No. 719,294. PATENTED JAN. 27, 1903.

D. F. ASBURY.

FLUID PRESSURE TURBINE.

APPLICATION FILED JUNE 21, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

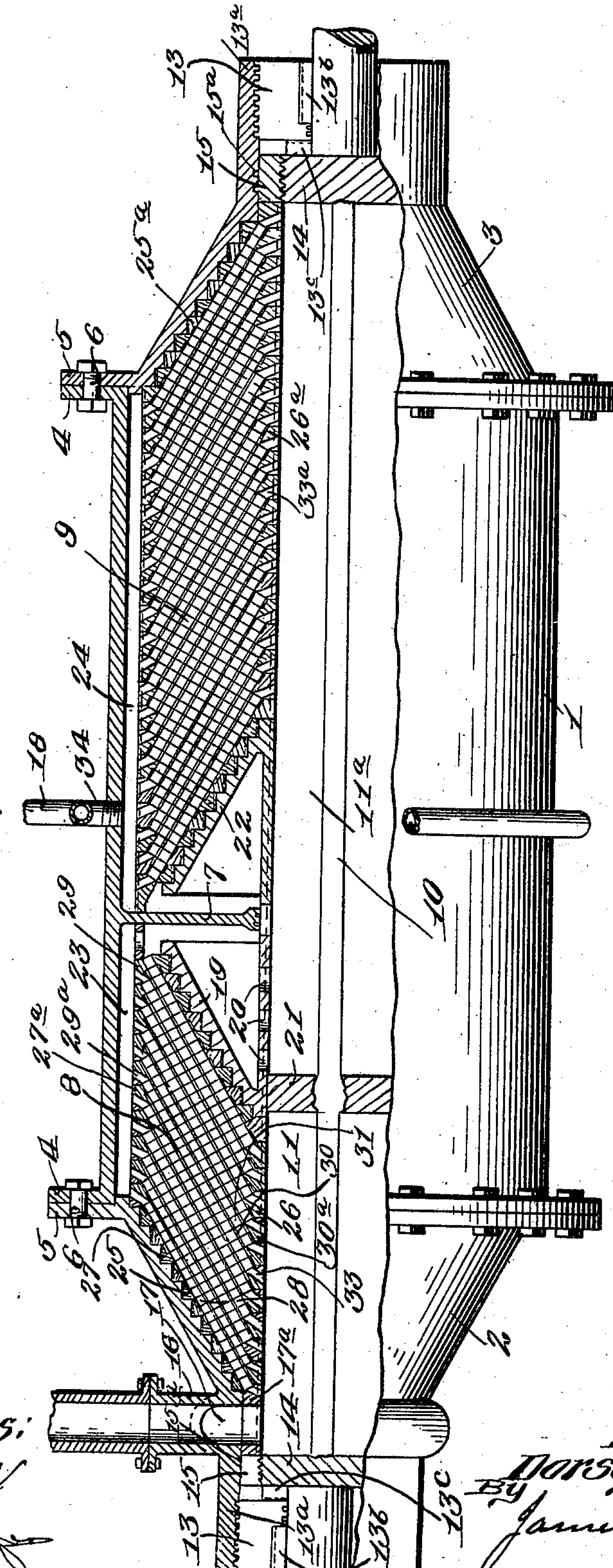

Fig. 1.

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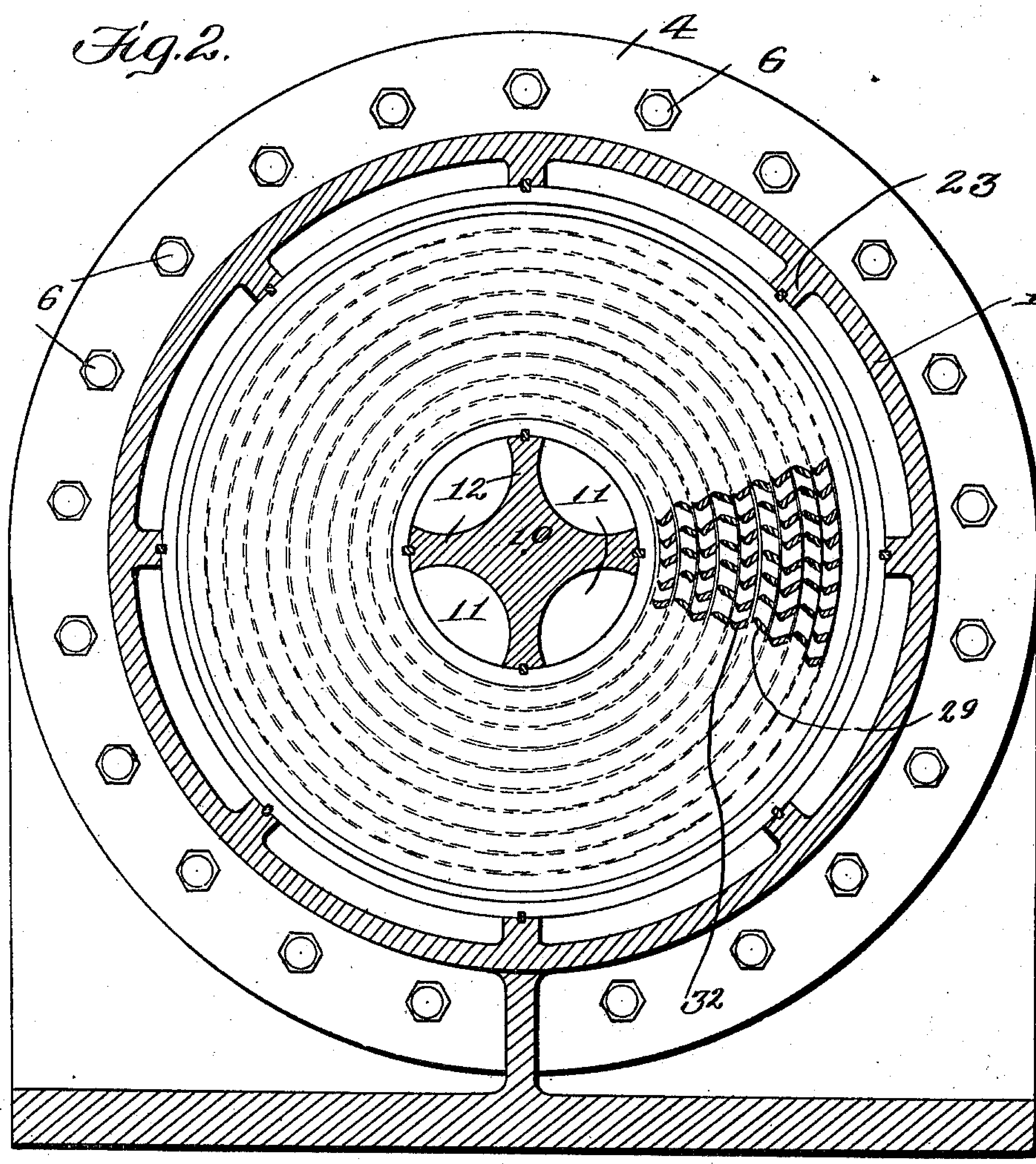
NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2.



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NO MODEL.

3 SHEETS—SHEET 3.

Fig. 3.

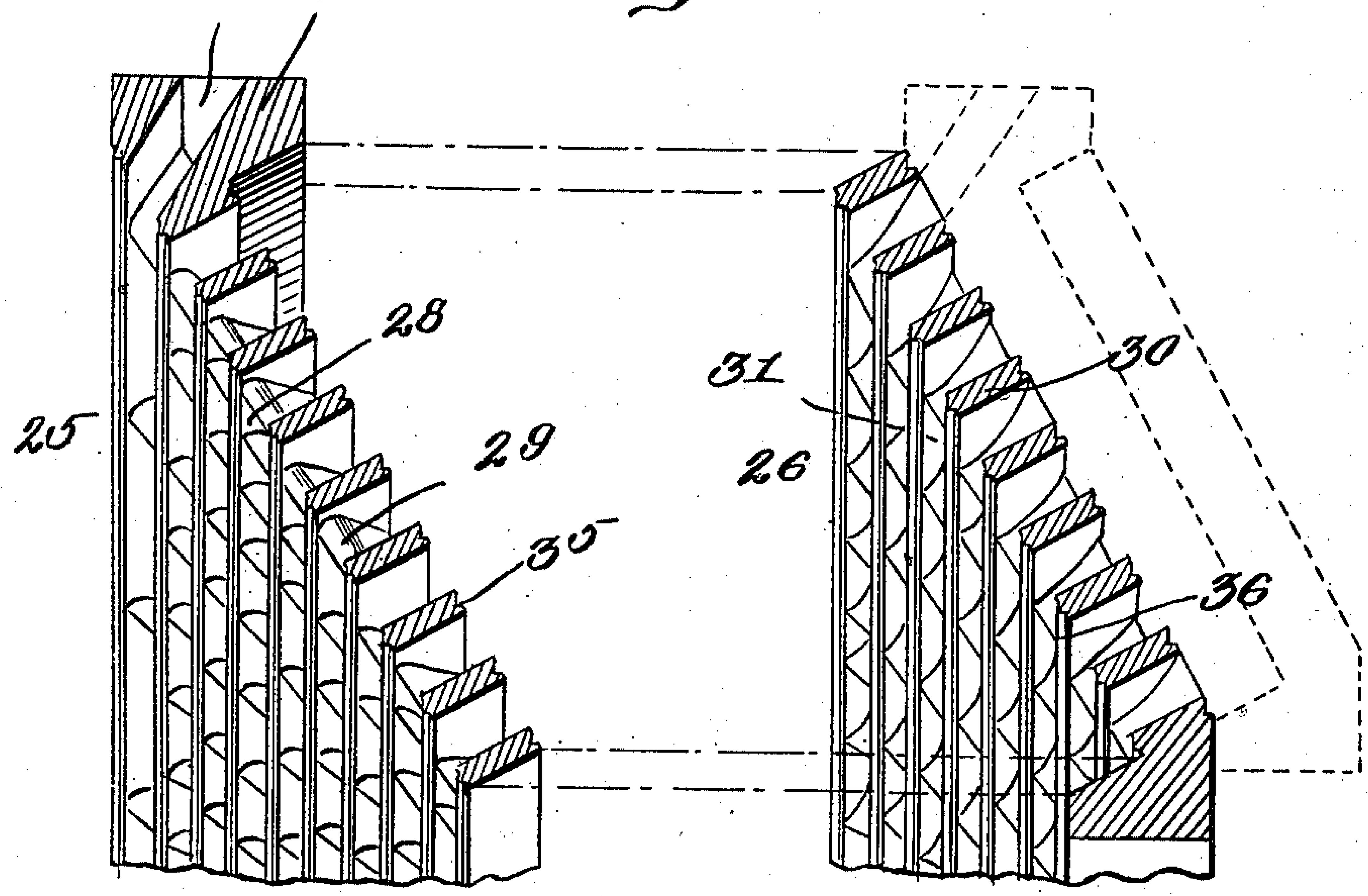


Fig. 4.

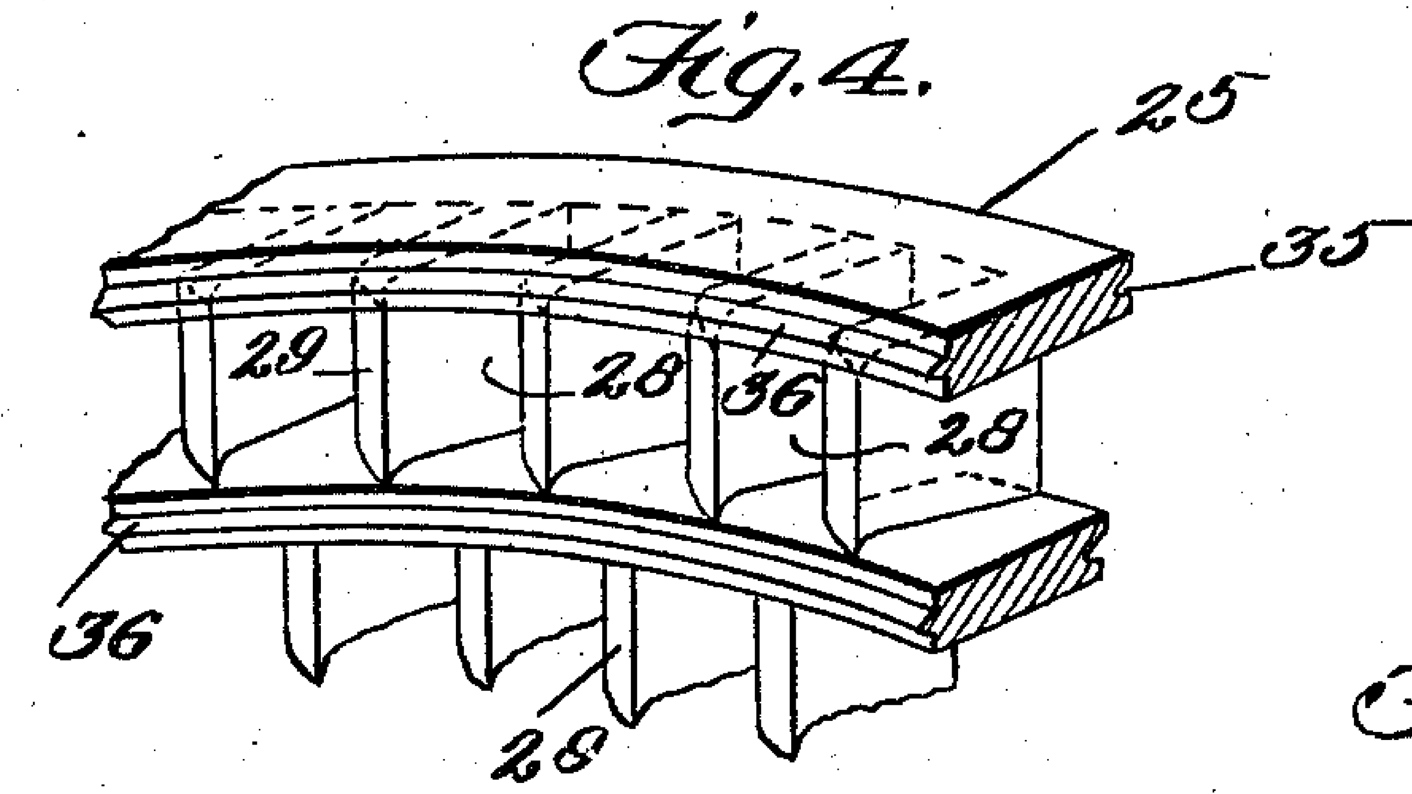


Fig. 6.

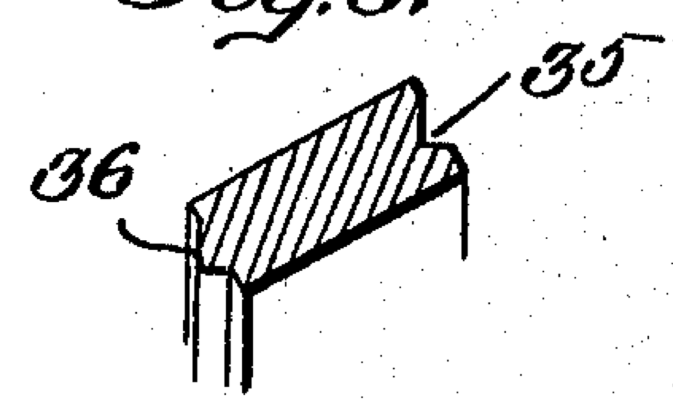
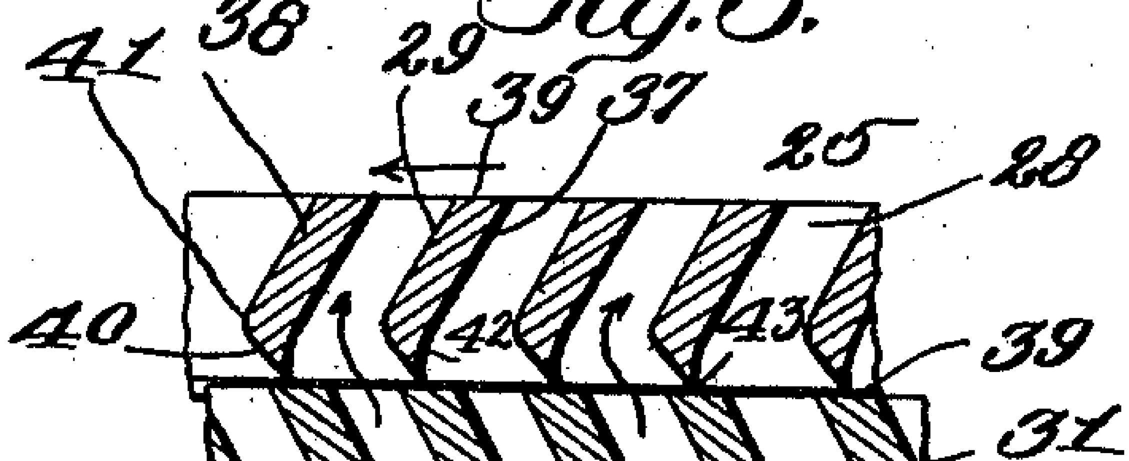


Fig. 5.



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UNITED STATES PATENT OFFICE.

DORSEY FROST ASBURY, OF MORGANTOWN, NORTH CAROLINA.

FLUID-PRESSURE TURBINE.

SPECIFICATION forming part of Letters Patent No. 719,294, dated January 27, 1903.

Application filed June 21, 1902. Serial No. 112,681. (No model.)

To all whom it may concern:

Be it known that I, DORSEY FROST ASBURY, a citizen of the United States, residing at Morgantown, in the county of Burke and State of North Carolina, have invented new and useful Improvements in Fluid-Pressure Turbines, of which the following is a specification.

My invention relates to fluid-pressure turbines, the object of the same being to simplify and otherwise improve the construction of this class of devices, whereby greater efficiency may be obtained, whereby leakage and friction are reduced to a minimum, and whereby end thrust is avoided and any desired speed obtained.

Other objects and advantages of the invention will hereinafter appear, and the novel features thereof will be set forth in the claims.

In the drawings forming part of this specification, Figure 1 is a longitudinal section of a turbine constructed in accordance with my invention. Fig. 2 is a cross-section of the same. Fig. 3 is a detail sectional view showing two of the cone-shaped diaphragms separated from each other. Fig. 4 is a detail perspective view of one of the diaphragms. Fig. 5 is a detail sectional view showing two of the diaphragms in coöperative relation to each other, and Fig. 6 is an enlarged sectional detail.

Like reference-numerals indicate like parts in the different views.

The casing of my improved turbine is made up of a cylindrical body or central portion 1 and conical or tapering ends 2 3. The body 1 is provided with annular flanges or lugs 4 and the ends 2 and 3 are provided with corresponding flanges or lugs 5, which when the parts of the device are assembled and are in operative position abut against the flanges 4 and are secured thereto by means of bolts 6 or other analogous devices passing through the flanges 4 and 5.

Formed integral with the body 1 at a point intermediate its ends is an inwardly-extending annular web or partition 7, which serves to separate the interior of the casing into two parts or chambers, the chamber 8 on the inlet side of the partition 7 constituting the high-pressure chamber, whereas the chamber 9 on the exhaust side of the partition 7 constitutes the low-pressure chamber.

Extending centrally through the casing is a rotary shaft 10, the same being longitudinally grooved at different points to form channels or passages 11 and the ribs or webs 12. The shaft 10 extends through the sleeves 13, screwed into cylindrical extensions 13^a of the ends 2 and 3, the said sleeves having bearings 13^b, on which the shaft 10 turns, and having bearings 13^c for receiving the end thrust of the shaft. The shaft itself is formed with externally-screw-threaded cylindrical collars 14, upon which are screwed the rings 15, between which and the extension 13^a are the packing-rings 15^a. Communicating with the channels 11 in the shaft 10 is a steam-inlet pipe 16, the same communicating with an annular passage 17, surrounding the shaft 10 and formed upon the end 2 of the casing at the contracted portion thereof. Surrounding the shaft 10 is a perforated ring 17^a, through which the steam passes from the channel 17 to the passages 11. This ring receives the thrust toward the inlet end of the device and transmits it to the ring 15.

An exhaust-pipe 18 leads from the low-pressure chamber 9, as clearly shown.

Keyed or otherwise secured to the shaft 10, on the inlet side of the partition 7, is a hollow cone-shaped support 19, whose inclined wall lies parallel to the end 2 of the casing. Through the inner cylindrical wall of the cone-shaped support 19 passages 20 are formed, which communicate with the channels 11^a in the shaft 10. The channels 11^a are identical with the channels 11 in the shaft 10, but are separated from the channels 11 by an annular collar 21, which serves as a cut-off for the passage of steam. The outer wall of the cut-off 21 lies in close contact with the inner cylindrical surface of the cone-shaped support 19 at the apex of the latter. On the exhaust side of the partition 7 is a cone-shaped support 22, similar to the cone-shaped support 19, except that the same is oppositely disposed and is not provided with passages 20 through the cylindrical wall thereof. The support 22 is secured to the shaft 10 in a similar manner to the support 19.

Formed integral with the cylindrical body portion 1 of the casing and extending longitudinally thereof along its inner surface are the ribs 23 on the inlet side of the partition 7 and the ribs 24 on the exhaust side thereof.

Coöperating with the parts just described are the fixed cone-shaped diaphragms 25 and the movable cone-shaped diaphragms 26. The diaphragms 25 are keyed to the end 2 of the casing and to the ribs 23 on the inner surface of the body 1, the construction being such that these parts may be slid into place and when in place will be locked to the casing, so as to be immovable. The said diaphragms are formed with enlarged or widened bases 27, which serve to separate the web portions of said diaphragms from each other. The said web portions of the diaphragms 25 are parallel to each other, substantially at right angles to the end 2, and are formed with transverse passages 28, in which are located the guide vanes or blades 29. The passages 28 in the different diaphragms 25 are in line with each other and the vanes 29 in each of the passages 28 extend in the same direction. In the bases 27^a of those diaphragms which are keyed to the ribs 23 are formed inclined passages 29^a, communicating with the passages 28 and leading into the spaces between the ribs 23, which spaces constitute passages for the escape of the steam from the high-pressure chamber. The cone-shaped diaphragms 26 coöperate with the diaphragms 25 and are keyed to the cone-shaped portion of the support 19 and to the shaft 10, as clearly shown, the construction being such that these parts may be readily slid into place and when in place will be secured to the shaft 10, so as to rotate therewith. The bases of the diaphragms 26 are slightly widened, as shown, and the web portions 30 thereof fit within the spaces between the web portions of the diaphragms 25. Said web portions are further provided with transverse passages 31 extending therethrough, which are in line with each other and are adapted to register with the passages 28 in the diaphragms 25. In said passages 31 guide-vanes 32 are formed, all of the vanes 32 extending in the same direction with each other, but in a direction opposite that of the guide-vanes 29 in the passages 28. The bases 30^a of the diaphragms 26 are provided with outwardly-extending inclined passages or ports 33, which communicate at their inner ends with the channels 11 in the shaft 10 and at their outer ends with the ports or passages 28 and 31 in the diaphragms 25 and 26. The parts just described are all located in the high-pressure chamber 8 of the turbine, and the diaphragms 25 and 26 are so arranged that one set may move freely with respect to the other without any friction whatever. The necessity for internal lubrication of the device is therefore avoided.

In the low-pressure chamber 9 diaphragms 25^a, keyed to the end 3 and to the ribs 24, and diaphragms 26^a, keyed to the shaft 10 and to the cone-shaped support 22, coöperating with the diaphragms 25^a, are shown. These diaphragms 25^a and 26^a are similar in all respects to the diaphragms 25 and 26 heretofore referred to, except that they are arranged in the opposite direction. The passages 33^a, leading through the bases of the diaphragms 26^a, also extend in the opposite direction to the ports or passages 33. The exhaust-pipe 18, heretofore referred to, leads off from a series of branch pipes 34, which communicate with the passages between the ribs 24 on the inner surface of the body 1.

From the foregoing description it is thought that the operation of my improved turbine will be readily understood. Briefly stated, however, it is as follows: Steam being admitted through the inlet-pipe 16 and the annular passage 17 to the channels 11 in the rotary shaft 10 passes out through the ports 33 in the bases 30^a of the diaphragms 26, through the ports 28 and 31 in the web portions of said diaphragms, acting upon the vanes 29 and 32 therein. As all of the vanes 29 extend in the same direction and in a direction opposite to that of the vanes 32, the action of the steam on said vanes will serve to rotate the shaft 10 and the parts connected therewith. The steam after acting upon the blades or vanes 29 and 32 passes through the ports 29^a into the passages between the ribs 23, and thence out of the high-pressure chamber 8 down to the interior of the hollow cone-shaped support 19. From this point the steam escapes through the ports 20 into the channels 11^a in the shaft 10 and afterward passes through the ports 33^a, and thence through the passages in the diaphragms 25^a and 26^a in the low-pressure chamber 9. The steam acts on the vanes in the ports of the diaphragms 25^a and 26^a to rotate the shaft 10 in the same direction that said shaft is rotated by the passage of the steam through the high-pressure chamber 8. The steam exhausts through the passages between the ribs 24, the branch pipes 34, and the exhaust-pipe 18. The result of the construction described is that all the energy of the steam is utilized and the efficiency of the device very greatly increased. Furthermore, the loss by leakage is reduced to a minimum, as there are only two places where such leakage can occur, the same being at the bearing-points between the shaft 10 and the heads 2 and 3 of the casing. Friction is also reduced to a minimum for the same reason, and as there are no internal bearings the necessity for internal lubrication is dispensed with and the feed-water will not have to be purified.

It will be noted that the low-pressure chamber 9 is of greater dimensions than the high-pressure chamber 8, the intention being to so proportion these two chambers that the power generated in each will be equal. The result will be that the thrust at opposite ends of the device will be neutralized. This tends to further reduce the friction, as the only strain the bearings will have to sustain will be the weight of the shaft 10 and the parts carried thereby. By arranging the cone-shaped diaphragms in the manner described the diameter of the device is very greatly reduced from old constructions. The apparatus will therefore take up but very little space and an unusually high degree of speed may be obtained. The conical ends 2 and 3 offer great resistance to any bursting force within the casing, and as there are no longitudinal seams or joints in either of these ends or in the body portion 1 the strength of the casing as a whole is augmented.

While I have described the shaft 1 as rotating within a fixed casing, it is obvious that the shaft may be fixed and the casing rotatable, or that both of these parts may be mounted for rotation in opposite directions.

In case my improved turbine is employed for propelling a ship the thrust on the propeller-shaft will be taken up by the thrust on the turbine, thereby eliminating the friction which is caused by the thrust-block now always fitted on board ship. In other words, the thrust of one will balance the other. In this particular case the turbine if made compound would have both high and low pressure cylinders turning in the same direction.

It will be noted that the imperforate parts of the web portions of the fixed diaphragms 25 are provided with annular grooves or recesses 35 and that the web portions 30 of the movable diaphragms 26 are provided with annular tongues or ribs 36, which register with and are adapted to fit within the grooves or recesses 35. One wall of each groove 35 and the corresponding wall of the rib 36 lies at right angles to the shaft 10, and the other wall of each of the grooves or recesses 35, as well as the corresponding wall of the rib 36, which fits within said groove, extends parallel to the shaft 10. The result of this construction is that the shaft 10, with the diaphragms connected therewith and carried thereby, is capable of a small degree of longitudinal movement without disturbing the close contact between the movable diaphragms 26 and the fixed diaphragms 25. This construction also serves to prevent the escape of any steam through the passages 28 and 31, as the same would have to pass backwardly or rearwardly in escaping from one series of passages to the next adjacent series.

It has heretofore been stated that the vanes or blades 29 on the fixed diaphragms 28 are arranged parallel to each other and that the vanes or blades 32 on the movable diaphragms 26 are arranged parallel to each other, but are set at an angle to the vanes or blades 29. All of these vanes or blades are made comparatively thick, as clearly shown in Fig. 5 of the drawings, to preserve the strength of the diaphragm as a whole, which strength is necessary on account of the severe strain to which the movable diaphragms 26 are subjected. Except for the fact that they are set at an angle to each other the vanes 29 and 32 are alike. Each of the vanes 29 is formed with two plane parallel side walls 37 38, a plane end wall 39, coincident with one face of the diaphragm 25 in which it is formed, and a plane end wall 40, set at an angle to the end wall 39 and to the adjacent face of the diaphragm 25 in which said blade is formed. The end wall 40 is connected with the side wall 38 by a convex-curved wall 41, and the side wall 37 runs into a curved wall 42, adjacent to the inlet end of the blade. The result of this construction is that the spaces between the adjacent vanes 39 are formed with enlarged or flaring inlet ends, which merge into contracted passages having parallel walls. The curved wall 42 of the vane 29 constitutes the abutment against which the steam from the port of the adjacent diaphragm impinges. The inclined end wall 40 and the curved wall 42 meet at an acute angle, as shown, to form sharp edges 43 on the vanes 29, coincident with the plane of one face of the diaphragm 25. These sharp edges serve to keep the spaces between the vanes 29 in constant communication with the ports in the adjacent diaphragms, so that as there is a constant flow of steam through the passages 28 and 31 in the different diaphragms 25 and 26 there is a constant action of such steam upon all the vanes 29 and 32 of said diaphragms. The result is an even regular operation of the device, for the instant one vane passes out of range of the steam from one of the passages between the vanes of the adjacent diaphragm it is acted upon by the steam passing through the space between the adjacent vanes of the adjacent diaphragm. By forming the vanes 29 and 32 with the four straight or plane walls and with the curved walls, which are easily accessible, the device may be readily and conveniently made.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a fluid-pressure turbine, a casing and a shaft mounted therein and extending therethrough, one of said parts being rotatable, and said shaft having a longitudinal passage therethrough, cone-shaped diaphragms secured in parallel relation to each other to said casing and having transverse ports therein provided with guide-vanes extending in the same direction, cone-shaped diaphragms secured to said shaft arranged in parallel relation to each other located in the spaces between the diaphragms on said casing, provided with ports in line with each other and adapted to register with the ports in the diaphragms on said casing, and having guide-vanes in said ports extending in the same direction with each other but in a direction opposite to the guide-vanes in the ports of the diaphragms on said casing, means for admitting steam to the passage in said shaft, and ports leading from the passage in said shaft and communicating with the ports on said diaphragms.

2. In a fluid-pressure turbine, a casing and

a shaft mounted therein and extending therethrough, the said casing having cone-shaped ends and a cylindrical body provided with longitudinally-extending ribs, and said shaft having a longitudinal passage therein, a partition in said casing dividing the same into a high-pressure and a low-pressure chamber, a cone-shaped support 19 secured to said shaft on the high-pressure side of said partition having ports in the cylindrical wall thereof communicating with the passage in said shaft, a cut-off dividing the passage in said shaft into two parts located at the apex of said cone-shaped support, a cone-shaped support 22 on the low-pressure side of said partition secured to said shaft and oppositely disposed to the support 19, cone-shaped diaphragms secured to each end of said casing and to the ribs therein on opposite sides of said partition, the diaphragms in the high-pressure chamber lying parallel to each other, the diaphragms in the low-pressure chamber lying parallel to each other but of an angle to those in the high-pressure chamber, and all of said diaphragms being provided with ports having guide-vanes therein, the ports in the high-pressure chamber communicating with the spaces between the ribs on the high-pressure side of said partition and the ports in the low-pressure chamber communicating with the spaces between the ribs on the low-pressure side of said partition, the guide-vanes in the high-pressure chamber extending in the same direction with each other and the guide-vanes in the low-pressure chamber extending in the same direction with each other, cone-shaped diaphragms secured to said shaft and to the support 19, extending into the spaces between the diaphragms in the high-pressure chamber, and provided with transversely-extending ports having guide-vanes therein which are parallel to each other, the latter guide-vanes extending in the opposite direction to the guide-vanes in the coöperating parts, cone-shaped diaphragms secured to said shaft and to the support 22, said diaphragms being parallel to each other, fitting within the spaces between the diaphragms in the low-pressure chamber, having transverse ports therein adapted to register with the ports in the coöperating diaphragms which ports are provided with guide-vanes extending in the same direction with each other but in an opposite direction to the guide-vanes in the coöperating parts, ports leading from one part of the passage in said shaft and communicating with the ports in the diaphragms in the high-pressure chamber, a passage leading from the space between the ribs in said casing on the high-pressure side of said partition to the ports in the support 19, ports leading from the other part of the passage in said shaft to the ports in the diaphragms in the low-pressure chamber, an exhaust-pipe leading from the spaces between the ribs in the casing on the low-pressure side of the said partition, and means for admitting steam to that part of the passage in said shaft which lies on the high-pressure side of said cut-off.

3. In a fluid-pressure turbine, a casing and a shaft mounted therein and extending therethrough, one of said parts being rotatable and said shaft having a longitudinal passage therethrough, cone-shaped diaphragms secured to said casing in parallel relation to each other, having transverse ports therein provided with guide-vanes extending in the same direction, and having an annular groove or recess in one face thereof, one wall of said recess lying parallel to said shaft and the other wall of said recess lying at right angles to said shaft, cone-shaped diaphragms secured to said shaft in parallel relation to each other, located in the spaces between the diaphragms of said casing, provided with ports in line with each other and adapted to register with the ports in the diaphragms of said casing, having guide-vanes in said ports extending in the same direction with each other but in a direction opposite to the guide-vanes in the ports of the diaphragms on said casing and having an annular rib or tongue on one face fitting within the corresponding groove or recess in the adjacent fixed diaphragm, one wall of each of said tongue or rib extending parallel to said shaft and the other wall extending at right angles to said shaft, means for admitting steam to the passage in said shaft, and ports leading from the passage in said shaft and communicating with the ports on said diaphragm.

4. In a fluid-pressure turbine, a plurality of fixed and movable diaphragms arranged in close relation to each other and provided with transverse passages adapted to register with each other and having blades or vanes therein, the vanes of the fixed diaphragms being parallel to each other and the vanes of the movable diaphragms being parallel to each other but set at an angle to those on the fixed diaphragms, each of said vanes having plane parallel side walls, a plane end wall coincident with one face of the diaphragm on which said vane is formed, and a second plane end wall set at an angle to the other end wall and to the adjacent face of the diaphragm on which the vane is formed, the said second end wall forming an acute angle with a curved wall into which one of said side walls merges, as and for the purpose set forth.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

DORSEY FROST ASBURY.

Witnesses:
J. W. JORDAN, Jr.,
N. W. BRYANT.