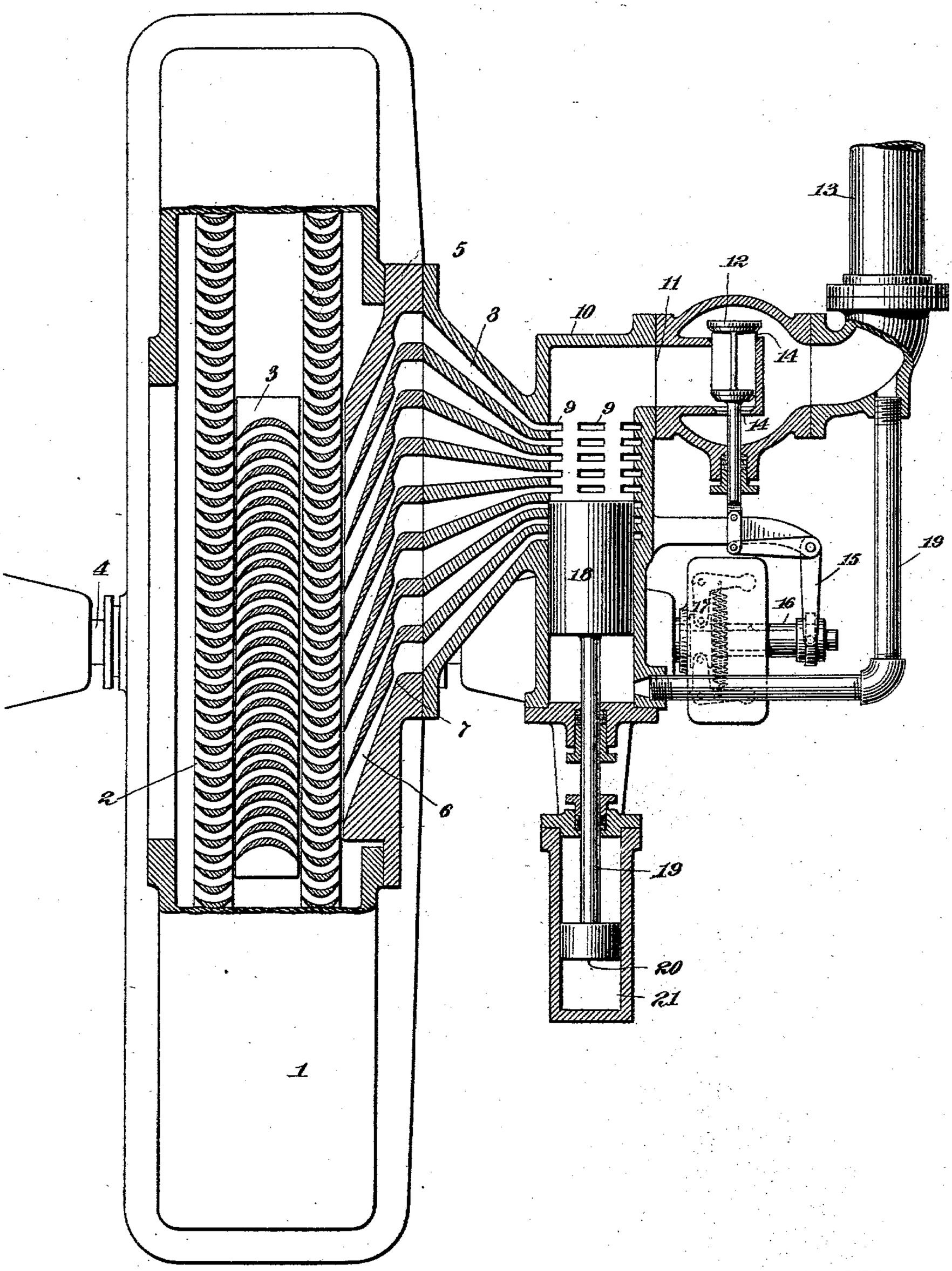
No. 715,246. Patented Dec. 9, 1902.

C. G. CURTIS.

GOVERNOR FOR ELASTIC FLUID TURBINES.

(Application filed Apr. 18, 1899. Renewed May 17, 1902.)

(No Model.)



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GOVERNOR FOR ELASTIC-FLUID TURBINES.

SPECIFICATION forming part of Letters Patent No. 715,246, dated December 9, 1902.

Application filed April 18, 1899. Renewed May 17, 1902. Serial No. 107,827. (No model.)

To all whom it may concern:

Be it known that I, CHARLES G. CURTIS, a citizen of the United States, residing in the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Governors for Elastic-Fluid Turbines, of which the following is a specification.

My invention relates to improvements in elastic-fluid turbines, and particularly to the regulation of such turbines by the invention described and claimed in my Patent No. 566,967, wherein regulation is effected without material loss of efficiency by varying the volume of the elastic fluid without substantial variation of its velocity at the point or points where it acts upon the movable elements or vanes of the turbines.

In an application for a patent filed January 12, 1898, Serial No. 666,379, I describe as an improvement upon my Patent No. 566,967 a new form of sectional nozzle. With the improved sectional nozzle described in my said application separate steam passages or pipes extend from the sections of the nozzle back to a connection with the steam-boiler or other source of elastic fluid under pressure, such passages being controllable by means of a valve or valves operated either by hand or automatically by a speed-governor, so as to vary the number of sections receiving the elastic fluid. In this way the effective inlet area for the elastic fluid is varied and in such a way as to cause no material or substantial change in the velocity and the conditions existing in the buckets of the turbine. My present invention is well adapted for use with a sectional nozzle of this type, and is designed especially as an improvement in the means shown and described in said application for effecting the regulation.

In order that my invention may be better understood, attention is directed to the accompanying drawing, forming part of the specification, and in which I show in section a turbine of the type invented by me having a sectional nozzle, as described in my said application, and provided with a convenient embodiment of my improved regulating device.

The turbine comprises a shell 1, carrying one or more movable vanes 2 and usually a set of stationary intermediate vanes 3, mounted between the movable vanes. The movable vanes are carried on a shaft 4. A sectional nozzle 5 is employed having a series of sections 6, each of approximately the same form, comprising a contracted throat 7 and diverging walls. Passages 8 connect the sections of the nozzle with ports 9, which open within a cylinder 10. The cylinder 10 is provided with an admission-opening 11, controlled by a regulating-valve 12, preferably balanced, as shown. A pipe 13 leads from a generator of fluid-supply, such as a steam-boiler, and supplies the elastic fluid to the interior of the cylinder 10 through the ports 14 14, controlled by the regulating or throttle valve 12. The stem of the regulating-valve 12 connects with a bell-crank 15, the other arm of which is connected with a sleeve 16, rotating with, but movable longitudinally on, the shaft 4 of the turbine. A centrifugal governor 17 of an ordinary type is shown for moving the sleeve 16 laterally under the variations in the speed.

Mounted within the cylinder 10 is a piston or valve 18, which is adapted to close and disclose a greater or lesser number of the ports 9 to thereby vary the valve-port area. One face of this piston is subjected to the pressure of the varying volume of elastic fluid within the cylinder 10, as will be obvious. The opposite face of this piston is subjected to a substantially constant opposing pressure and preferably to the pressure of the elastic fluid in the pipe 13. A pipe 19, therefore, is shown connecting the pipe 13 with the cylinder 10 opposite to the inlet-port 11 thereon. The stem 18^a of the piston 18 connects with a piston 20 in a dash-pot 21 and by which will be prevented sudden movement of the controlling-piston under the effect of variations of pressure. Assuming the cylinder 10 to be vertically arranged, the weight of the controlling-piston to be equal to five times its area in square inches and the pressure of the elastic fluid in the pipe 13 to be one hundred and fifty pounds per inch, it will be noted that the piston 18 will be just supported when

the pressure of the elastic fluid above the piston is one hundred and forty-five pounds per square inch, the difference in pressure between the two sides of the piston being five pounds per square inch. When the turbine is at rest, the throttle-valve 12 will be open to its maximum extent, and the piston 18 will descend by its weight, so as to give a maximum disclosure of the valve-ports. As soon as the turbine comes up to speed the valve 12 will commence to close, thus reducing the pressure on the upper side of the piston, so that the pressure below causes the piston to rise. The piston continues rising until the total port area open is just equal to the work to be done by the turbine, when the speed stops rising and an equilibrium is established. When the speed of the turbine reaches the desired point, the position of the valve 12 will be such as to permit the passage only of a sufficient volume of the elastic fluid as will result in the movement of the piston 18 to disclose the valve-port area necessary for the flow of the volume of elastic fluid at the desired pressure. Assuming the load, therefore, to be constant, the speed of the turbine will be constant and the piston 18 will occupy a position of balance to disclose the exact valve-port area required for the constant flow. If, however, the speed of the turbine under an increase in load should tend to decrease, the valve 12 will be opened to a greater extent, permitting an increased flow of the elastic fluid through the inlet area 11 of the cylinder. This increase in volume will result in a rise in pressure of the fluid, forcing the piston 18 downward until the pressure of the fluid entering the nozzle is again reduced to the desired point, this resulting in an increase in the valve-port area exactly sufficient to accommodate the increased volume of flow. If, on the other hand, the speed of the turbine tends to increase, the valve 12 will be moved toward its closed position, reducing the volume of the fluid and permitting the piston 18 to ascend to reduce the valve-port area to a corresponding extent.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. In an elastic-fluid turbine, the combination with a nozzle adapted to accommodate varying volumes of an elastic fluid, a valve controlling by its movement the effective cross-sectional area of the nozzle, and a throttle acting to vary the pressure which moves said controlling-valve, substantially as set forth.

2. In an elastic-fluid turbine, the combination with a sectional nozzle, a valve opening and closing by its movement the sections of said nozzle, and a throttle acting to vary the pressure which moves said valve, substantially as set forth.

3. The combination with an elastic-fluid turbine, of a sectional nozzle for supplying varying volumes of fluid to the turbine, a regulating-valve for regulating the volume of elastic fluid entering the sectional nozzle, a secondary valve automatically controlled by such variations in volume and arranged to disclose a number of the sections of the nozzle to accommodate such variations, and a centrifugal speed-governor for controlling the position of the regulating-valve, substantially as set forth.

4. The combination with an elastic-fluid turbine, of an expansion-nozzle for permitting the passage of varying volumes of elastic fluid to the turbine, a cylinder, the interior of which is connected to said nozzle, a piston in the cylinder arranged to disclose a varying area for the passage of the elastic fluid from the cylinder into said nozzle, a regulating-valve for permitting the passage of varying volumes of the elastic fluid into the cylinder, means for subjecting the piston to a substantially constant force opposing the pressure due to the elastic fluid entering the expansion-nozzle, and a centrifugal speed-governor connected to the regulating-valve, substantially as set forth.

5. The combination with an elastic-fluid turbine, of a sectional nozzle for supplying varying volumes of elastic fluid to the turbine, a cylinder into which all of the sections of the nozzle extend, a piston in the cylinder arranged to communicate the interior of the cylinder with one or more of the sections of said nozzle, a regulating-valve for admitting varying volumes of elastic fluid into the cylinder, means for subjecting the piston to a substantially constant force opposing that due to the varying volume of the elastic fluid, and a centrifugal governor connected to the regulating-valve, substantially as set forth.

6. The combination with an elastic-fluid turbine, of a sectional nozzle for permitting the passage of varying volumes of elastic fluid to the same, a cylinder into which all the sections of said nozzle extend, a piston in the cylinder arranged to disclose one or more of the sections of the sectional nozzle, a regulating-valve for permitting the introduction of varying volumes of elastic fluid into the cylinder, a main pipe for supplying elastic fluid to the regulating-valve, and a pipe connecting the main pipe with the cylinder opposite to the admission-port for the working fluid, substantially as set forth.

7. The combination with an elastic-fluid turbine, of a sectional nozzle for permitting the passage of varying volumes of elastic fluid to the same, a cylinder into which all the sections of said nozzle extend, a piston in the cylinder arranged to disclose one or more of the sections of the sectional nozzle, a regulating-valve for permitting the introduction of varying volumes of elastic fluid into the cylinder, a main pipe for supplying elastic fluid to the regulating-valve, a pipe connecting the main pipe with the cylinder opposite to the admission-port for the working fluid, and a centrifugal speed-governor connected

to said regulating-valve, substantially as set forth.

8. The combination with an elastic-fluid turbine, of a sectional nozzle for permitting the passage of varying volumes of elastic fluid to the same, a cylinder into which all the sections of said nozzle extend, a piston in the cylinder arranged to disclose one or more of the sections of the sectional nozzle, a regulating-valve for permitting the introduction of varying volumes of elastic fluid into the cylinder, a main pipe for supplying elastic fluid to the regulating-valve, a pipe connecting the main pipe with the cylinder opposite to the admission-port for the working fluid, and a dash-pot connected to said piston, substantially as set forth.

9. The combination with an elastic-fluid turbine, of a sectional nozzle for permitting the passage of varying volumes of elastic fluid to the same, a cylinder into which all the sections of said nozzle extend, a piston in the cylinder arranged to disclose one or more of the sections of the sectional nozzle, a balanced regulating-valve for permitting the introduction of varying volumes of elastic fluid into the cylinder, a main pipe for supplying elastic fluid to the regulating-valve, and a pipe connecting the main pipe with the cylinder opposite to the admission-port for the working fluid, substantially as set forth.

This specifiation signed and witnessed this 14th day of April, 1899.

CHARLES G. CURTIS.

Witnesses:
JNO. R. TAYLOR,
ARCHIBALD G. REESE.