R. O. MULLER.

ELASTIC FLUID TURBINE.

APPLICATION FILED AUG. 1, 1911.

1,025,921. Patented May 7, 1912.

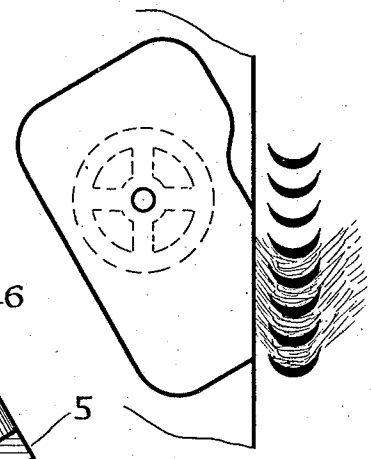

FIG. 1

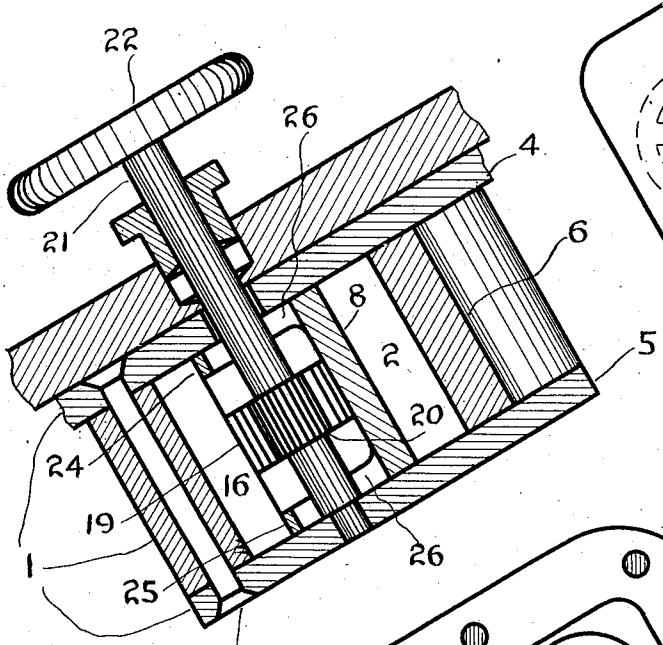

FIG 3

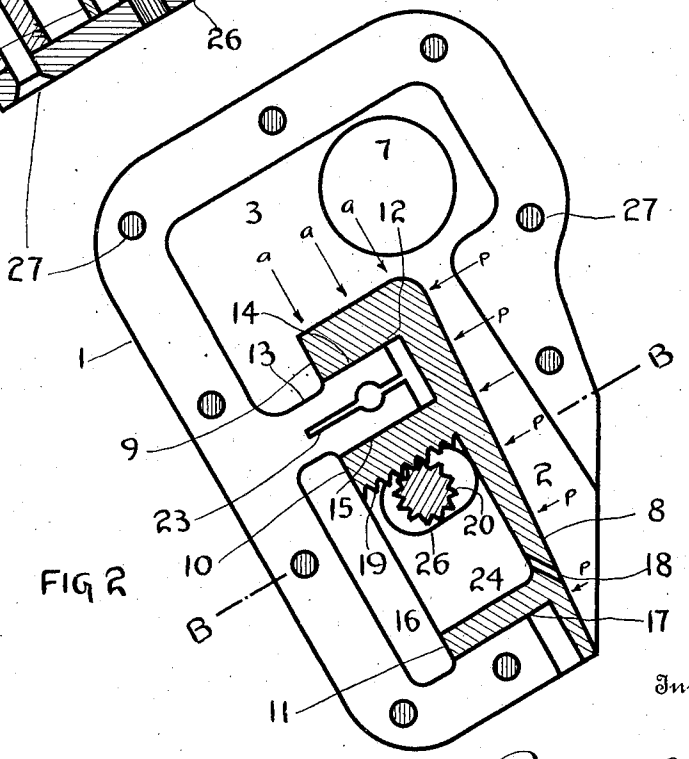

FIG 2

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ELASTIC-FLUID TURBINE.

1,025,921. Specification of Letters Patent. Patented May 7, 1912.

Application filed August 1, 1911. Serial No. 641,747.

To all whom it may concern:

Be it known that I, RICHARD OTTO MULLER, a subject of the German Emperor, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Elastic-Fluid Turbines, of which the following is a specification.

My invention relates to the class of turbines in which a vane wheel or rotor is actuated by one or more fluid jets to which a high velocity has been imparted by expansion through an orifice or "nozzle".

It relates more especially to the class in which the nozzle is made adjustable for the purpose of meeting more exactly the various conditions imposed by differences of pressure and power requirements. Its object is to provide a nozzle having easy adjustment to meet these requirements, and one combining freedom of movement and fluid tightness at all pressures, with a construction so simple as to be satisfactorily fitted at low cost by mechanics of ordinary skill. These objects are attained by means of mechanism illustrated in the accompanying drawing in which—

Figure 1 is an elevation of the complete nozzle showing the issuing jet of fluid impinging upon the vanes of a suitable rotor, Fig. 2 is a view of the inside of the nozzle, one side plate being removed and the movable nozzle wall in section, and Fig. 3 is a section through B B, Fig. 2.

Referring to the several figures, in which like symbols represent like parts throughout, 1 represents the casing as a whole, containing the mechanism of nozzle 2 and the chamber 3 for the accommodation of an elastic fluid under pressure. Casing 1 is made up of the two sides walls 4 and 5 and the distance piece 6, surrounding and inclosing the mechanism, the whole being fastened together by the rivets 27 as shown. The walls 4 and 5 may be finished over their entire inner surfaces or finished at the joint and at nozzle 2 only, which portions, in any case, should lie in the same plane and admit of finishing at one operation.

7 is an opening for the admission of fluid to chamber 3, and 2 is the orifice or nozzle through which it is allowed to expand into an atmosphere of lower pressure and thus acquire the high velocity to be utilized in connection with the turbine rotor. The nozzle 2 is rectangular in section, having three stationary walls provided by the sides 4 and 5 and the distance piece 6 respectively, and a fourth and movable wall 8 to afford the desired adjustment.

The movable wall 8 is just enough thinner than the distance piece 6 to allow of easy movement with fluid tight joints between it and the sides 4 and 5. On its back are projections 9, 10 and 11, which enter suitable recesses in distance piece 6, and by contact with the walls of said recesses, serve to guide the wall 8 in its movements. Flanges 24 and 25, connecting projections 10 and 11, provide maximum wearing surface with minimum leakage, while slot 26 serves to admit to chamber 16 the shaft 21 and, by contact with it, to limit the adjusting movement.

Of the guiding projections of wall 8, number 9 at the throat is most important for, besides its guiding effect, it serves to so balance fluid pressures as to leave no tendency of the wall 8 to move in any other than a straight line parallel to its guides and thus obviates any tendency to cramp and bind. To accomplish this result, the length of 9 is made such that the sum of the moments about the corner 12 of the guide 13, of all forces due to fluid pressure in chamber 3 upon projection 9, (represented by the arrows a, a, a, —) shall be slightly in excess of the sum of the moments about the same point of all pressures within the nozzle as indicated by the arrows p, p, p, —. In this way the tendency of projection 9 of wall 8 is to lie closely against surface 14 of guide 13 and to slide easily thereon, no other guide being required as long as pressure is maintained in chamber 3.

It is to be noted that at the throat of the nozzle the pressure drops abruptly to about 58% of that in chamber 3. It then gradually drops from the throat to the mouth of the nozzle, something as indicated by the relative lengths of the arrows p, p, p, —. This brings the resultant of all these pressures at a point about $\frac{1}{3}$ the distance from the throat to the mouth of the nozzle which, with the reduced pressure along the entire length of nozzle, admit of balancing with a comparatively short length of projection 9, acting, as it does, under the higher pressure of chamber 3.

In the chamber 16, back of the movable

wall 8, between it and the distance piece 6, pressure is maintained below that in chamber 3 and may be made approximately that of the chamber surrounding the rotor. This may be done by means of an open joint at 17 or by the introduction of an inclined duct 18 near the mouth of the nozzle to be acted upon by the suction of the passing fluid jet. For the purpose, then, of computing the balancing effect referred to in the preceding paragraph, pressures a, a, a, —, and p, p, p, —, represent unbalanced pressures above that maintained in chamber 16. In chamber 16 are also located means for moving wall 8 forward or back as specified. The preferred means here shown consists of a rack 19, attached to projection 10 of wall 8, and engaging therewith a pinion 20 attached to a shaft 21, running to a hand wheel 22 located in an accessible position. If desirable, shaft 21 may be operated by the turbine governor, thus making the regulation automatic. In any case the lower pressure of chamber 16 admits of looser packing and consequent reduced friction of the operating connection which, for automatic regulation, is of prime importance.

In the recess between the projections 9 and 10 of wall 8 is located the guide 13 attached to distance piece 6, its opposite sides 14 and 15 adapted to act as guides for wall 8 when pressure is removed from chamber 3. Near the center of guide 13 is a slot 23 having therein a taper pin hole as shown. Into this hole a short taper pin may be lightly tapped thus spreading the parts slightly and compensating for any slight wear that might occur on surfaces 14 or 15.

From the foregoing the mode of operation becomes apparent. When, from increasing pressure in chamber 3, or from a decrease in the power required, power is being generated faster than consumed, shaft 21 is turned by hand or by the governor in such a direction as to advance wall 8 of nozzle 2 thus reducing its area and consequent flow of fluid. With decreasing pressure or increasing demand for power, movement of 8 takes place in the opposite direction with consequent increase of area and of fluid delivered.

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

1. An adjustable elastic-fluid nozzle comprising a casing in which is provided a high pressure chamber for elastic fluid, and leading therefrom a nozzle orifice, said nozzle having all stationary walls identical with portions of the inner walls of said casing, and two of said stationary walls being parallel planes between which is fitted a movable wall for purposes of adjustment, said movable wall being provided at the throat or high pressure end with a projection extending into the high pressure chamber at substantially right angles to the nozzle axis and in the direction of motion of said movable wall, where it lies in contact with a portion of the wall of said high pressure chamber whose finished surface is adapted to act as a guide therefor and against which it is held by fluid pressure of said chamber all substantialy as and for the purpose set forth.

2. An adjustable elastic-fluid nozzle comprising a casing in which is provided a high pressure chamber for elastic fluid, and leading therefrom an adjustable nozzle orifice, said nozzle having all its stationary walls identical with portions of the inner walls of said casing, two of said stationary walls being parallel planes between which is fitted a movable wall for purposes of adjustment, said movable wall being provided, near the throat or high pressure end of said nozzle, with two parallel projections or slides, extending at substantially right angles to the axis of said nozzle and in the direction of movement of said wall, one of said projections extending into the high pressure chamber and the other into an adjacent chamber of lower pressure; and a combined division wall and guide, being a part of said casing, dividing said chambers, lying between said parallel slides and provided with a finished surface in contact with each adapted to guide the same in any movement which may take place during reduced pressure in said high pressure chamber, all substantially as and for the purpose set forth.

3. An adjustable elastic-fluid nozzle comprising a casing in which is provided a high pressure chamber for elastic fluid, and leading therefrom an adjustable nozzle orifice, said nozzle having all its stationary walls identical with portions of the inner walls of said casing, two of said stationary walls being parallel planes between which is fitted a movable wall for purposes of adjustment, said movable wall being provided, near the throat or high pressure end of said nozzle, with two parallel projections or slides, extending at substantially right angles to the axis of said nozzle and in the direction of movement of said wall, one of said projections extending into the high pressure chamber and the other into an adjacent chamber of lower pressure; and a combined division wall and guide, being a part of said casing, dividing said chambers, lying between said parallel slides and provided with a finished surface in contact with each, adapted to guide the same in any movement which may take place during reduced pressure in said high pressure chamber, a slot near the middle of said guide dividing it into two longitudinal prongs, a taper hole, part in each side of said slot, adapted to have forced therein a taper pin thereby spreading said

guide walls to compensate for wear, the whole substantially as and for the purpose set forth.

4. An adjustable elastic-fluid nozzle comprising a casing in which is provided a high pressure chamber for elastic fluid, and leading therefrom an adjustable nozzle orifice, said nozzle having all its stationary walls identical with portions of the inner walls of said casing, two of said stationary walls being parallel planes between which is fitted a movable wall for purposes of adjustment, said movable wall being provided, near the throat or high pressure end of said nozzle, with two parallel projections or slides, extending at substantially right angles to the axis of said nozzle and in the direction of movement of said wall, one of said projections extending into the high pressure chamber and the other into an adjacent chamber of lower pressure; a combined division wall and guide, being a part of said casing, dividing said chambers, lying between said parallel slides and provided with a finished surface in contact with each, adapted to guide the same in any movement which may take place during reduced pressure in said high pressure chamber, and a rack attached to the slide located in said low pressure chamber, with pinion and shaft adapted to operate the same, the whole substantially as and for the purpose set forth.

5. An adjustable elastic-fluid nozzle comprising a casing in which is provided a high pressure chamber for elastic fluid, and leading therefrom an adjustable nozzle orifice, said nozzle having all its stationary walls identical with portions of the inner walls of said casing, two of said stationary walls being parallel planes between which is fitted a movable wall for purposes of adjustment, said movable wall being provided, near the throat or high pressure end of said nozzle, with two parallel projections or slides, extending at substantially right angles to the axis of said nozzle and in the direction of movement of said wall, one of said projections extending into the high pressure chamber and the other into an adjacent chamber of lower pressure; a combined division wall and guide, being a part of said casing, dividing said chambers, lying between said parallel slides and provided with a finished surface in contact with each, adapted to guide the same in any movement which may take place during reduced pressure in said high pressure chamber, and means for imparting motion to said movable nozzle wall operatively connected to said slide within said low pressure chamber, the whole substantially as and for the purpose set forth.

6. An adjustable elastic-fluid nozzle comprising a casing in which is provided a high pressure chamber for elastic fluid, and leading therefrom an adjustable nozzle orifice, said nozzle having all its stationary walls identical with portions of the inner walls of said casing, two of said stationary walls being parallel planes between which is fitted a movable wall for purposes of adjustment, said movable wall being provided, near the throat or high pressure end of said nozzle, with two parallel projections or slides, extending at substantially right angles to the axis of said nozzle and in the direction of movement of said wall, one of said projections extending into the high pressure chamber and the other into an adjacent chamber of lower pressure, said movable wall being provided also at each joint between the nozzle passage and said low pressure chamber, with a flange extending into said chamber, increasing the area of said joint and connecting the main body of the movable wall with the slide within that chamber; a combined division wall and guide, being a part of said casing dividing said high and low pressure chambers, lying between said parallel slides and provided with a finished surface in contact with each, adapted to guide the same in any movement which may take place, and means for imparting motion to said movable wall operatively connected to said slide within said low pressure chamber, the whole substantially as and for the purpose set forth.

7. An adjustable elastic-fluid nozzle comprising a casing in which is provided a high pressure chamber for elastic fluid, and leading therefrom an adjustable nozzle orifice, said nozzle having all its stationary walls identical with portions of the inner walls of said casing, two of said stationary walls being parallel planes between which is fitted a movable wall for purposes of adjustment, said movable wall being provided, near the throat or high pressure end of said nozzle, with two parallel projections or slides, extending at substantially right angles to the axis of said nozzle and in the direction of movement of said wall, one of said projections extending into the high pressure chamber and the other into an adjacent chamber of lower pressure, said movable wall being provided also at each joint between the nozzle passage and said low pressure chamber, with a flange extending into said chamber, increasing the area of said joint and connecting the main body of the movable wall with the slide within that chamber, one of said flanges being provided with an opening to admit to the low pressure chamber the shaft of an operating device and adapted by contact therewith to limit the adjusting movement; a combined division wall and guide, being a part of said casing dividing said high and low pressure chambers, lying between said parallel slides

and provided with a finished surface in contact with each, adapted to guide the same in any movement which may take place, and means for imparting motion to said movable wall operatively connected to said slide within said low pressure chamber, the whole substantially as and for the purpose set forth.

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

RICHARD OTTO MULLER.

Witnesses:
HARRY LUSHBAUGH,
JOHN MCCALL.