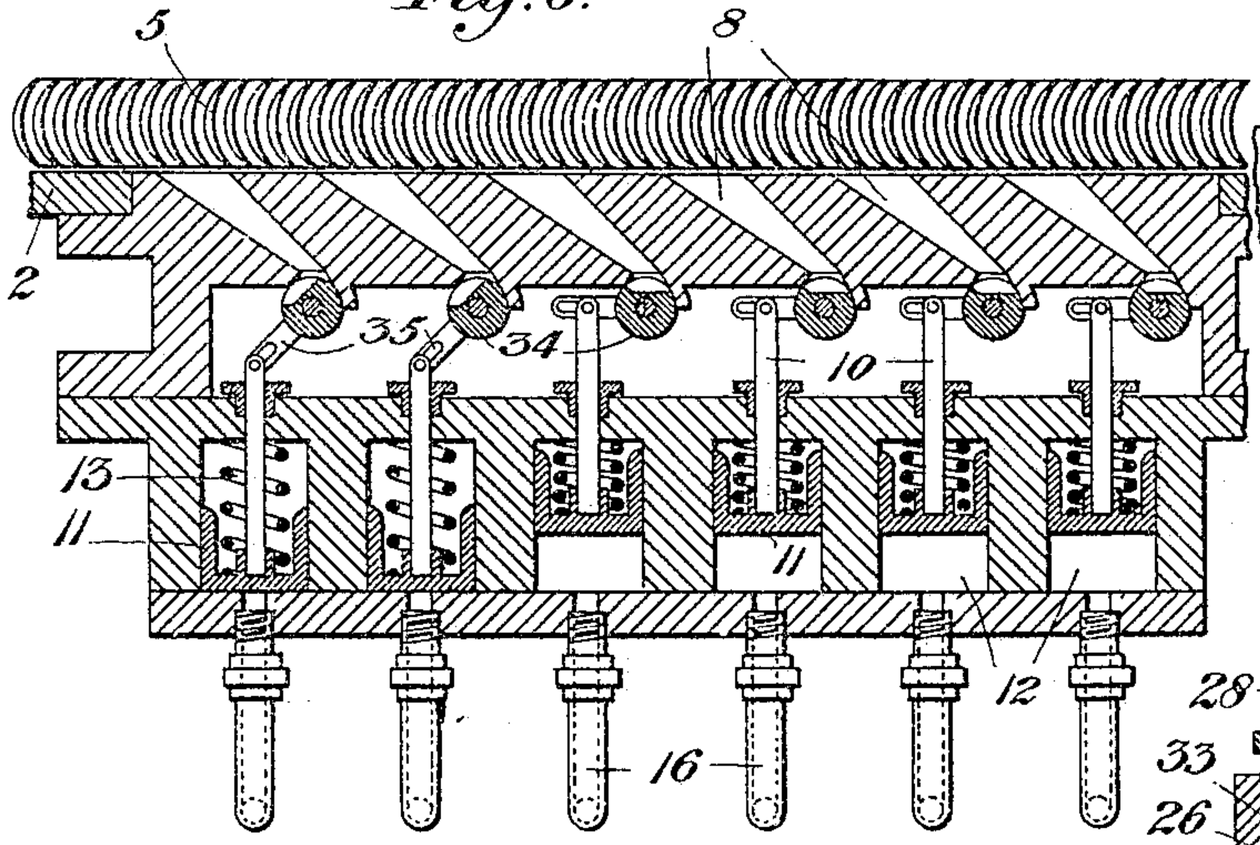


Fig. 4.

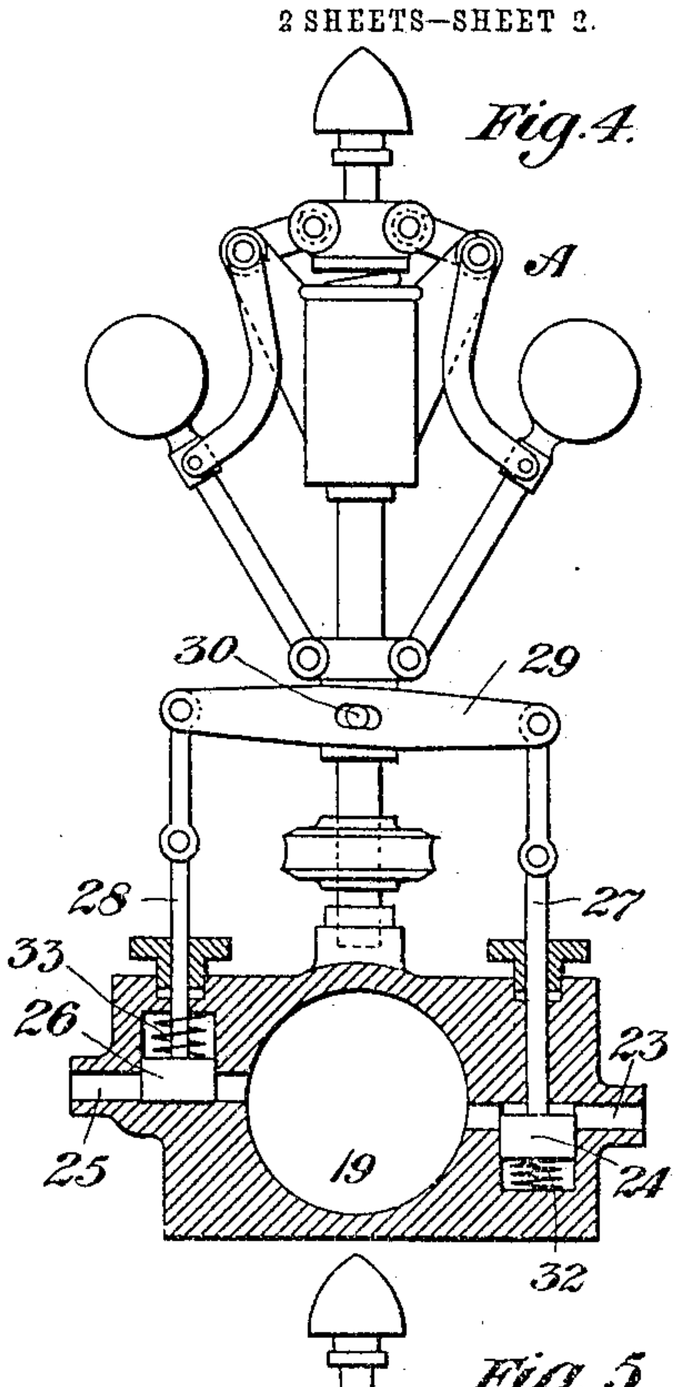
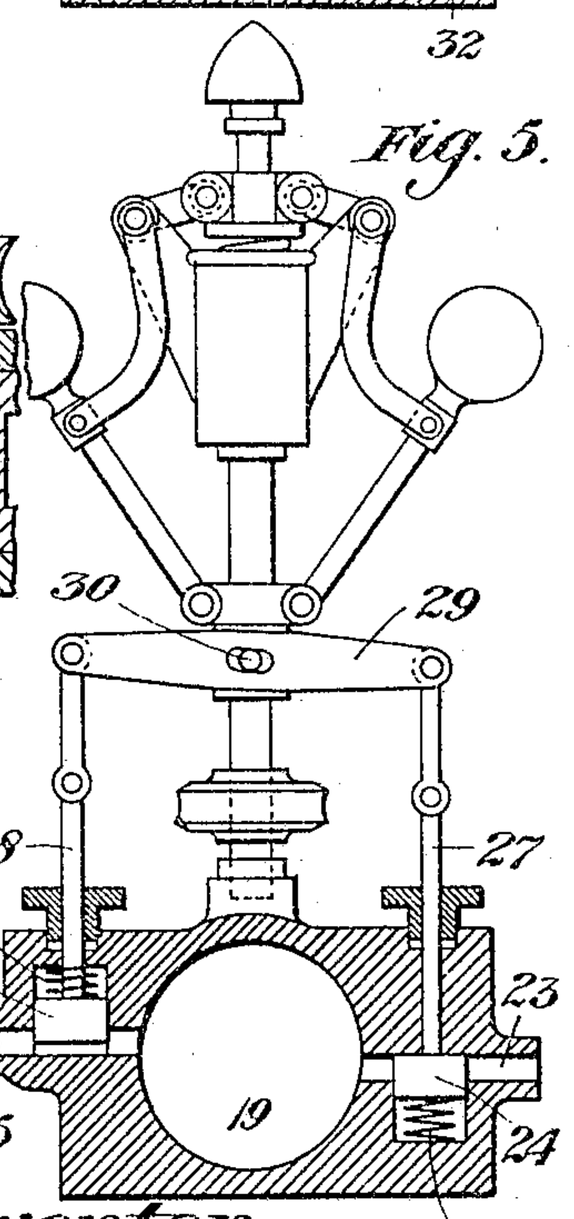


Fig. 5.



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No. 775,106. Patented November 15, 1904.

UNITED STATES PATENT OFFICE.

WILLIAM S. ELLIOTT, OF PITTSBURG, PENNSYLVANIA.

ELASTIC-FLUID TURBINE.

SPECIFICATION forming part of Letters Patent No. 775,106, dated November 15, 1904.

Application filed March 2, 1904. Serial No. 196,195. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM S. ELLIOTT, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Elastic-Fluid Turbines, of which the following is a specification, reference being had therein to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a partial end view of an elastic-fluid turbine provided with my improved governing apparatus. Fig. 2 is a horizontal sectional view taken on the arc-line II II of Fig. 1. Fig. 3 is a vertical sectional view indicated by the line III III of Fig. 1, portions of the valve-chambers being shown in section. Figs. 4 and 5 are detail sectional views through the inlet and outlet valves of the pressure-cylinder, showing different positions of said valve corresponding to varying positions of the governor. Fig. 6 is a view similar to Fig. 2, but showing a modified form of valve for admitting pressure to the nozzles.

The object of my invention is to automatically govern the speed of an elastic-fluid turbine so as to maintain uniform speed under varying loads. For this purpose I employ a governor, preferably centrifugal, to the moving portion of which I attach valve-actuating mechanism adapted to control the supply and exhaust to and from a cylinder within which is a piston-valve adapted to be shifted by variations in the pressure resulting from changes in the speed of the governor. The valve controls the fluid-supply to a plurality of pistons connected with a series of valves controlling the supply of fluid leading to the nozzles, which in turn deliver the fluid against the vanes of the turbine. The device is intended to regulate the supply of fluid to the turbine dependent upon the variations in its load and to maintain a resulting constant speed.

Referring now to the drawings, 2 is the shell or case of the turbine surrounding the wheel 3, mounted on the usual shaft and provided with the customary peripheral vanes 5.

6 is a fluid-inlet shell having a supply-passage 7 secured on the face of the case 2 to supply fluid through the various valve-controlled nozzles leading to the vanes of the turbine-wheel.

At intervals along the inner side of the shell 6 are a number of valve-seated nozzles 8, leading to the vanes 5, each of said nozzle-seats being provided with a valve 9, mounted on the inner end of stem 10, passing out through a stuffing-box in the front of the case. Each stem is provided with a piston 11 in cylinder 12, an interposed spring 13 being provided surrounding the stem 10, adapted to bear outwardly against the piston, so as to unseat the valve when pressure is relieved from the piston.

Means are provided by which pressure is applied to one or more of the pistons 11 as follows: Mounted in a suitable position is a cylinder 14, to which constant fluid-pressure is supplied by connection 15, while pipes 16 connect each of the cylinders 12 with the interior of the cylinder 14 and are adapted to supply constant pressure against such of the pistons 11 to which said constant pressure is maintained.

17 is a piston-valve mounted in cylinder 14 on the end of a stem 18, projecting into a supplemental cylinder 19 of a diameter or area greater than cylinder 14 and provided with a corresponding larger piston 20.

The inner ends of pipes 16 communicate with the interior of cylinder 14 by ports 21, through which the pressure from pipe 15 is communicated to the piston 11 when such inner ports 21 are uncovered by piston-valve 17. Communicating with such inlet-ports 21 either by a diagonal groove or by any other suitable passage are terminal ports 22, so located that when the inlet-ports 21 are covered by the advancing piston-valve 17 the ports 22 or the other end of the groove will become uncovered. By this construction the exhaust from cylinders 12 is delivered behind the piston-valve and escapes through exhaust-pipe connected with the cylinder.

Beyond the piston 20 the cylinder 19 is provided with an inlet-port 23, controlled by valve 24, and an outlet-port 25, controlled by valve 26, mounted on the ends of stems 27 and 28, respectively. These stems are pivotally con-

nected to the outer extremities of yoke 29, which is mounted at its center upon pins 30, with which it makes slotted engagement to allow free movement of the yoke. The pins 30 are connected with or form a part of the vertically-movable portion of a centrifugal governor A, geared by belt 31 from the main shaft or in any other suitable manner usual with this class of devices.

A cushion-spring 32 is inserted below valve 24, by which it is normally held in closed position to shut off the supply of fluid to the cylinder 19, while a similar spring 33 is inserted above valve 26 and adapted to normally close port 25 to cut off the exhaust therefrom.

The constant fluid-pressure acting on piston 17 and also on the pistons 11 of the nozzle-valve stems is supplied from the same source which supplies the turbine and preferably at the same pressure.

When the load of the engine increases, resulting in decreased speed and closing in of the balls of the governor, valve 24 is lowered by stem 27, connected with the downwardly-movable end of the yoke 29, adapted to admit pressure through port 23 against piston 20, as in Fig. 4, causing said piston to travel outwardly, projecting piston-valve 17 inwardly, cutting off the supply of pressure to one or more of pipes 16 and pistons 11, allowing said piston to be retracted by spring 13, unseating valve 9, and admitting an increased supply to the vanes. On the other hand, when the speed becomes too great the balls of the governor fly out. Valve 26 is raised by stem 28, attached to the normally movable end of yoke 29, as in Fig. 5, opening exhaust through port 25 from cylinder 19 and permitting the pressure in cylinder 14 to act against piston-valve 17 to move it backwardly, thereby uncovering one or more of the ports 21, leading to pipes 16 and pistons 11, seating their valves 9 against the valve-seated nozzles. This action operates to reduce the supply of pressure to the vanes, resulting in a corresponding reduction of speed. The speed is thus maintained constant and the equilibrium of the engine established.

In Fig. 6 I show a modified construction in which rotating valves 34 govern the supply to the nozzles, each of said valves being connected by a slotted arm 35 with the inner end of piston-stems 10, whereby movement is imparted to valve 34 by piston 11 to open and close the supply to the nozzles, as will be readily understood, a series of such valves being actuated successively, as already described.

It is evident that various constructions or arrangements of valves and actuator mechanism may be used to control the admission of fluid to the turbine-vanes in combination with the regulating mechanism which I have shown and described, and I do not desire to be limited to the detailed construction herein set forth.

I claim—

1. The combination with an elastic-fluid turbine, of a series of valves adapted to admit fluid successively, a series of cylinders provided with pistons connected with said valves, a pressure-governing device controlling the supply and exhaust of said cylinders, and means connected therewith actuated by a variable-pressure mechanism, with means for controlling the variable pressure thereof in conformity with the speed of the engine, substantially as set forth.

2. The combination with an elastic-fluid turbine, of a series of valves adapted to admit fluid successively, a series of spring-retracted pistons connected therewith, and a pressure-governing device controlling the operation of said pistons.

3. The combination with an elastic-fluid turbine, of a series of valves in communication with a supply-cylinder adapted to admit fluid successively, a series of pistons connected therewith, a pressure-governing device actuated by variable pressure controlling the operation of said pistons, and means for retracting the pistons and valves when pressure to the pistons is cut off.

4. The combination with an elastic-fluid turbine, of a series of valves adapted to admit fluid successively, a series of spring-retracting pistons connected therewith, a pressure-cylinder, connections between the pistons and the pressure-cylinder, and a supply-controlling piston mounted in the pressure-cylinder controlled by variations in the speed of the turbine.

5. The combination with an elastic-fluid turbine, of a series of valves adapted to admit fluid successively, a series of pistons connected therewith, a pressure-cylinder, connections between the pistons and the pressure-cylinder, a piston-valve mounted in the pressure-cylinder, a piston connected therewith having a greater area, and means controlling the supply and exhaust to and from said piston governed by variations in the speed of the turbine.

6. The combination with an elastic-fluid turbine, of a series of valves adapted to admit fluid successively, a series of pistons connected therewith, a pressure-cylinder, connections between the piston and the pressure-cylinder, a piston-valve mounted in the pressure-cylinder, a piston connected therewith having a greater area, a cylinder therefor having an inlet and exhaust valve, and a governing device adapted to control the operation of said valves.

7. The combination with an elastic-fluid turbine, of a series of supply-valves, spring-retracted pistons connected therewith, piston-chambers, a constant-pressure and a variable-

pressure cylinder, connections between the piston-chamber and the constant-pressure cylinder, a piston-valve in the constant-pressure cylinder connected with a piston in the variable-pressure cylinder, a pressure and exhaust valve respectively controlling the inlet and outlet of the variable-pressure cylinder, and a governing device adapted to control the operation of said valves.

8. Valve-controlling mechanism for an elastic-fluid turbine consisting of two pistons having unequal areas, a series of nozzle-valves, means for opening and closing the nozzle-valves controlled by one of said pistons, and means controlled by variations in the speed of the turbine for varying the pressure on the other piston.

9. A fluid-controlling mechanism for a series of valves of an elastic-fluid turbine consisting of pistons connected with the valves, a cylinder provided with constant pressure having communicating connections with said pistons, a piston-valve adapted to open and close said connections, and variable-pressure fluid-actuated means governed by variations in the speed of the turbine for actuating the piston-valve.

10. The combination with an elastic-fluid turbine, of a nozzle-valve provided with a spring-retracted piston, a constant-pressure cylinder, a pressure connection from said cylinder to the valve-piston, and a piston-valve controlling the supply therethrough, with means governed by variations in the speed of the turbine for actuating the piston-valve.

11. The combination with an elastic-fluid turbine, of a nozzle-valve provided with a spring-retracted piston, a constant-pressure cylinder, a pressure connection from said cylinder to the valve-piston, a supply and exhaust port communicating with said pressure connection, and a piston-valve controlling the supply and exhaust, with means governed by variations in the speed of the turbine for actuating the piston-valve.

12. The combination with an elastic-fluid turbine, of a nozzle-valve provided with a spring-retracted piston, a constant-pressure cylinder, a pressure connection from said cylinder to the valve-piston, a supply and exhaust port communicating with said pressure connections, a piston-valve controlling the supply and exhaust, a variable-pressure piston connected with the piston-valve, and means governed by the speed of the turbine for controlling the pressure on the variable-pressure piston.

13. The combination with an elastic-fluid turbine, of a nozzle-valve provided with a spring-retracted piston, a constant-pressure cylinder, a pressure connection from said cylinder to the valve-piston, a supply and exhaust port communicating with said pressure connection, a piston-valve controlling the supply and exhaust, a variable-pressure piston connected with the piston-valve, a pressure and exhaust valve controlling the inlet and exhaust to and from the variable-pressure piston, and a governing device geared with the turbine-shaft and provided with a pivoted yoke connected with said valves.

14. The combination with an elastic-fluid turbine, of a nozzle-valve provided with a spring-retracted piston, a constant-pressure cylinder, a pressure connection from said cylinder to the valve-piston, a supply and exhaust port communicating with said pressure connections, a piston-valve controlling the supply and exhaust, a variable-pressure piston connected with the piston-valve, a pressure and exhaust valve controlling the inlet and exhaust to and from the variable-pressure piston, and a governing device geared with the turbine-shaft and provided with a pivoted yoke connected with said valves, with retracting-springs for the valves.

15. The combination of a series of nozzle-valves, pistons connected therewith provided with springs, chambers for the valve-pistons, a constant-pressure cylinder, connections therefrom to the nozzle-valve chambers, a piston-valve mounted in the constant-pressure cylinder, a variable-pressure cylinder, a piston mounted therein connected with the piston-valve, and means governed by variations in the speed of the turbine for controlling the pressure on the piston of the variable-pressure cylinder.

16. The combination of a series of nozzle-valves, pistons connected therewith provided with springs, chambers for the valve-pistons, a constant-pressure cylinder, connections therefrom to the nozzle-valve chambers, a piston-valve mounted in the constant-pressure cylinder, a variable-pressure cylinder, a piston mounted therein connected with the piston-valve, pressure and exhaust valves controlling the inlet and exhaust to and from the variable-pressure piston, and a governing device geared with the turbine-shaft and provided with a pivoted yoke connected with said valves.

17. The combination with an elastic-fluid turbine, of a series of nozzle-valves, and a corresponding series of operating devices actuated by an elastic fluid and controlled by a variable-pressure mechanism, with governor-controlled valves therefor.

18. The combination with an elastic-fluid turbine, of a series of nozzle-valves, operating devices therefor, a variable-pressure mechanism, and connections between said operating devices and the variable-pressure mechanism provided with single supply and exhaust ports under the control of the variable-pressure mechanism, and arranged to communicate with the supply and exhaust sides thereof.

19. In an elastic-fluid turbine, the combination with a valve-operating device adapted

to be actuated by fluid-pressure, of a cylinder provided with a diagonal port, a variable-pressure mechanism provided with a piston adapted to cover and uncover said port at either side of said piston, and a connection between said operating device and said port, substantially as set forth.

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

WILLIAM S. ELLIOTT.

Witnesses:
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C. M. CLARKE.