No. 814,477. PATENTED MAR. 6, 1906.

R. H. RICE.

NOZZLE FOR ELASTIC FLUID TURBINES.

APPLICATION FILED NOV. 19, 1904.

2 SHEETS—SHEET 1

Fig. 1.

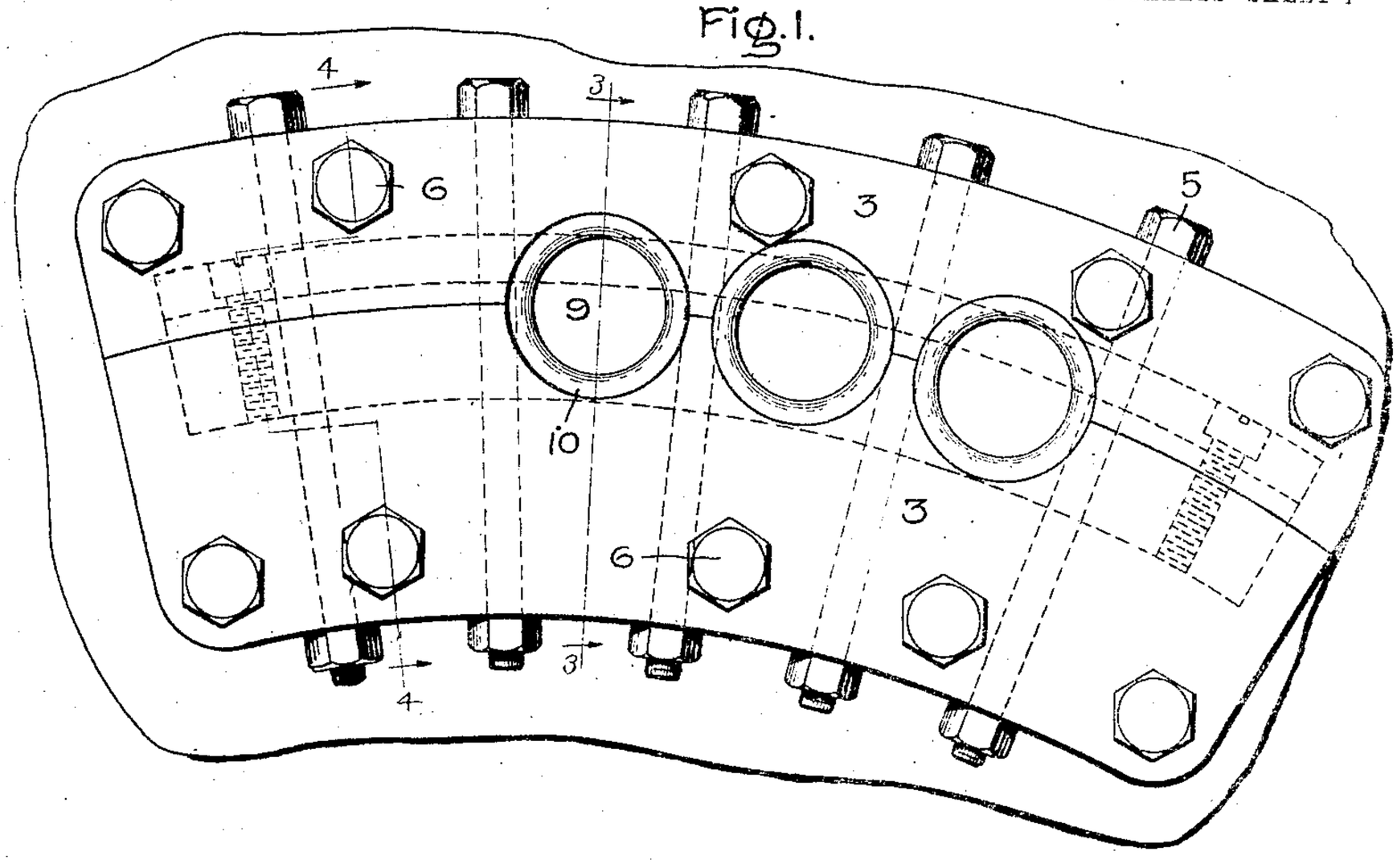


Fig. 2.

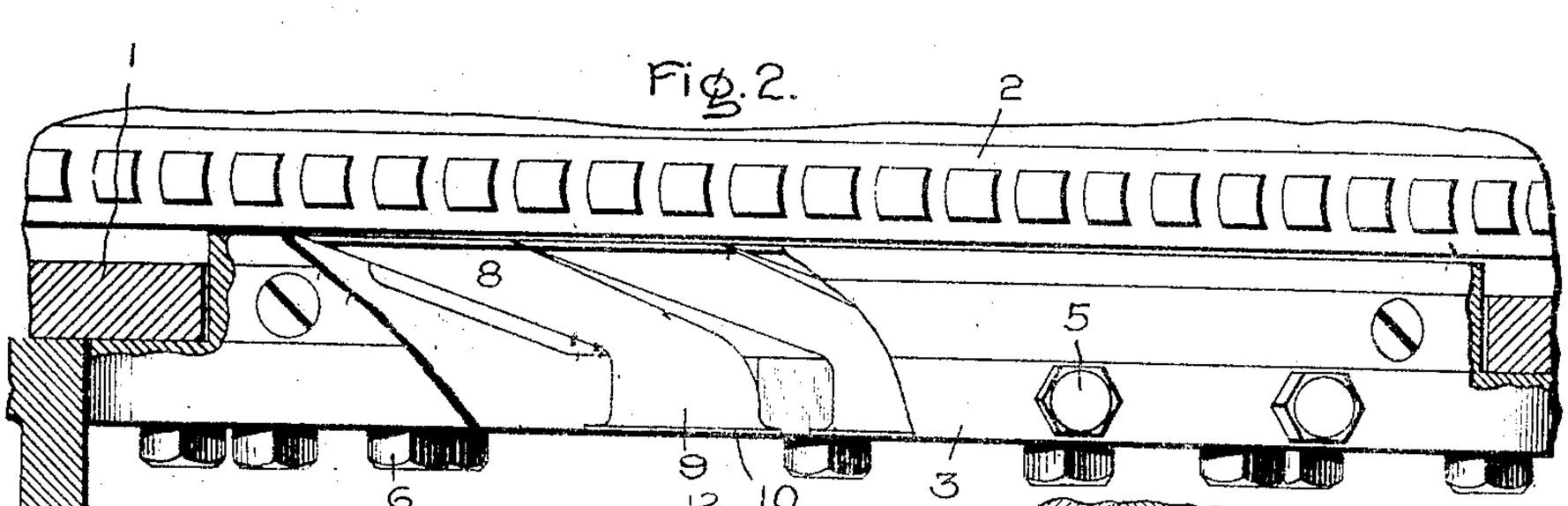


Fig. 3.

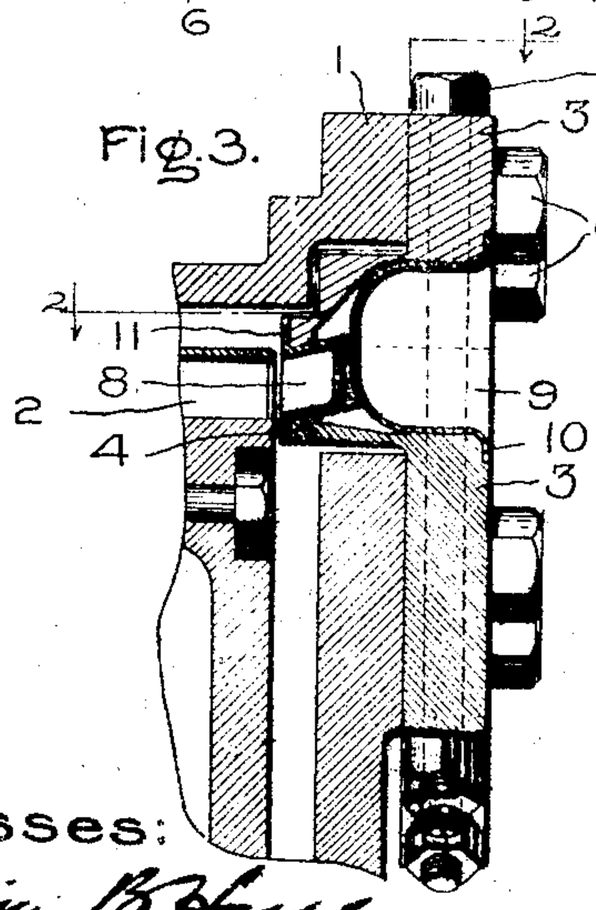
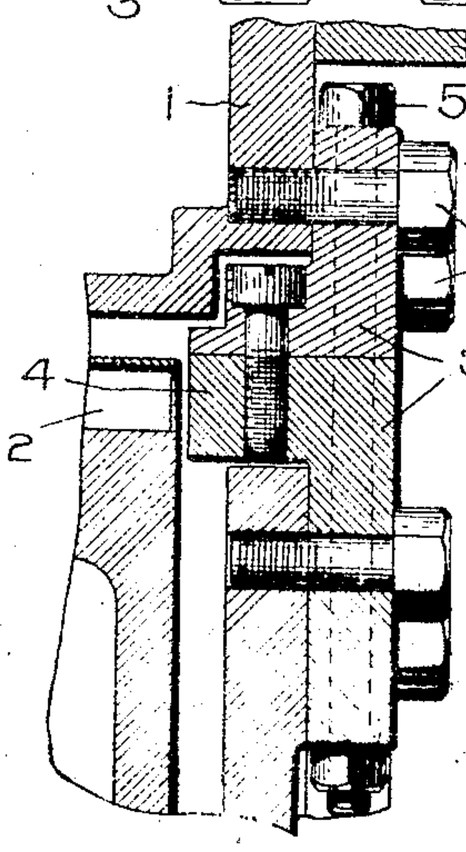


Fig. 4.



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2 SHEETS—SHEET 2.

Fig. 5.

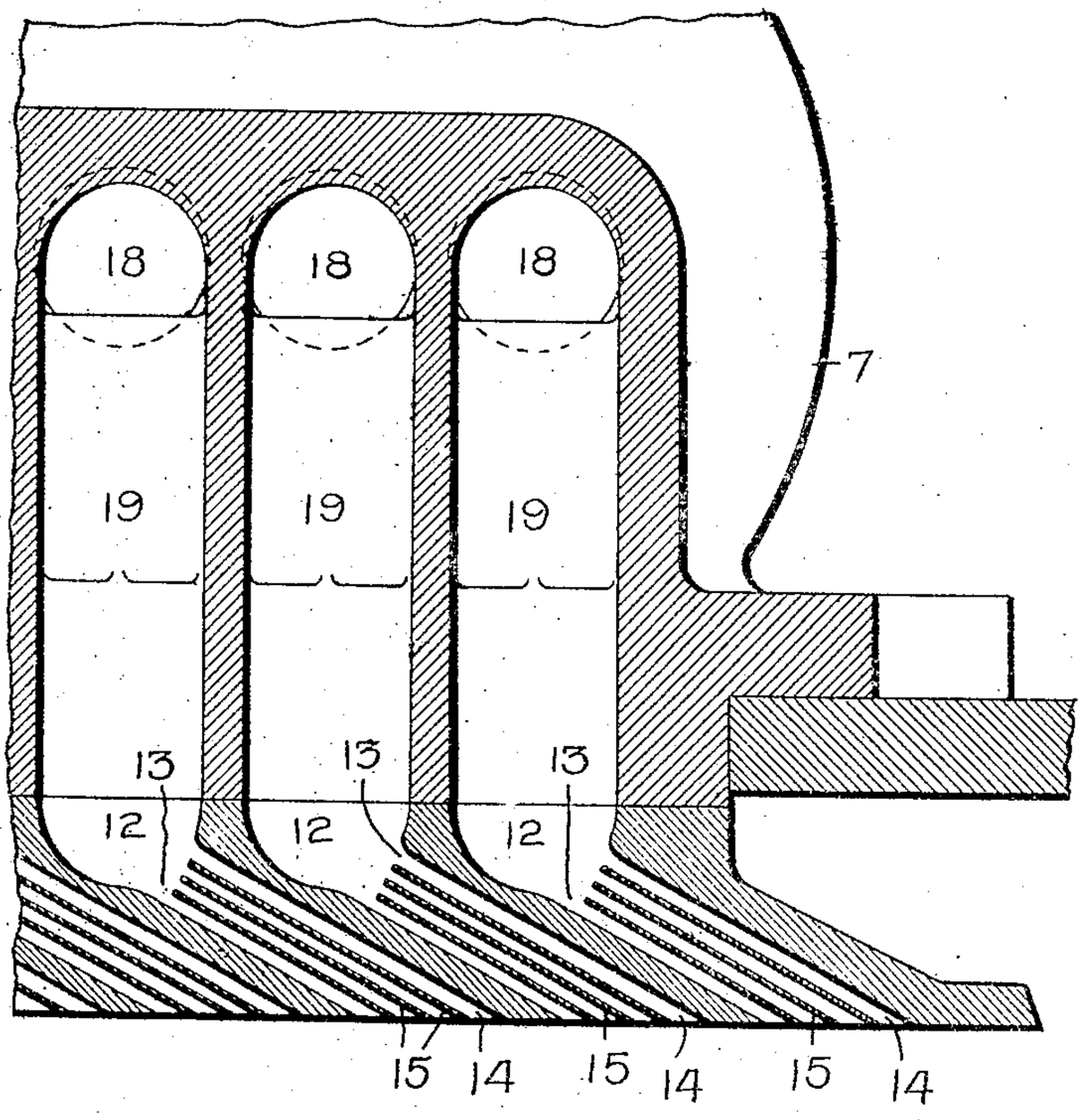
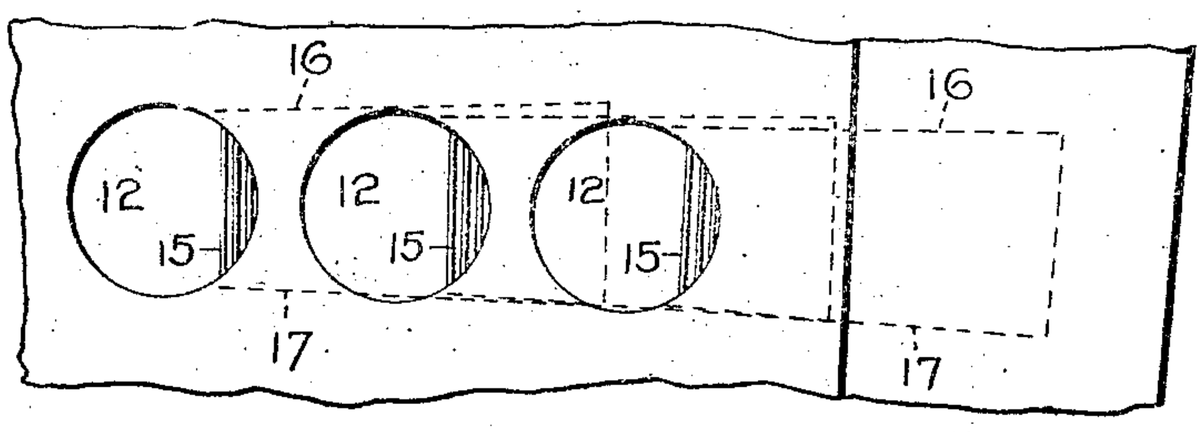


Fig. 6.



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UNITED STATES PATENT OFFICE.

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NOZZLE FOR ELASTIC-FLUID TURBINES.

No. 814,477. Specification of Letters Patent. Patented March 6, 1906.

Application filed November 19, 1904. Serial No. 233,467.

To all whom it may concern.

Be it known that I, RICHARD H. RICE, a citizen of the United States, residing at Swampscott, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Nozzles for Elastic-Fluid Turbines, of which the following is a specification.

The present invention has for its object to improve the construction of nozzles for elastic-fluid turbines and also to so arrange those parts which convert the pressure of the motive fluid into velocity and discharge it against the buckets that they can be readily removed in case of wear or injury and new ones substituted.

A further object of my invention is to provide means for directing the fluid particles in their passage through the nozzle passage or passages in such a way that they will be effectively discharged against the buckets.

In the accompanying drawings, which illustrate one embodiment of my invention, Figure 1 is a view in elevation of a sectionalized nozzle looking into the bowls. Fig. 2 is a view at right angles to that shown in Fig. 1 with certain of the parts broken away, which show the projections for supporting the detachable nozzles at various points, the section being taken on line 2 2 of Fig. 3. Fig. 3 is a sectional view taken on line 3 3 of Fig. 1 and looking in the direction of the arrow. Fig. 4 is a sectional view taken on line 4 4 of Fig. 1 looking in the direction of the arrow. Fig. 5 is a sectional view showing a nozzle with partitions for directing passage of the fluid particles; and Fig. 6 is another view of the same, showing the expansion of the side walls.

1 represents the casing, and 2 a wheel mounted therein having buckets of any suitable form. The casing is cut away at some point adjacent to the wheel-buckets to receive the nozzle-plate 3. The latter is provided with one or more orifices, depending upon the number of individual nozzles it has to support. The plate is divided in a plane passing through the center of nozzle-receiving orifices, so that the nozzles may be readily slipped into place. On the side adjacent to the wheel the plate is provided with a projection 4, having the same general curvature as that of the wheel. This projection is arranged to engage with the sides of the discharge portion of the nozzle or nozzles and hold it or them in place. The arrangement of the parts for supporting the discharge portion of the nozzles is best shown in Figs. 2 and 3.

The parts of the nozzle-plate are secured by means of radially-extending bolts 5. The plate as a whole is secured to the casing by bolts 6. Surrounding the nozzle-plate is a valve-chest 7 of any suitable construction. The nozzles may be used as admission-nozzles or as nozzles between stages. In the latter case it would not ordinarily be necessary to provide a valve-chest 7; but it can be provided, if desired.

The nozzles are similar in construction and are alike in form and angle of discharge. Each nozzle is provided with a discharge portion 8, which may be expanding or non-expanding in character. A suitable throat is also provided between the discharge portion and the bowl 9. The latter should be of substantial size and well rounded. The bowl is provided with a flange 10, that is seated in a circular groove or depression in the parts of the nozzle-plate. The flange constitutes a means for securing the nozzles in place and also a means for insuring a steam-tight joint. The wall of the nozzle-plate adjacent to the flange preferably overhangs to a slight extent, and the metal of which the flange is composed is crowded under the said overhanging wall in a manner well understood. Various other arrangements may be employed for securing the nozzles in place without departing from my invention. The discharge end of each nozzle is also provided with a flange 11, which may be secured to the projection on the nozzle-plate in the manner described in connection with the flange 10. It will thus be seen that each nozzle or, more strictly, each nozzle-section is provided with two flanges, one at each end, with the support therefor located between them. Hence the nozzles can be readily clamped in place and yet are easily removed in case it is desired to replace them either with new nozzles of the same form and angle of delivery or with new nozzles having a slightly-different form and angle of delivery or nozzles having a different ratio of expansion between the throat and the discharge end.

The nozzles may be constructed in any suitable manner. I have found that sheet-

metal nozzles are satisfactory for the purpose, and these may be formed in a number of different ways. Preferably each nozzle is made of some sort of homogeneous metal which is capable of receiving a smooth finish, since the smoother the surfaces are which are presented to the steam the more efficient will be the action thereof.

Referring to Fig. 5, I have shown an arrangement which is desirable for nozzles handling large volumes of steam or other elastic fluid. It has been found by experience that where large nozzle-passages are provided the particles of the steam do not always flow in parallel planes and that owing to this fact they tend to cause eddies, and thus decrease the effective action of the nozzle. Again, the bucket-spaces are not always completely filled. To overcome this, I provide thin partitions or laminations, which are located within each of the nozzle-passages and, extending from the throat to the discharge end and at every point, are parallel with each other and with two walls of the nozzle. I may use one or more of the partitions in each nozzle-passage, as desired, the number varying somewhat, depending upon the capacity of the nozzle. 12 represents the bowl of the nozzle, 13 the throat, and 14 the discharge portion. It is to be noted that the upper and lower walls of the nozzle from the throat 13 to the discharge end are parallel and that the thin metal partitions 15, located within the discharge portion, are also parallel to each other and to the upper and lower walls. With such a construction the particles of steam or other elastic fluid will be directed along parallel planes, and the tendency to eddies and other disturbances will be reduced to a minimum. I may use these partitions in connection with sheet-metal nozzles of the form shown in Figs. 1 to 4, inclusive, or I may use them in connection with cast-metal nozzles or nozzles otherwise formed. In these cases the partitions can be supported in longitudinal grooves formed in the side walls or by other suitable means.

Since it is important to direct the steam through the nozzles in parallel planes, the expansion must take place at right angles to the plane of the partition in order to obtain the most satisfactory results. In Fig. 6 the throat of the nozzle is substantially square, and from this point to the discharge end the walls 16 and 17 gradually diverge. To state the matter in a different way, the expansion in this case takes place in a radial rather than a circumferential direction. In Fig. 5 is shown the separately-actuated valves 18 for controlling the passage of fluid to the sections or passages of the sectionalized nozzle. These valves are so constructed and arranged that they are fully open or closed, so as not to throttle the admission of fluid to the nozzle-sections. Leading from the valve to the bowl of each section is a passage 19 for conveying motive fluid. These passages may be formed in separate or in a common structure. The valves may be operated electrically by mechanical means, by hydraulic or other fluid-pressure, or by other means.

I am aware of the patent to John T. Fanning, No. 123,388, dated February 6, 1872, wherein a gate for a hydraulic turbine is shown having relatively thick partitions and a valve coöperating therewith to cut one section out after the other. In other words, the object of the patent is to change the flow of water; but in doing so a throttling action of each section takes place. My improved construction differs from this in that it relates to elastic-fluid turbines, and the partitions serve only to direct the fluid particles as distinguished from partitions which coöperate with and form a seat for a valve to regulate the supply of fluid. Again, my improved construction comprises a bowl for each passage, the latter being of the expansion type. Various other distinctions will be apparent from the specification and drawings.

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 other means.

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

1. In a nozzle for elastic-fluid turbines, the combination of one or more separately-formed nozzles having enlarged bowls, a nozzle-plate having a number of orifices corresponding to the number of nozzles each orifice receiving a bowl, and a means for securing each of the nozzles to the plate.

2. In a nozzle for elastic-fluid turbines, the combination of one or more separately-formed nozzles, each nozzle having a bowl and a discharge portion, a nozzle-plate which is provided with as many orifices as there are nozzles each orifice receiving a bowl, and projections or walls that engage the discharge portion of the nozzle or nozzles.

3. In a nozzle for elastic-fluid turbines, the combination of a nozzle-plate containing one or more orifices, one or more sheet-metal nozzles, each having a discharge portion, and an enlarged flanged bowl, the flange on the bowl or bowls engaging with the plate and acting as a securing means for the nozzle or nozzles.

4. In a nozzle for elastic-fluid turbines, the combination of one or more separately-formed nozzles, a divided plate which receives the nozzle or nozzles, and means for uniting the parts of the plate.

5. In a nozzle for elastic-fluid turbines, the combination of a plate having one or more orifices, which is divided in a plane passing

through the center of the orifices, nozzles corresponding in number to the orifices, each nozzle being provided with a bowl which fits into an orifice and a discharge portion, and means for clamping the parts of the plate around each of the bowls.

6. In an elastic-fluid turbine, the combination of a bucket-wheel, a casing therefor having an opening to receive the nozzle or nozzles, one or more separately-formed nozzles, a divided nozzle-plate which receives the nozzles and supports them at the bowl and also at the discharge portion, and means for uniting the parts of the nozzle-plate and for securing the plate to the casing.

7. In a nozzle for elastic-fluid turbines, the combination of side walls therefor, other walls which separate the space between the first-mentioned walls into a plurality of sections and also coöperate to form an individual bowl for each section, and partitions in the sections which extend from the bowls to the end of the nozzle for directing the passage of and causing the fluid particles to flow in parallel planes and preventing eddies.

8. A nozzle comprising a bowl, and a discharge portion having plane walls two of which are parallel, in combination with a plurality of partitions located in the discharge portion and extending from the throat to the end of the nozzle to form individual expanding passages common to the bowl, said partitions being parallel to the parallel walls of the discharge portion and to each other.

9. A sectionalized nozzle for an elastic-fluid turbine, comprising a plurality of nozzle-passages which are alike in form and angle of delivery, each passage having two parallel walls and two diverging walls, a bowl and throat for each nozzle, and partitions in each passage which are parallel with said parallel walls.

10. In combination, a nozzle having outwardly-extending end flanges with a divided supporting-plate which engages the nozzle and also both of the flanges.

In witness whereof I have hereunto set my hand this 17th day of November, 1904.

RICHARD H. RICE.

Witnesses:
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