No. 814,466. PATENTED MAR. 6, 1906.

G. MEYERSBERG.

NOZZLE FOR ELASTIC FLUID TURBINES.

APPLICATION FILED MAY 6, 1905.

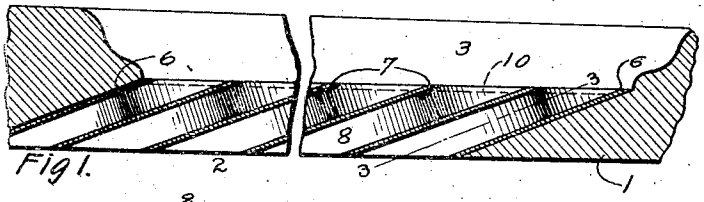

Fig. 1.

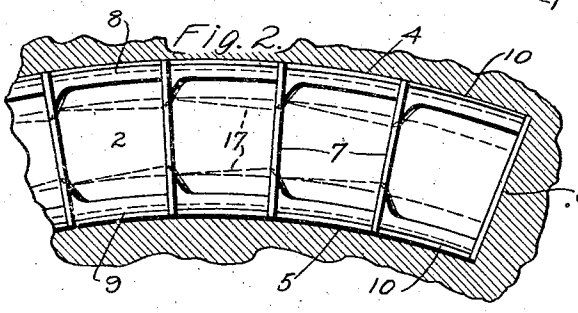

Fig. 2.

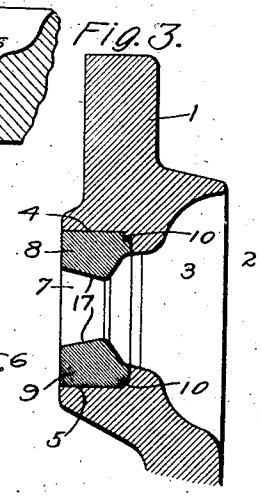

Fig. 3.

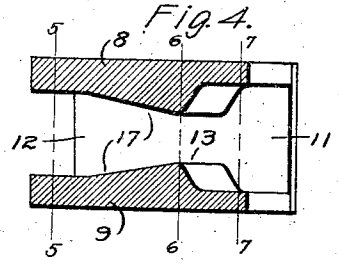

Fig. 4.

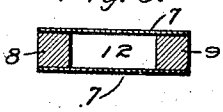

Fig. 5.

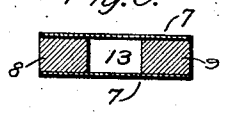

Fig. 6.

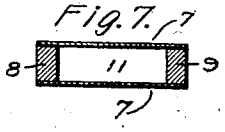

Fig. 7.

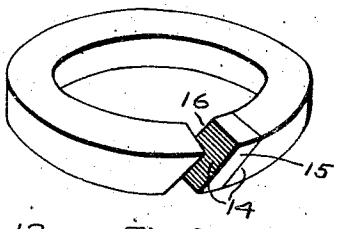

Fig. 8.

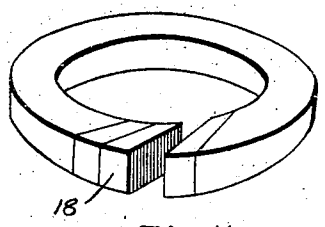

Fig. 10.

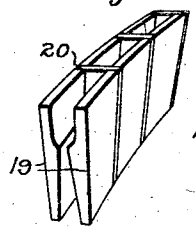

Fig. 12.

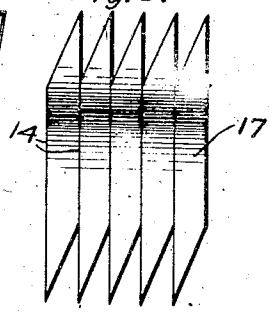

Fig. 9.

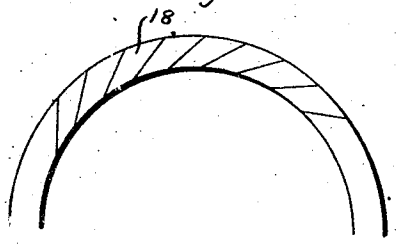

Fig. 11.

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By Albert G. Davis

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UNITED STATES PATENT OFFICE.

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NOZZLE FOR ELASTIC-FLUID TURBINES.

No. 814,466. Specification of Letters Patent. Patented March 6, 1906.

Application filed May 6, 1905. Serial No. 259,090.

To all whom it may concern:

Be it known that I, GUSTAV MEYERSBERG, a subject of the Emperor of Austria-Hungary, residing at Berlin, Germany, have invented certain new and useful Improvements in Nozzles for Elastic-Fluid Turbines, of which the following is a specification.

My invention relates to the art of making nozzles for elastic-fluid turbines; and its object is to improve the method of constructing the nozzles so that they can be manufactured at relatively low cost with a high degree of accuracy and in less time than is required according to the methods usually employed. I attain these results by making the nozzle as a built-up structure, the individual parts of which are accurately machined and completely finished before assembling, and for economy of production they are preferably made in large quantities. In practice the nozzles are arranged in a stationary part of the turbine at one or more points adjacent to the buckets of the wheel or wheels to discharge the motive fluid against them. They may be supported in the wall of the casing, in a diaphragm, or in a ring or segment thereof adapted to be secured to the casing or diaphragm. The member designed to support the nozzle or nozzles is provided with one or more openings or recesses, cast or otherwise formed therein, in which the nozzle parts are assembled. For a nozzle comprising a plurality of fluid-discharging passages, or, as commonly termed, a "sectionalized" nozzle, the opening is segmental in shape, having a curvature corresponding to that of the wheel, and the nozzle parts are arranged therein to divide it into separate fluid-discharging passages and form at the same time the walls of the latter. In a single-passage nozzle the opening in the supporting member is preferably rectangular in cross-section, and the parts are fitted therein to face the walls of the opening and form the passage. The parts which constitute the set for each fluid-discharging or nozzle passage comprise a pair of suitably-formed pieces which form two end walls and a pair of suitably-shaped plates or partitions which form the side walls. The plates are preferably made of sheet metal or strips whose surfaces are smoothly finished, the said plates being cut therefrom to the desired size, after which their edges are dressed. The pieces forming the end walls are shaped to give to the passage the desired configuration. They may be so shaped as to form a passage which is expanding or non-expanding, rectangular or square in cross-section, and which is or may be provided with a bowl, as desired. These pieces are constructed of blocks which are preferably substantially oblique prisms, cut from a ring of suitable cross-section, a segment thereof, or a straight bar, or they may be cast. They may be shaped by hand; but it is preferable to employ a profiling-machine whereby a large number can be finished in one operation. The pieces are made up in two lots, the pieces of one lot being the reverse of the pieces of the other lot, or, in other words, they are shaped as "rights" and "lefts." These pieces may be so arranged that the expansion of the nozzle may be obtained by suitably shaping one of them, or both pieces may contribute to produce this result. In assembling the nozzle parts in the nozzle-receiving openings of the supporting member the pieces are symmetrically arranged along the two arc-shaped side walls, while the plates which are usually rectangular are disposed transversely between the curved walls and parallel to the end walls of the opening in the diaphragm or other support. The end walls of the nozzle-opening in the support are preferably inclined to correspond to the angle of discharge of the passages. The plates thus constitute partitions which separate the passages and give to them the proper angle of discharge, while the symmetrical pieces impart to the passages their characteristic configuration. The symmetrical pieces and the walls of the nozzle-receiving openings are provided with interlocking shoulders which retain the pieces in place. Furthermore, as the pieces are disposed between rectangular plates the latter function as filling or wedging pieces, whereby the nozzle parts are tightly wedged in the supporting member.

With nozzles built up in the manner described the fluid-discharging passages can be constructed according to theoretical requirements with great accuracy and the surfaces or walls of the passage be highly finished, so that the coefficient of friction between the walls and the working fluid is reduced to a minimum. Again, the amount of machine-

work is materially reduced, which decreases the cost of manufacture.

For an understanding of the details of construction reference is to be had to the following description, taken in connection with the accompanying drawings, and the novel features of the invention will be set forth in the claims appended hereto.

In the accompanying drawings, which illustrate one embodiment of my invention, Figure 1 is a longitudinal section of a sectionalized nozzle for an elastic-fluid turbine, showing a portion broken away. Fig. 2 is a plan view of a portion of the nozzle, showing a fragment of the supporting member in section. Fig. 3 is a transverse section on line 3 3, Fig. 1. Fig. 4 is a longitudinal section of one of the discharge-passages. Figs. 5, 6, and 7 are transverse sections taken, respectively, on lines 5 5, 6 6, and 7 7, Fig. 4. Fig. 8 is a perspective view of the stock from which the blocks for making the symmetrical pieces are cut, drawn on a reduced scale. Fig. 9 is a view showing the manner of arranging the blocks for shaping them in the profiling-machine. Fig. 10 is a perspective view showing the manner of cutting the blocks for the symmetrical pieces of a nozzle for a turbine of the radial-flow type. Fig. 11 illustrates the manner of arranging the block for shaping them in a profiling-machine, and Fig. 12 is a perspective view of a portion of a sectionalized nozzle of the radial-flow type.

Referring to the drawings, Figs. 1, 2, and 3, 1 represents a portion of the diaphragm or supporting member that is cast or otherwise provided with a segmental nozzle-receiving opening 2. The walls 3 of the inlet portion of the opening converge inwardly to the portion containing the nozzle parts and serve as a bowl or distributing-chamber for receiving and delivering the motive fluid to the discharging-passages. The portion of the opening containing the nozzle parts comprises concentric side walls 4 and 5, which correspond to the curvature of the row of buckets on the wheel, and end walls 6, which are inclined to correspond to the angle of discharge of the motive fluid.

The nozzle parts comprise flat rectangular plates 7 and symmetrical forming-pieces 8 and 9. The plates are arranged in the nozzle-receiving opening at the inclined ends thereof and at intermediate points and extend parallel to the end walls. Under certain conditions the plates at the ends of the opening may be omitted and the surfaces of the support finished. The plates thus divide the opening 2 into individual passages and serve to direct or discharge the fluid against the wheel-buckets at the proper angle. The symmetrical pieces are arranged in the passages, the piece 8 against the concave side wall 4 and the piece 9 against the convex side wall 5 of the opening, and they are both located between adjacent plates. By this arrangement the plates are disposed between the pieces 8 and 9 of adjacent passages and also between the side walls 6 and the pieces adjacent thereto. The plates are or may be of such size as to make a driven fit between the pieces, thus wedging the parts in place. The pieces 8 and 9 are further secured, by means of interlocking shoulders 10, at their inner ends and adjacent parts of the support 1, Fig. 3.

The pieces 8 and 9 may be shaped to form passages of any desired configuration. As shown in the present instance, the passages formed thereby are of that type which impart velocity to the motive fluid by expansion, each passage comprising a bowl or enlargement 11 and an expanding discharge portion 12, which both merge into a contracted throat 13 between them, Fig. 4. The area of the discharge-passage at these portions is shown in Figs. 5 to 7.

Considering now the process of constructing the nozzle parts, the plates 7 are preferably made from polished strips, cut to the required length and beveled or dressed at their ends, the finished product being simply a flat rectangular plate. To make the symmetrical pieces 8 and 9, substantially prismic blocks are employed. I prefer to make these from two different size rings, one of which having an outer circumference corresponding to the curvature of the concave wall 4 of the opening 2 and the other having an inner circumference corresponding to the curvature of the convex wall 5, so that the block or pieces will snugly fit the walls of the opening when assembled. One of the rings is shown in Fig. 8 to illustrate the manner of cutting the blocks therefrom. It is to be noted in this connection that no attempt has been made to show the ring according to proper scale. The plane of the cuts is radial in one direction and oblique in a direction at right angles thereto, Fig. 8. This produces a block whose surfaces 14 slightly converge in one direction, thereby adapting the blocks to fit the converging spaces between the plates 7, as shown in Fig. 2. Furthermore, the convex surface 15 of the block snugly fits the concave wall 4 when the blocks are cut from the larger ring and the concave surface 16 fits the convex wall 5 when the blocks are cut from the smaller ring. The radial dimension of the cross-section of each ring is sufficient to at least equal the thickest portion of the pieces, and that is represented on line 6 6, Fig. 4. The pieces 8 and 9 are thus made in two lots cut from different size rings. The next operation consists in forming the active or working surface 17 of the pieces, Figs. 2 and 4—that is to say, the surfaces which are in contact with the motive fluid in a finished nozzle and which give to the discharge-passages the desired configuration. These sur-

faces may be cut in any preferred manner. In practice I use a profiling-machine and arrange a number of blocks of one lot, as shown in Fig. 9, and finish them in one operation. Assuming the blocks shown in Fig. 9 to be those employed for the outer pieces 8, the active surfaces 17 are cut on the concave sides of the blocks, thus leaving the convex surfaces on the opposite side to fit the wall 4 of the nozzle-receiving opening 2, Fig. 2. After the pieces 8 are finished the active surfaces are cut on the blocks of the other lot. These latter blocks are arranged in the shaping-machine in a position reverse to that shown in Fig. 9, so that the convex surface may be cut away, and thereby leave the concave surface to fit the convex wall 5 of the opening 2. With the pieces 8 and 9 made in this manner the active surfaces are substantially symmetrical and the other surfaces exactly conform to the opening in which they are assembled.

In a nozzle having a single discharge-passage the nozzle-receiving opening in the supporting member is preferably square or rectangular in cross-section and the walls thereof plane surfaces, so that the symmetrical pieces can be made from straight stock.

In constructing nozzles for a turbine of the radial-flow type rings of uniform size may be used for the stock from which to cut the blocks for making the symmetrical pieces. As shown in Fig. 10, the blocks 18 are cut from the ring by a chordal and transverse cut as distinguished from a radial and oblique cut, as is employed to cut the block for the symmetrical pieces of the nozzles of the axial-flow type. The blocks are made up in two lots as before in order to obtain the symmetrical working or active surfaces. Hence the blocks of one lot are arranged in a circular profiling-machine in the manner shown in Fig. 11 and cut down to the desired shape, while the blocks of the other lot are arranged reversely to those shown, so that the active surfaces will be symmetrical. To construct the nozzle, the symmetrical pieces 19, Fig. 12, are arranged between flat rectangular plates 20 in a manner practically similar to that described in connection with the axial-flow type of nozzle.

In the low-pressure stages the nozzle may extend entirely around the bucket wheel or wheels, in which case suitable provision must be made by the use of ribs or equivalent construction to unite the outer portion of the diaphragm or support with the web or central part, as will be readily understood. These ribs may extend across the nozzle with a suitable steam-space between or they may be arranged between nozzles.

In accordance with the provisions of the patent statutes I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by equivalent means.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. A nozzle for elastic-fluid turbines, comprising oppositely-disposed flat members, and oppositely-disposed symmetrical members which form with the flat members a fluid-discharging passage having an enlarged inlet end.

2. A nozzle for elastic fluid-turbines, comprising oppositely-disposed flat members, and oppositely-disposed symmetrical members which form with the flat members a fluid-discharging passage having an enlarged inlet, and an expanding discharge portion connected with the inlet.

3. In a nozzle, the combination of a support, parallel plates arranged on the support which form a plurality of closely-associated fluid-discharging passages, and forming-pieces which impart the desired configuration to the passages.

4. In a nozzle, the combination of a support provided with an opening or slot, plates arranged in the opening which divide the same into passages, and a pair of forming-pieces arranged between adjacent plates which impart to the passages the desired configuration.

5. In a nozzle, the combination of a support provided with an opening, and symmetrically-arranged forming-pieces arranged adjacent the opposite walls of the opening.

6. In a nozzle, the combination of a support having a curved opening, a plurality of forming-pieces which are symmetrically arranged adjacent the longitudinal walls of the opening, and plates arranged transversely of the opening which divide the same into independent fluid-discharging passages.

7. In a nozzle, the combination of a support having a segmental opening, plates therein which divide the opening into fluid-discharging passages and serve as walls of the latter, and pieces which form the other walls of the passages and are shaped to impart the desired configuration to the passages.

8. In a nozzle, the combination of a support having a segmental opening whose end walls are inclined and parallel, transversely-arranged plates spaced apart in the opening and disposed parallel to the end walls thereof, and forming-pieces between the plates whose adjacent surfaces are symmetrical and whose outer surfaces conform to the curvature of the walls of the openings.

9. In a nozzle, the combination of a support having a segmental opening whose end walls are inclined and parallel, transversely-arranged plates in the opening which are disposed parallel to the end walls, and forming-

pieces arranged along the curved side walls of the opening and between the plate and wedged in position by the latter.

10. In a nozzle, the combination of a support having an elongated opening whose end walls are inclined and parallel, transversely-arranged plates spaced apart in the opening and disposed parallel to the end walls thereof, forming-pieces arranged along the side walls of the opening and between the plates, and interlocking retaining-shoulders on the support and the said pieces.

11. In a nozzle for turbines, the combination of a support having an orifice, detachable members mounted therein which form walls of the fluid-discharging passage and guide and direct the passage of the motive fluid, and other detachable members also located in the orifice which form the other walls of the passage and assist in guiding and directing the motive fluid.

12. In a nozzle for turbines, the combination of a support having an orifice, a detachable member mounted therein which forms a side wall of a discharge-passage and guides and directs the passage of motive fluid, and another detachable member also mounted in the orifice which forms an end wall of the same passage and assists in guiding and directing the motive fluid.

13. In a nozzle for turbines, the combination of a support having an orifice, a plurality of partitions therein which form the side walls of the nozzle-passages, and direct and guide the motive fluid, and detachable members which are also located within the orifice and between the partitions for guiding and directing the motive fluid, the said detachable members engaging the partitions.

14. In a nozzle for turbines, the combination of a support having a bowl, a passage of smaller cross-section than the bowl and receiving fluid therefrom, and members in the passage which face the walls thereof and direct and guide the motive fluid.

15. In a nozzle for turbines, the combination of a support having an opening or orifice, one portion of the opening forming a converging bowl or distributing-chamber, the other portion of the opening having inclined end walls, and members for facing the end walls which guide and direct the motive fluid.

16. In a nozzle for turbines, the combination of a support having a segmental opening or orifice, one portion of the opening having converging walls which form an inlet or bowl, the other portion of the opening having parallel and inclined end walls, and members arranged in the opening parallel to the end walls, some of the members facing said walls and the other or others dividing the opening into separate fluid-discharging passages.

17. In a nozzle for turbines, the combination of a support having a plurality of bowls or distributing-chambers and openings communicating with the bowls, and plates which face the walls of the openings and form passages which guide and direct the motive fluid.

18. In a nozzle for turbines, the combination of a support having a distributing-chamber, a plurality of passages communicating with the chamber and receiving fluid therefrom, thin sheet-metal plates which separate the passages, each passage comprising a bowl, a throat receiving fluid from the bowl, and a discharge portion which receives fluid from the throat and directs it against the bucket-wheels.

19. A nozzle for turbines, the combination of a support provided with an opening, members therein each of uniform cross-section which divide the opening into closely-associated fluid-discharging passages, certain of the members serving to face the end walls of the opening.

20. In combination, a supporting member cast with a segmental nozzle-receiving opening, one portion of the opening being enlarged to form a bowl or chamber for receiving motive fluid and discharging it to the nozzle-passages, and members in the other portion of the opening which divide it into fluid directing and discharging passages.

In witness whereof I have hereunto set my hand this 18th day of April, 1905.

GUSTAV MEYERSBERG.

Witnesses:

JULIUS RUMLAND,

EARL RICKEBEN.