No. 820,714. PATENTED MAY 15, 1906.

A. E. GUY.

ELASTIC FLUID TURBINE.

APPLICATION FILED APR. 14, 1905.

2 SHEETS—SHEET 1.

Fig. 1.

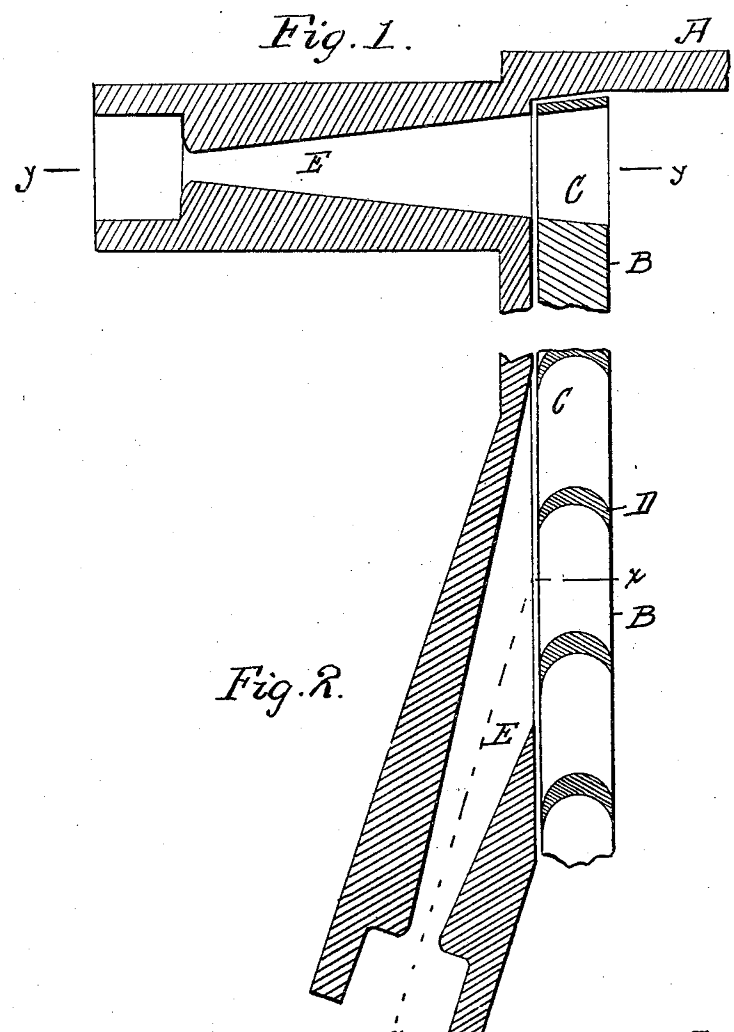

Fig. 2.

Witnesses.
Park Benjamin Jr
Janet A. Glendinning

Inventor
Albert E. Guy
by Park Benjamin
his Attorney.

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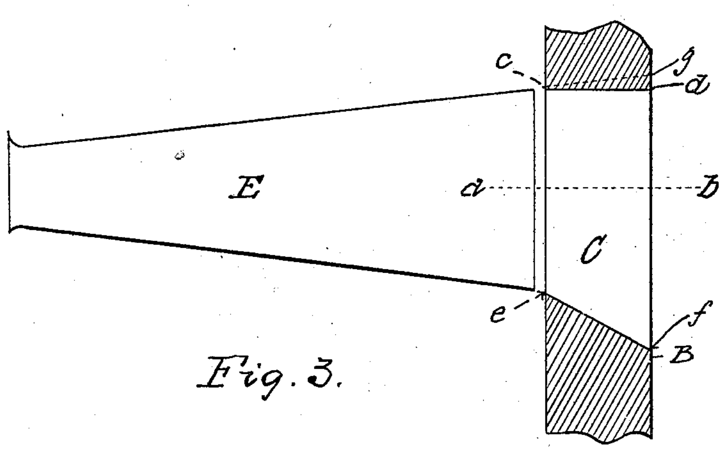

Fig. 3.

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UNITED STATES PATENT OFFICE.

ALBERT E. GUY, OF TRENTON, NEW JERSEY, ASSIGNOR TO DE LAVAL STEAM TURBINE COMPANY.

ELASTIC-FLUID TURBINE.

No. 820,714. Specification of Letters Patent. Patented May 15, 1906.

Application filed April 14, 1905. Serial No. 255,517.

To all whom it may concern:

Be it known that I, ALBERT E. GUY, of Trenton, Mercer county, New Jersey, have invented a new and useful Improvement in Elastic-Fluid Turbines, of which the following is a specification.

In United States Patent No. 522,066, dated June 26, 1894, and granted to C. G. P. De Laval, there is set forth, in combination with a bucket or turbine wheel, a stationary nozzle adjacent to the wheel and having its bore diverging or increasing in area of cross-section toward its discharge end, whereby the elastic fluid under pressure is expanded in passing through the diverging nozzle and its pressure is converted into velocity before the jet is delivered against the wheel. In the wheel illustrated in the said patent the working passages between the buckets traversed by the fluid have their cross-sectional areas gradually diminishing and then gradually increasing in the direction of the fluid-flow, or, in other words, the cross-sectional area of the inlet of the working passage and also of the outlet of said working passage is in each case greater than the cross-sectional area of the passage between said inlet and outlet. This conformation results from the shape of the buckets employed.

My invention consists in the combination of an elastic-fluid turbine-wheel having a working passage of maximum cross-sectional area at its exhaust end and an expansion-nozzle constructed to expand the working fluid to the pressure at the exhaust end of said passage prior to the entrance of said fluid into said passage, also in the preferred form of working passage hereinafter described.

In the accompanying drawings, Figure 1 shows the expansion-nozzle, together with the working passage of the elastic-fluid turbine-wheel, in vertical section on line *x x* of Fig. 2. Fig. 2 is the horizontal section on line *y y* of Fig. 1. Fig. 3 illustrates in section a modified form of the working passage in the wheel.

Similar letters of reference indicate like parts.

A represents a portion of the wheel-casing; B, the turbine-wheel; C, the working passage in said wheel; D, the wheel-buckets, and E the expansion-nozzle.

The nozzle E is substantially the nozzle set forth in the aforesaid De Laval patent and is to be so constructed and proportioned as to produce an expansion of the elastic fluid down to the exhaust-pressure before said fluid enters the wheel-passage. In other words, the elastic-fluid pressure in the chamber of the casing in which the wheel rotates is everywhere the same. As the volume of fluid entering and leaving the working passage in the wheel is constant per unit of time and as the passage increases in cross-sectional area in the direction of flow, it follows that the velocity of the fluid at the exhaust end of said passage is less than at the entrance end thereof. Hence as the efficiency of the wheel depends upon the difference between the squares of the velocities of the fluid at entrance and exhaust end an increase of efficiency by reason of this reduction of the velocity at the exhaust end follows. In order to make this entirely clear, it is necessary to consider the wheel first as at rest and second as in rotation.

The wheel at rest:

First. If the passage is uniform in cross-sectional area, the velocity of the fluid (friction disregarded) at entrance and exit will be the same.

Second. If the passage increases in cross-sectional area, the velocity of the fluid at exit will be less than at entrance.

The wheel in rotation:

Third. If the passage is uniform in cross-sectional area, the velocity of the fluid at exit will be less than that at entrance, the difference being expended in work in the wheel.

Fourth. If the passage increases in cross-sectional area, the velocity of the fluid at exit will be still less than in the immediately preceding condition, (third,) and this increased reduction, therefore, will be due to the diverging passage.

The gain in efficiency already noted therefore results.

In the drawings, Fig. 1, I have shown a passage which diverges in the direction of flow on both sides of a line *a b* parallel to the wheel-axis. While this form of passage is operative, as set forth, I prefer to employ the shape of passage shown in cross-section in Fig. 3. The outer bounding periphery *c d* of the annular passage, as shown in cross-section, is parallel to the wheel-axis, while the inner bounding periphery *e f* is divergent. The object here is to avoid the effect of centrifugal force due to rotation of the wheel, which would tend to throw the mass of fluid radially outward and which would act to increase the velocity thereof at the point *g* more than at the point *d*. This increase of velocity would tend to diminish to some extent the reduction of velocity normally due to the diverging passage if the latter were formed as shown in Fig. 1. Hence the form of passage shown in Fig. 3 is considered preferable.

I claim—

1. The combination of an elastic-fluid turbine-wheel having a working passage of maximum cross-sectional area at its exhaust end, and an expansion-nozzle constructed to expand the working fluid to the pressure at the exhaust end of said passage prior to the entrance of said fluid into said passage.

2. The combination of an elastic-fluid turbine-wheel having a working passage gradually increasing in cross-sectional area in the direction of fluid-flow, and an expansion-nozzle constructed to expand the working fluid to the pressure at the exhaust end of said passage prior to the entrance of said fluid into said passage.

3. The combination of an elastic-fluid turbine-wheel having an annular working passage, the outer bounding periphery of which is parallel in cross-section to the axis of said wheel, and the inner periphery of which is diverging from said outer periphery in the direction of fluid-flow through said passage, and an expansion-nozzle constructed to expand the working fluid to the pressure at the exhaust end of said passage prior to the entrance of said fluid into said passage.

4. An elastic-fluid turbine-wheel of the axial-flow type having an annular working passage, the outer bounding periphery of which is parallel in cross-section to the axis of said wheel and the inner periphery of which is diverging from said outer periphery in the direction of fluid-flow through said wheel, and an expansion-nozzle constructed to expand the working fluid to the pressure at the exhaust end of said passage prior to the entrance of said fluid into said passage.

5. An elastic-fluid turbine-wheel of the axial-flow impulse type having an annular working passage, the outer bounding periphery of which is parallel in cross-section to the axis of said wheel and the inner periphery of which is diverging from said outer periphery in the direction of fluid-flow through said wheel, and an expansion-nozzle constructed to expand the working fluid to the pressure at the exhaust end of said passage prior to the entrance of said fluid into said passage.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ALBERT E. GUY.

Witnesses:
WM. H. SIEGMAN,
PARK BENJAMIN, JR.