No. 822,258. PATENTED JUNE 5, 1906.

W. L. R. EMMET.

ELASTIC FLUID TURBINE.

APPLICATION FILED APR. 7, 1904. RENEWED SEPT. 28, 1905.

2 SHEETS—SHEET 1.

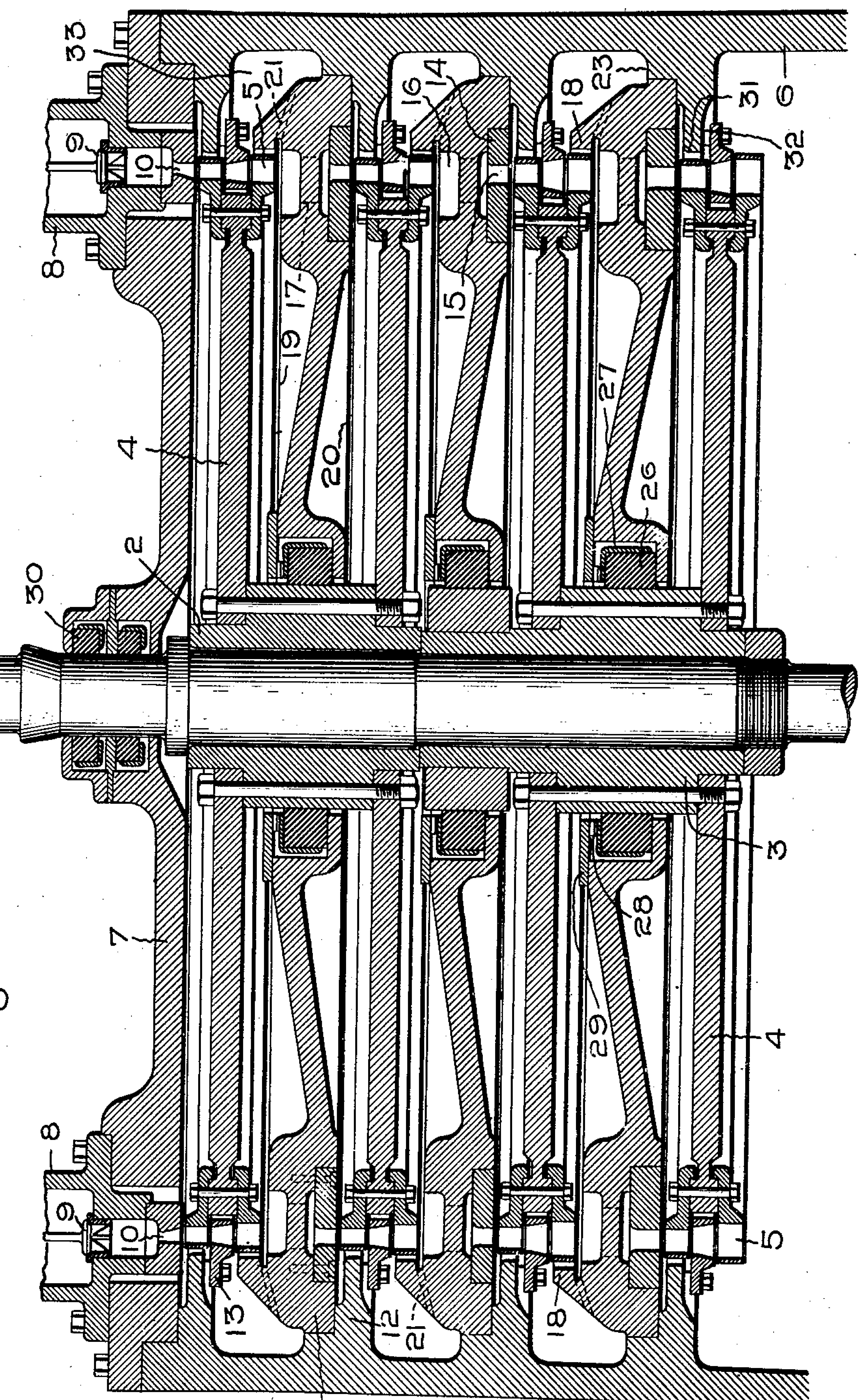

Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 2.

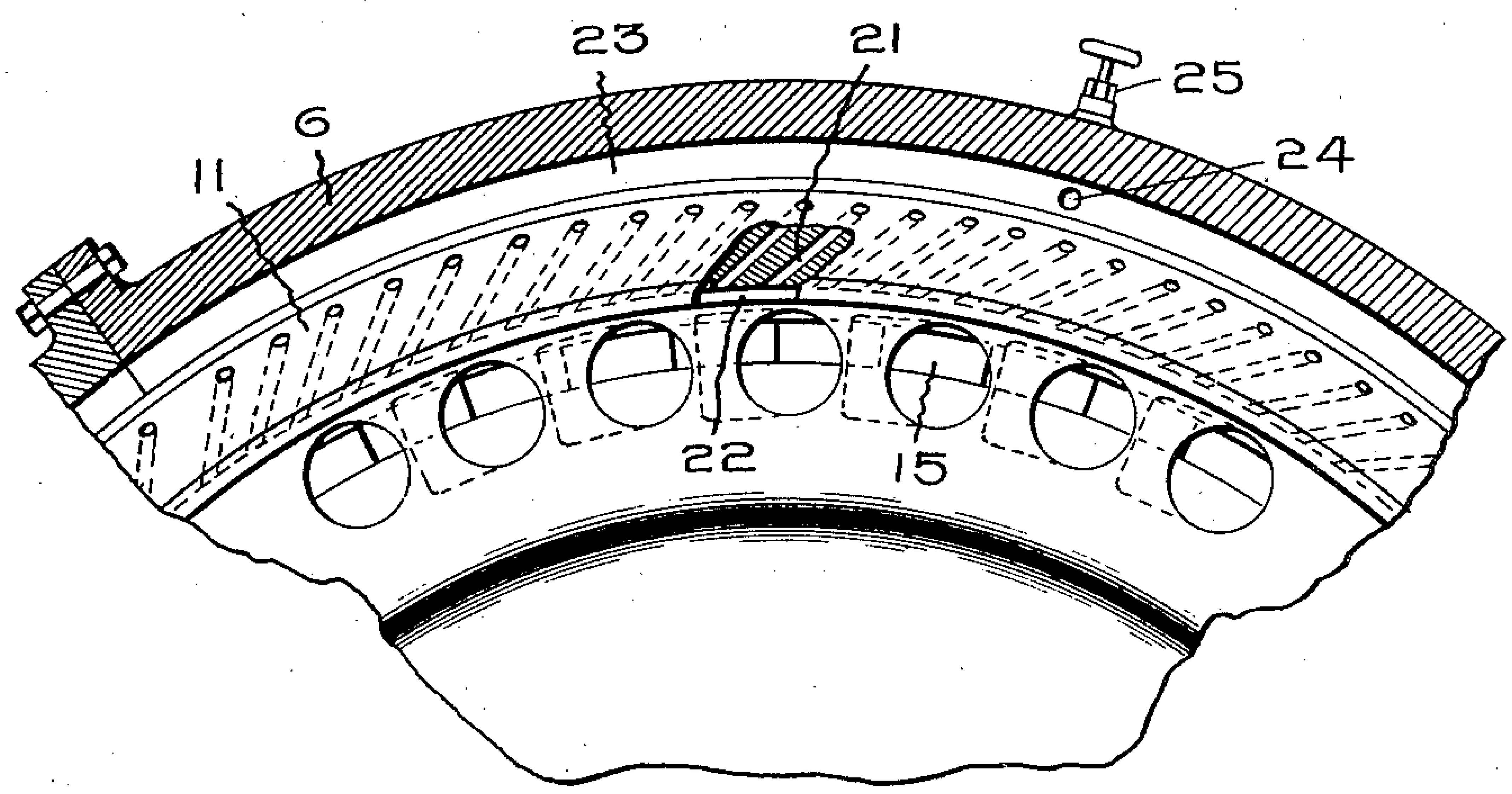
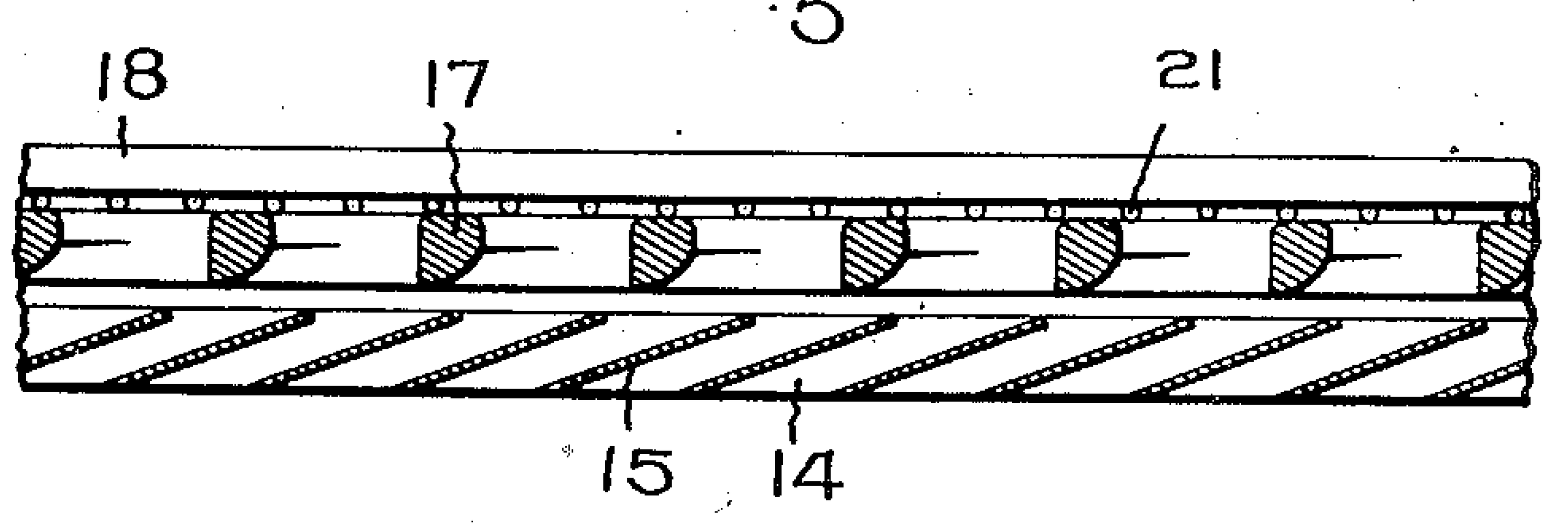


Fig. 3.



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Inventor:
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UNITED STATES PATENT OFFICE.

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ELASTIC-FLUID TURBINE.

No. 822,258. Specification of Letters Patent. Patented June 5, 1906.

Application filed April 7, 1904. Renewed September 28, 1905. Serial No. 280,462.

To all whom it may concern:

Be it known that I, WILLIAM L. R. EMMET, a citizen of the United States, residing at Schenectady, in the county of Schenectady and State of New York, have invented certain new and useful Improvements in Elastic-Fluid Turbines, of which the following is a specification.

The present invention relates to elastic-fluid turbines, and has for its object to increase their efficiency and also to simplify and improve their construction.

In carrying out my invention the turbine is divided into any number of stages, and each stage contains a wheel having one or more rows of buckets. Where each stage has two or more rows of wheel-buckets, intermediate buckets are provided between each two rows. These buckets may extend wholly or partially around the wheel, depending principally upon the power to be developed by the machine and whether it be a high or low pressure stage. Steam or other elastic fluid is discharged into the turbine by one or more nozzles, preferably of the sectionalized type. The several sections of which the nozzle is composed are preferably closely associated, so as to discharge the fluid in the form of a solid column, and these sections may be expanding or non-expanding in character. The cross-sectional area of the nozzles or other discharging devices increases from the high to the low pressure stage to accommodate the increased volume of fluid. This increase may take place in a radial or circumferential direction, or in both.

The operating parts are inclosed within a casing which is made up in segments, preferably divided in axial planes and the several segments properly united. The casing is provided with a number of internal shoulders, and seated thereon are diaphragms which divide the casing into compartments each containing a wheel. In a vertical machine the diaphragms may be held against the shoulders by their own weight and by the pressure of motive fluid thereon. In a horizontal machine provision should be made for holding the diaphragms in place when the pressure is relieved. In addition to supporting the diaphragms each shoulder supports a more or less complete row of intermediate buckets. In this manner the longitudinal dimension of the turbine is reduced to a minimum. The arrangement also simplifies the machine-work, since the shoulder for the diaphragm and that for the intermediate are on the same piece. The projection also acts to reduce the rotation losses by presenting a smooth wall in close proximity to the outer ends of the buckets or to the cover.

The diaphragms are cut away on the under side to receive the nozzles and on the upper side are provided with one or more chambers communicating with the preceding wheel-chamber and also with the inlet portions of the nozzles. The arc covered by the chambers in the several diaphragms increases from the inlet to the exhaust.

Extending across each of the chambers of the low-pressure diaphragms are ribs which are employed to strengthen the diaphragms. These ribs are more necessary in the low-pressure diaphragms than in the high, because more metal has to be cut out to give free admission to the adjacent nozzles; but they can also be used in the high-pressure diaphragms, if desired. In this construction the chamber or chambers for supplying the nozzles, which do not require special finishing, are formed in the diaphragm, while the nozzle portions which do require special finishing are made in a separate structure, and, being relatively light, can easily be handled. This arrangement of parts decreases the cost of manufacture and also simplifies the character of the machine-work to be performed.

In order to reduce the windage losses due to the rotation of idle buckets in a comparatively dense medium, the wall of the diaphragm adjacent the discharge side of the wheel-buckets is made smooth and is located in close proximity thereto. The portions of the diaphragm on the opposite or inlet side and between the nozzles are also made smooth and situated in close proximity to the next wheel or lower pressure for the same reason. In other words, each diaphragm is provided with walls or surfaces on opposite sides, which act on different wheels to decrease rotation losses. In addition to the foregoing I may provide walls located at the ends of the buckets and at right angles or substantially at right angles to the side walls for further decreasing the rotation losses. These walls may be mounted on the diaphragm, or they may be formed integral therewith, the latter being the better construction, since it reduces the number of parts and the amount of machine-work. As before stated, the projections which support the diaphragms and intermediates also assist in reducing the rotation losses.

In order to discharge the water given up by the steam in expanding, the end walls are provided with gravity-discharge passages, and these passages may all communicate with a groove situated in line with the clearance between the relatively movable buckets.

In the accompanying drawings, which illustrate one embodiment of my invention, Figure 1 is a vertical section of a four-stage turbine of the jet type having two rows of wheel-buckets per stage. Fig. 2 is a detail sectional view of a slight modification of the nozzle and showing the arrangement of the end wall for decreasing the rotation losses, together with the passages for discharging the water; and Fig. 3 is a sectional view through one of the low-pressure nozzles.

1 represents the main shaft, and mounted thereon are sleeves 2 and 3, each of which is provided with two wheel-disks 4, each disk being located in a separate compartment. At the periphery the disk is provided with rows of wheel-buckets 5, which are attached to its side faces. Surrounding the wheels is a casing 6, which may be divided into sections in any suitable manner. The upper end of the casing is provided with a shoulder to receive the cover 7, the latter being provided with one or more openings to receive the valve-chests 8. Each of these chests contains a plurality of separately-actuated valves 9, which control the admission of motive fluid to the first-stage nozzles 10. The valves are directly or indirectly controlled by a speed-responsive device moving in synchronism with the main shaft 1.

Situated between the wheel-disks are diaphragms 11, which are seated on shouldered projections 12, formed on the inside of the casing. The shoulder for the diaphragm is formed on the upper side of the projection, and on the lower side of the projection a second shoulder is formed to receive the support 13 of the intermediate buckets, which receive fluid from one row of wheel-buckets and discharge it at the proper angle against the next. The under side of the diaphragm is cut away to receive the nozzle 14, which comprises a relatively thin flat plate, which is curved in the arc of a circle and is provided with a number of passages 15, which may be expanding or non-expanding in character. The upper surface of the diaphragm is provided with one or more chambers 16, which extend in the arc of a circle and cover an area substantially the same as that covered by the nozzle. Extending across these chambers are strengthening-ribs 17.

Formed integral with the diaphragms and extending at right angles thereto are projections 18, having smooth walls situated adjacent to the ends of the buckets.

These walls serve to decrease the rotation losses. The upper surface 19 of the diaphragm is faced off smooth and is situated in close proximity to the discharge side of a row of wheel-buckets. The under side of the diaphragm is provided with a smooth flat surface 20, which is situated in close proximity to the receiving side of the idle buckets and reduces the rotation loss at this point.

For convenience in description I have termed the portion 18 an "end wall," because it is located at the ends of the buckets, and the surfaces 19 and 20 "side walls," because they are located, respectively, at the discharge and inlet sides of the buckets. These walls serve as a hood or mask to inclose the idle buckets, and surrounding the walls is a chamber wherein the expanding motive fluid is given a chance to discharge its moisture.

In order to discharge the water given up by the expanding steam as it leaves the wheel, inclined passages 21 are provided, which are formed in the diaphragm. The passages are inclined, as shown in Fig. 2, so that their general direction is tangential to the periphery of the wheel. These passages communicate with a groove 22, that is also formed in the diaphragm. Surrounding the diaphragm is a gutter 23, into which the water is discharged by the passages 21. This gutter is in communication with an adjacent stage or wheel chamber of low pressure by means of the vertically-extending passage 24, that may be provided with a valve 25.

The diaphragm is provided with a central cut-away portion to receive the carbon packing 26, which packing is provided with a metal holder 27, and engaging with the latter is a spring 28. Situated above the spring and attached to the diaphragm is a plate 29. The carbon ring 26 engages with the peripheral flange on the sleeve 3 at a point between the wheel-disks and prevents the escape of fluid from one compartment to the other. The cover 7 is also provided with suitable packing-rings 30 for preventing the escape of motive fluid at this point.

In Figs. 2 and 3 the ribs 17 between the nozzle-openings are flush with the surface of the diaphragm instead of being below the surface, as in Fig. 1.

The projections in addition to acting as a support for the diaphragms and intermediates also act to reduce the rotation losses of the wheels. This is due to the smooth end wall 31, which is situated in close proximity to the bucket-cover on the wheel. The water discharged through the clearances passes through the openings 32, strikes the inclined wall of the diaphragm below it, and is deflected into the gutter.

Surrounding the walls of the hood is a

chamber 33, wherein the motive fluid escaping through the clearances is somewhat removed from the whirling effects of the wheel and is given an opportunity to discharge the moisture due to expansion.

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. An elastic-fluid turbine comprising wheel and intermediate buckets, and a diaphragm between the wheels, in combination with an internal projection on the casing, which forms a support that is common to the diaphragm and the intermediate buckets.

2. An elastic-fluid turbine comprising wheel and intermediate buckets, and a diaphragm between the wheels, in combination with an internal projection on the casing, which has shoulders on opposite sides, one shoulder being adapted to receive the diaphragm and the other the intermediates.

3. An elastic-fluid turbine comprising wheel and intermediate buckets, and a diaphragm between the wheels, in combination with an internal projection on the casing, having a shoulder on its upper side upon which the diaphragm rests, and a shoulder on its under side with which the intermediate buckets engage, and means for securing the buckets in place.

4. An elastic-fluid turbine comprising wheel and intermediate buckets, and a diaphragm between the wheels, in combination with an internal projection on the casing, having two shoulders thereon, one of said shoulders being of greater diameter than the other, the one of larger diameter receiving the diaphragm and the other the intermediate buckets.

5. An elastic-fluid turbine comprising a casing and bucket-wheels, in combination with a diaphragm between the wheels, which is provided with a chamber on one side, and a cut-away portion on the other, and a nozzle mounted in the cut-away portion and arranged to receive motive fluid from the chamber.

6. An elastic-fluid turbine comprising a casing, bucket-wheels, and intermediate buckets, in combination with a diaphragm situated between the wheels, and a means carried by the diaphragm and located adjacent to the moving buckets for decreasing the rotation losses.

7. An elastic-fluid turbine comprising a casing, bucket-wheels, and intermediate buckets, in combination with a diaphragm situated between the wheels, and a projection formed on the diaphragm, which incloses the wheel for decreasing the rotation losses.

8. An elastic-fluid turbine comprising a casing, bucket-wheels, and intermediate buckets, in combination with a diaphragm situated between the wheels, the walls of which are in close proximity to the sides of the wheel-buckets for reducing the rotation losses, and an end wall carried by the diaphragm for further reducing the rotation losses.

9. An elastic-fluid turbine comprising a casing, bucket-wheels, and intermediate buckets, in combination with a diaphragm situated between the wheels, a projection formed on the diaphragm which incloses the wheel for decreasing the rotation losses, and a passage for discharging moisture given up by the expanding motive fluid.

10. An elastic-fluid turbine comprising a casing, bucket-wheels, intermediate buckets, and a diaphragm between the wheels, in combination with an internal projection on the casing, which forms a support common to the diaphragm and intermediates, and also serves to reduce the rotation losses of a wheel.

11. An elastic-fluid turbine comprising a casing, bucket-wheels, and intermediate buckets, in combination with an internal projection formed on the casing, which acts to reduce the rotation losses of a wheel, a diaphragm, and means carried by the diaphragm which also acts to reduce the rotation losses.

12. An elastic-fluid turbine comprising a casing, a wheel having rows of buckets, a diaphragm, a wall formed on the casing which acts to reduce the rotation losses at the end of one row of buckets, and a wall formed on the diaphragm, which acts to reduce the rotation losses at the end of a different row of buckets.

13. An elastic-fluid turbine comprising a casing, a bucket-wheel, and a diaphragm, in combination with an internal projection on the casing, which supports the diaphragm and also acts to reduce rotation losses.

14. An elastic-fluid turbine comprising a casing, a bucket-wheel, intermediate buckets, and a diaphragm, in combination with an internal projection on the casing, which supports the diaphragm and the intermediate buckets and also acts to reduce the rotation losses.

15. In an elastic-fluid turbine, the combination of a casing, wheel-disks within the casing, a shaft, a sleeve mounted thereon, which forms a support common to the disks, and a diaphragm which is situated between the wheels and rests on the casing at the periphery and closely surrounds the sleeve at its central portion.

16. An elastic-fluid turbine comprising a casing, and movable buckets, in combination with an internal projection formed on the

casing, which acts to reduce the rotation losses of the buckets.

17. An elastic-fluid turbine comprising a casing, and movable buckets, in combination with an internal projection formed on the casing, which acts to reduce the rotation losses of the buckets, and passages formed in the projection for discharging moisture given up by the expanding motive fluid.

18. An elastic-fluid turbine comprising a casing, a nozzle, and wheel-buckets, in combination with a diaphragm between the wheel-buckets, a support for the diaphragm, a hood for the wheel-buckets for reducing rotation losses, a chamber inclosing the hood, and passages discharging moisture from the spaces between the hood and wheel into the chamber.

19. In an elastic-fluid turbine, the combination of a casing, and a diaphragm which divides the casing into wheel-compartments, the diaphragm presenting a smooth surface to the idle buckets to reduce rotation losses and coöperating with the casing to form a chamber for collecting moisture given up by the expanding motive fluid.

20. An elastic-fluid turbine comprising a casing, a bucket-wheel, and a diaphragm, in combination with an internal projection on the casing which presents a smooth surface to the buckets and acts to reduce rotation losses and which coöperates with the diaphragm and the casing to form a chamber for collecting the moisture given up by the expanding motive fluid.

21. An elastic-fluid turbine comprising a casing, a diaphragm dividing the casing into compartments, bucket-wheels in the compartments, and a shaft, in combination with a sleeve on the shaft which forms a support common to the wheels.

22. An elastic-fluid turbine comprising a casing, a diaphragm dividing the casing into compartments, bucket-wheels in the compartments, and a shaft, in combination with a sleeve secured to the shaft which forms a support common to the wheels, and means for securing the wheels to the sleeve to rotate therewith.

23. An elastic-fluid turbine comprising a casing, and bucket-carrying disks, in combination with a wall located in the space between the disks for dividing the casing into compartments, and which also acts to reduce rotation losses, and a sleeve on the shaft which forms a support common to the disks.

24. An elastic-fluid turbine comprising a casing, bucket-wheels therein, a shaft for the wheels, and a diaphragm located between the wheels, in combination with a sleeve on the shaft to which the wheels are secured, and a packing between the diaphragm and the sleeve.

In witness whereof I have hereunto set my hand this 5th day of April, 1904.

WILLIAM L. R. EMMET.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.