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MULTISTAGE ELASTIC FLUID TURBINE.

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1,119,731. Patented Dec. 1, 1914.

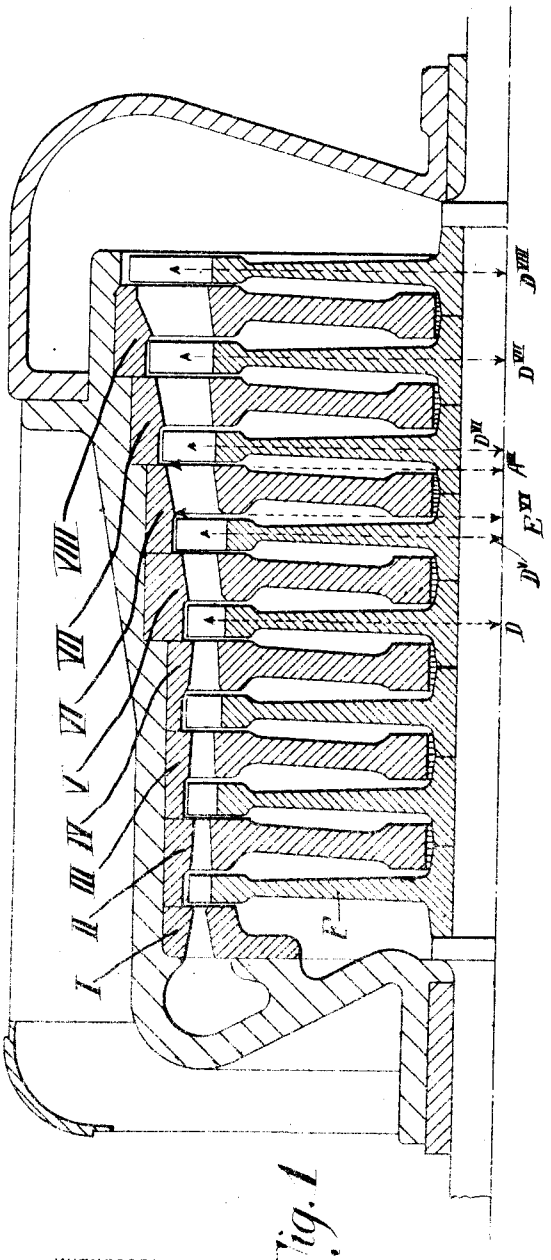


Fig. 1

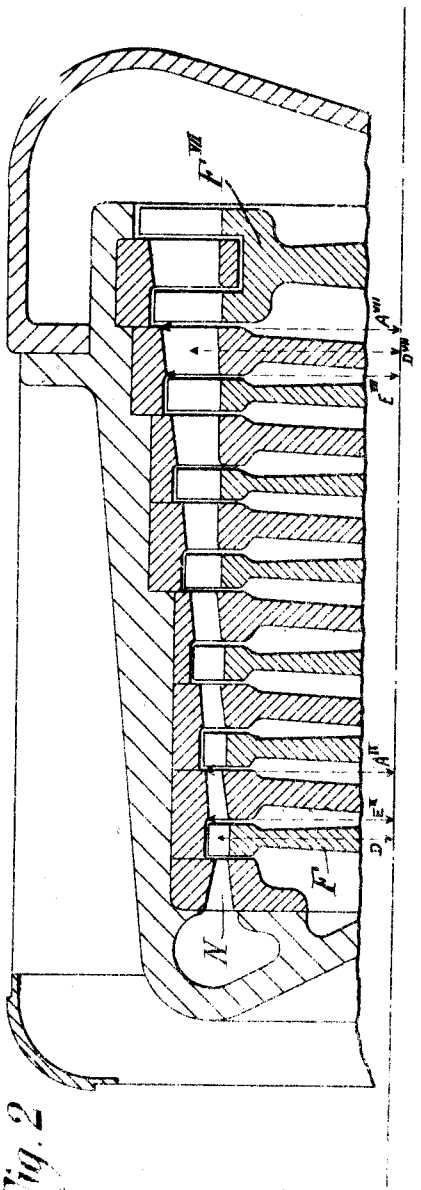


Fig. 2

WITNESSES.

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MULTISTAGE ELASTIC-FLUID TURBINE.

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To all whom it may concern:

Be it known that I, PAUL SPIESS, a citizen of the Republic of Switzerland, residing at Zurich, in the Republic of Switzerland, have invented certain new and useful Improvements in Multistage Elastic-Fluid Turbines, of which the following is a full, clear, and exact specification.

This invention relates to multi-stage axial working elastic fluid impulse turbines which are especially intended to deliver large power at high speeds, and which are required to have a good efficiency at full as well as partial loads.

The turbine to which this invention is applicable, consists of high and low pressure stages in series, the mean rotor diameter in the high pressure stages being less than that in the low pressure stages so that the friction of the wheels, and the total pressure on the diaphragm walls and casing in the high pressure stages shall not be too great. In the low pressure portions the mean rotor diameter is made as large as possible so that the angles of the stationary and moving blades may not be excessive within the permissible limits of blade length, whereby the energy of the steam shall be most efficiently utilized without the use of special exhaust diffusers.

In axial working elastic fluid turbines of the impulse type at present known, having wheels in the low pressure stages of greater mean diameter than those in the high pressure stages, the transition from one diameter to another is abrupt. That is, instead of the steam flowing in a generally straight path parallel to the axis, as it does in passing from one stage to another of the same diameter, the steam is diverted in passing from a stage of a certain diameter to a stage of larger diameter from an axial path to a radial path outwardly, and then again turned parallel to the axis, so as to pass in a straight line through the wheels of larger diameter. These two right-angled changes in the path of the steam result in considerable losses. Because of changing the direction of the steam from axial to radial and then again to axial, the exhaust velocity at the wheel of lower diameter cannot be used in the following stage, and moreover, there are considerable energy losses owing to change of direction, eddies and pressure drops. In some constructions where the mean rotor diameter increases from stage to stage, the diameter of the rotor disk relatively to the next following guide channel or nozzle varies abruptly, because of the necessity of keeping the mean diameter constant within the following guide channel or nozzle. This also involves an appreciable energy loss in each stage, due to loss of exhaust velocity, abrupt changes in the direction of the steam, eddies, etc.

It is the object of this invention to minimize these drawbacks, due to a great difference between the mean rotor diameter of one stage and the mean rotor diameter of the following stage, and between the outer diameter of a rotor and the following guide channel or nozzle for the next larger rotor, by avoiding abrupt changes in the direction of the steam flow, either between one wheel and the next larger wheel, or between one wheel and the guide channel or the nozzle for the next larger wheel. This is accomplished at least in the low pressure stages or in all of the pressure stages where the mean rotor diameter increases from stage to stage, by evenly increasing not only the mean diameter or the runner wheels but also the diameter of the guide channels between their inlet sides and their exhaust sides. These increases of rotor and guide channel or nozzle diameters from stage to stage are preferably made uniform, but of course this is not absolutely essential so long as abrupt turns in the steam path are avoided. According to this invention, therefore, the path of the steam from the high pressure stages with small diameter wheels to the low pressure stages with large diameter wheels is not exactly parallel to the axis, with successive abrupt changes, but is divergent in the channels and preferably in approximately a straight line.

The invention is chiefly applicable in the low pressure portion of an axial working elastic fluid impulse turbine, whether steam or gas, in order to take care of the relatively large volume of exhaust fluid. The high pressure stages may, according to the present practice, have a constant mean diameter, and the remaining low pressure stages have a substantially uniform increasing diameter. In very large units, however, operating at high speed and especially where already the high pressure stages

have full admission of fluid, the invention would be advantageously applied to all stages.

In the accompanying drawings, Figure 1 is a longitudinal section through an eight stage turbine in which the first four stages have a constant mean diameter, and the remaining stages an increasing diameter according to this invention, and Fig. 2 is a longitudinal section through a multi-stage turbine in which there is an increased diameter from the first stage on. In Fig. 1, the mean diameter D steadily increases between stages V and VIII, so that for instance, the mean diameter D—VII is greater than D—VI, and also in each latter stage the exhaust diameter of the guide channel is greater than the inlet diameter E thereof. Thus A—VI is greater than E—VI. In this manner, the steam is carried evenly and without appreciable eddies and pressure losses from one runner wheel to the somewhat larger succeeding runner wheel.

In Fig. 2, is shown an example wherein the mean wheel diameters successively increase between the first and the last stages, and the inlet and exhaust sides of the guide channel successively increase, as explained above in connection with stage VI of Fig. 1. In Fig. 2 the first wheel F has already full admission through guide channels N. In Fig. 1 however the last four stages V, VI, VII, VIII have full admission. It may be stated here, that the runner wheels may be fitted with one or more rows of buckets. as wheel F VII in Fig. 2.

By this invention, it will be seen that there will be no abrupt changes in the direction of fluid flow with consequent loss of exhaust velocity in passing from the exhaust side of one runner wheel through the succeeding guide channels or nozzles to the inlet side of the next runner wheel of larger diameter. Eddies, and pressure drops are likewise avoided, thereby securing increased efficiency.

Having thus described my invention, I declare that what I claim as new and desire to secure by Letters Patent, is:

1. A multi-stage axial working elastic fluid impulse turbine comprising at least some low pressure stages whose runner-wheel-mean-diameter evenly and steadily increases from stage to stage and whose guide-channel-outer-diameter increases between the fluid inlet and exhaust.

2. A multi-stage axial working impulse fluid turbine comprising a series of stages whose runner-wheel-mean-diameter evenly and steadily increases from stage to stage and whose guide-channel-outer-diameter increases between the fluid inlet and exhaust.

3. A multi-stage axial working elastic fluid impulse turbine comprising at least some low pressure stages whose runner-wheel-mean-diameter evenly and steadily increases from stage to stage and whose guide-channel-outer-diameter increases between the fluid inlet and exhaust, certain of the runner wheels having at least two rows of buckets.

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

PAUL SPIESS.

Witnesses:
HULDREICH KELLER,
CARL GUBLER.