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ELASTIC FLUID TURBINE.

APPLICATION FILED NOV. 12, 1906.

969,606.

Patented Sept. 6, 1910.

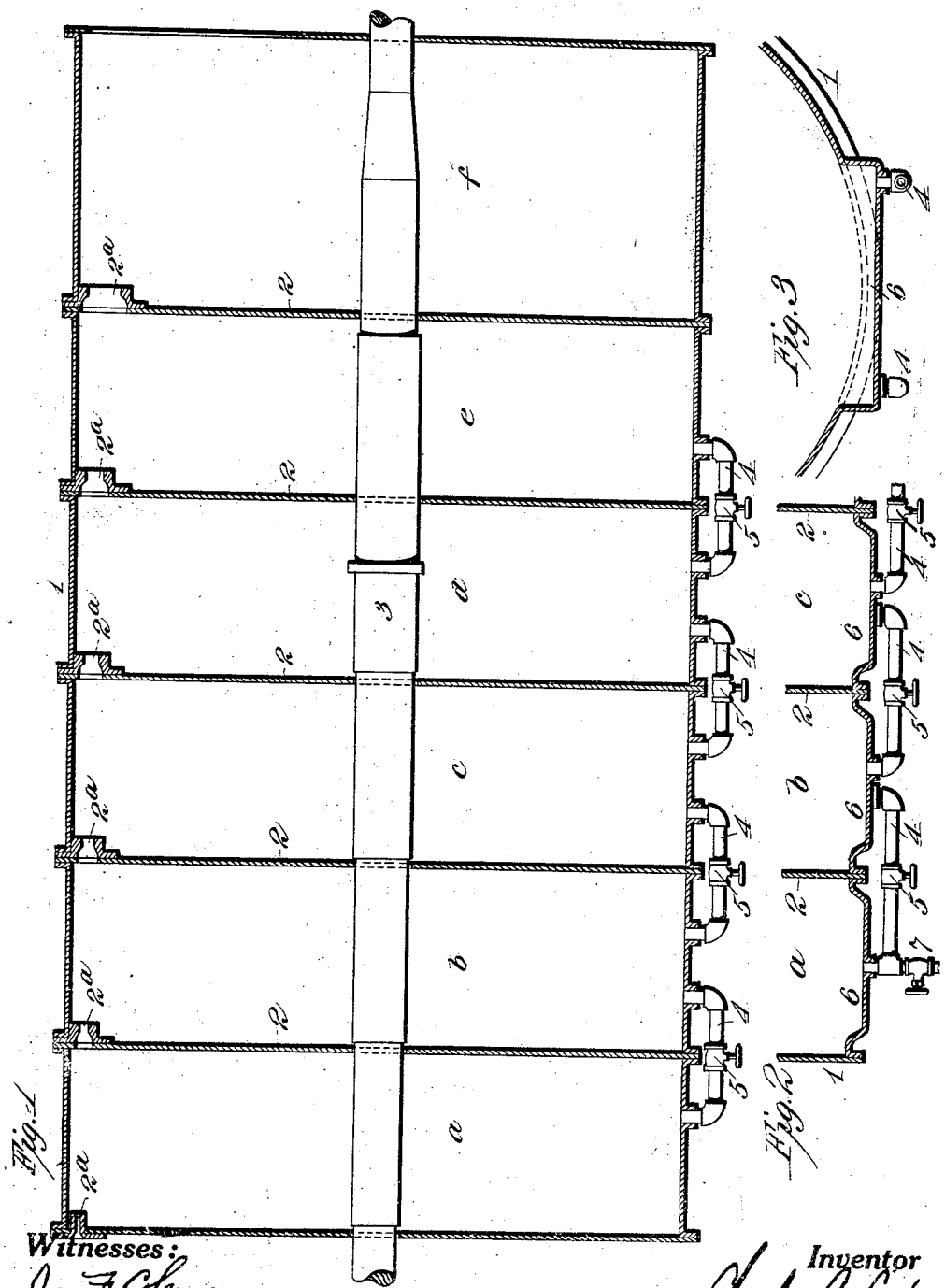

Fig. 1

Fig. 3

Fig. 2

Witnesses:

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UNITED STATES PATENT OFFICE.

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ELASTIC-FLUID TURBINE.

969,606. Specification of Letters Patent. Patented Sept. 6, 1910.

Application filed November 12, 1906. Serial No. 343,102.

To all whom it may concern:

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

The object I have in view is to increase the efficiency of elastic fluid turbines, by preventing the accumulation of water of condensation in the casing within the different stages of a stage expansion turbine, which water will have a braking action upon the rotor, and also to improve the efficiency by converting a certain proportion of the water of condensation into steam, which may be used in successive stages.

I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 represents a section of a horizontal turbine, of six stages; Fig. 2 is a detail view of a modification, and Fig. 3 is a transverse section of the type shown in Fig. 2.

In all of the views, like parts are designated by the same reference characters.

In the turbine illustrated, the six stages are shown as formed within one shell, the stages being separated by diaphragm. The invention, however, may be carried out in any form of turbine, no matter how the separate stages are made.

In the drawings, 1 represents the shell, and 2, 2 the diaphragm, dividing the shell into stages. 3 is the shaft which supports the rotating element (not shown).

a, *b*, *c*, *d*, *e* and *f* are the stages. Within each stage is a series of fixed and moving buckets, of any form. The entrance to the first stage and to each succeeding stage is made by means of a nozzle 2^a. I desire it to be distinctly understood that any form of nozzle may be used, the particular nozzle illustrated forming no portion of my present invention. In operation, a certain amount of steam (it depends upon conditions) will condense in each stage. If the water of condensation be allowed to accumulate, it will have a detrimental braking action upon the moving element. If it is drained off, the efficiency of the turbine will be considerably reduced owing to the loss of heat carried off by the water. In order to prevent this reduction of efficiency, I provide means for permitting the water of condensation to pass successively from a stage of high pressure to one of lower pressure, whereby, owing to its higher temperature than the steam contained in the receiving stage, a certain proportion of water will be reconverted into steam and be utilized.

One means of carrying out this invention is to provide tubes or pipes 4, 4 connecting adjacent stages. They can communicate with the lower sides of the shell. Suitable valves, as 5, may be introduced in the pipes in order to regulate the flow of water through them. As the difference in pressure between two adjacent stages is considerable, the water if condensed in the higher pressure stage will be forced by the difference in pressure between the stages into the adjacent stage. The valve is provided so that the amount of water passing through may be regulated and losses thereby prevented.

A modification is shown in Figs. 2 and 3, in which the pipes 4 instead of passing directly into the stages pass into chambers 6, which communicate with the stages and permit the water of condensation to remain in considerable quantity without causing a braking action upon the rotating element within that stage. These chambers are so proportioned as to give a somewhat shallow body of water in them. This is an advantage as it presents a large surface of water for evaporation.

In Figs. 2 and 3, one of the pipes 4 is provided with a draw-off cock 7 which is useful for relieving the stage *a* of the surplus condensed water. Similar draw-off cocks may be provided in the pipes connecting the other stages. By connecting the draw-off cocks directly with the pipes, the water of condensation may be drawn off from the pipes as well as from the shells. In the same modification, the different pipes are shown as communicating with alternate sides of the stages. As shown in Fig. 3, a pipe to a stage connects upon one side of the chamber 6 while the pipe from that stage connects with the other side. These pipes may be diagonally located below the shell, so that this arrangement may be secured. By this construction the water must enter a chamber

6 and pass across its entire length before it has an opportunity to go out, which will insure circulation and prevent the accumulation of a body of water at a lower temperature than the temperature of the steam within that stage.

As an example of the efficiency of the invention, let it be assumed that the several stages, *a*, *b*, *c*, *d*, *e*, *f*, work with the following pressures; stage *a*, 60 pounds; *b*, 20 pounds, and *c* 1 pound gage; *d*, 5 inches, *e* 15 inches, and *f*, 24 inches of vacuum. These will give absolute pressures approximately of 80; 40; 20; 10; 5, and 2.5 pounds to the square inch for the several stages. The temperatures will be approximately 312; 267; 299; 195; 162; 134 degrees Fahrenheit, for the several stages. Taking the first two stages, viz., *a* and *b*, the difference in pressure between the two will be 40 pounds, consequently the water of condensation in chamber *a* will readily flow into *b;* the difference in temperature between *a* and *b* will be about 44.43 degrees Fahrenheit. This will cause a reëvaporation of some proportion of the water of condensation within the stage *b*, received from the stage *a*. This reëvaporated steam being of the same pressure as the steam within the stage *b*, will be applied to the doing of useful work. Aside from the saving by avoiding the braking action of the condensed water within the shell, a further saving will thereby be secured.

The invention may be equally well used with a plurality of turbines working in separate shells, providing there be a difference in pressure between the different turbines.

In accordance with the provisions of the patent statutes, I have described the principle of my invention, together with the apparatus which I no wconsider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is merely illustrative and that the invention can be carried out in other ways.

Having now particularly described and ascertained the nature of my invention and in what manner the same may be performed, I declare that what I claim and desire to secure by Letters Patent, is:

1. A multi-stage elastic fluid turbine having a plurality of stages, a nozzle in each stage for introducing fluid into the stage, there being a chamber in the stage, the said chamber being at the bottom of the shell, and arranged to retain water of condensation away from the rotor, and a passage connecting the chamber with a chamber in another stage.

2. A multi-stage elastic fluid turbine, having a chamber in a stage, the said chamber being at the bottom of the shell, and arranged to retain water of condensation away from the rotor, the said chamber being so proportioned as to give a somewhat shallow body of water in it, there being a passage connecting the chamber with a stage of different pressure.

3. A multi-stage elastic fluid turbine, having a horizontal shaft, a cylindrical shell, the said shell being divided into stages of difference of pressure, the said shell within a stage being so formed as to produce a flat chamber, the said chamber being so proportioned as to give a somewhat shallow body of water in it, there being a passage connecting the chamber with a stage of different pressure.

4. A multi-stage elastic fluid turbine, having a shell divided into a plurality of stages, a chamber within each stage, the said chamber being at the bottom of the shell and arranged to retain water of condensation away from the rotor, and connecting pipes outside of the shell and communicating between the different stages, the said pipes communicating with the chamber on alternate sides so that the water entering a chamber will pass across its entire length before it has an opportunity to go out.

This specification signed and witnessed this seventh day of November, 1906.

CHARLES G. CURTIS.

Witnesses:
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