No. 719,295. PATENTED JAN. 27, 1903.

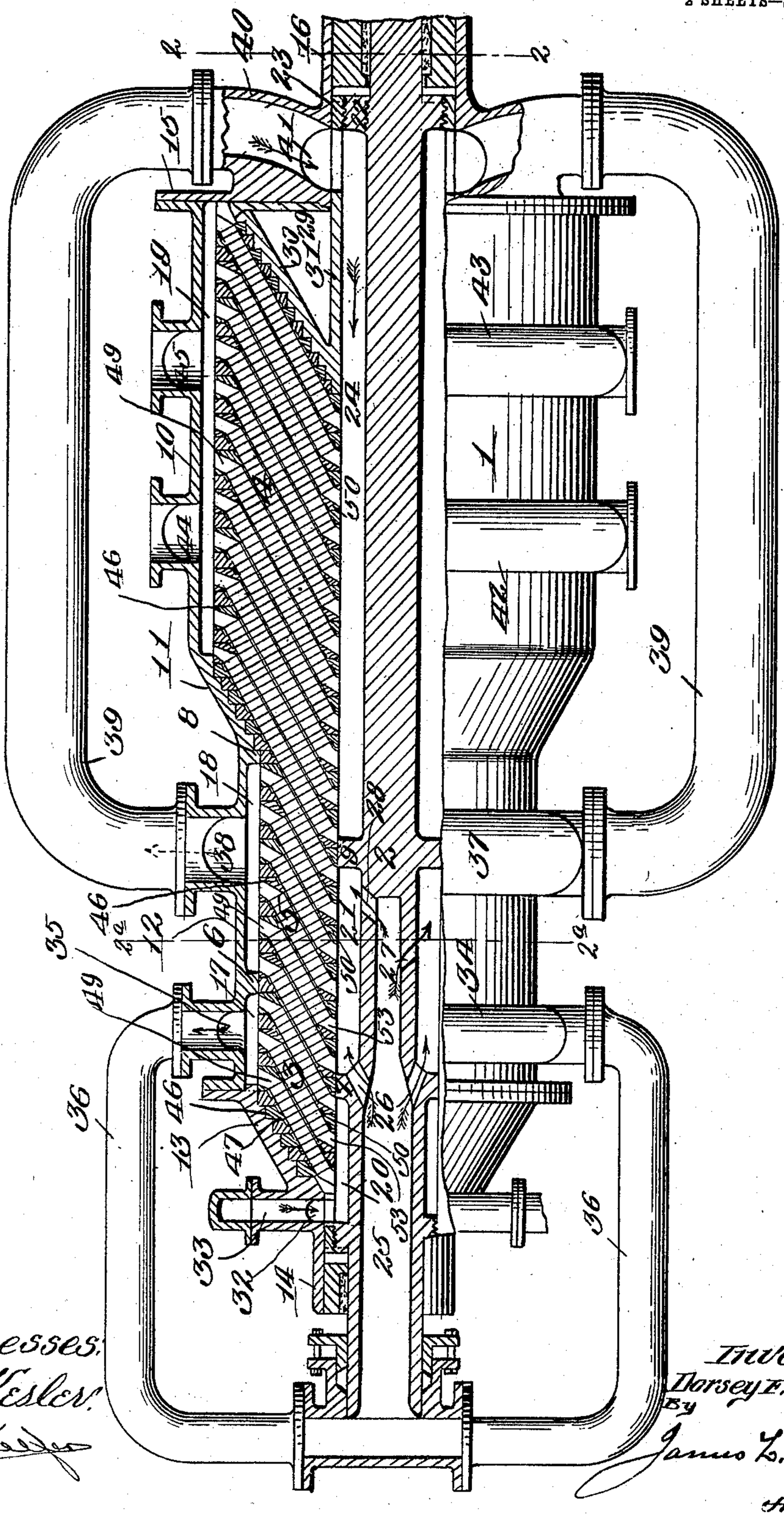
D. F. ASBURY.

TRIPLE EXPANSION FLUID PRESSURE TURBINE.

NO MODEL. APPLICATION FILED AUG. 9, 1902.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

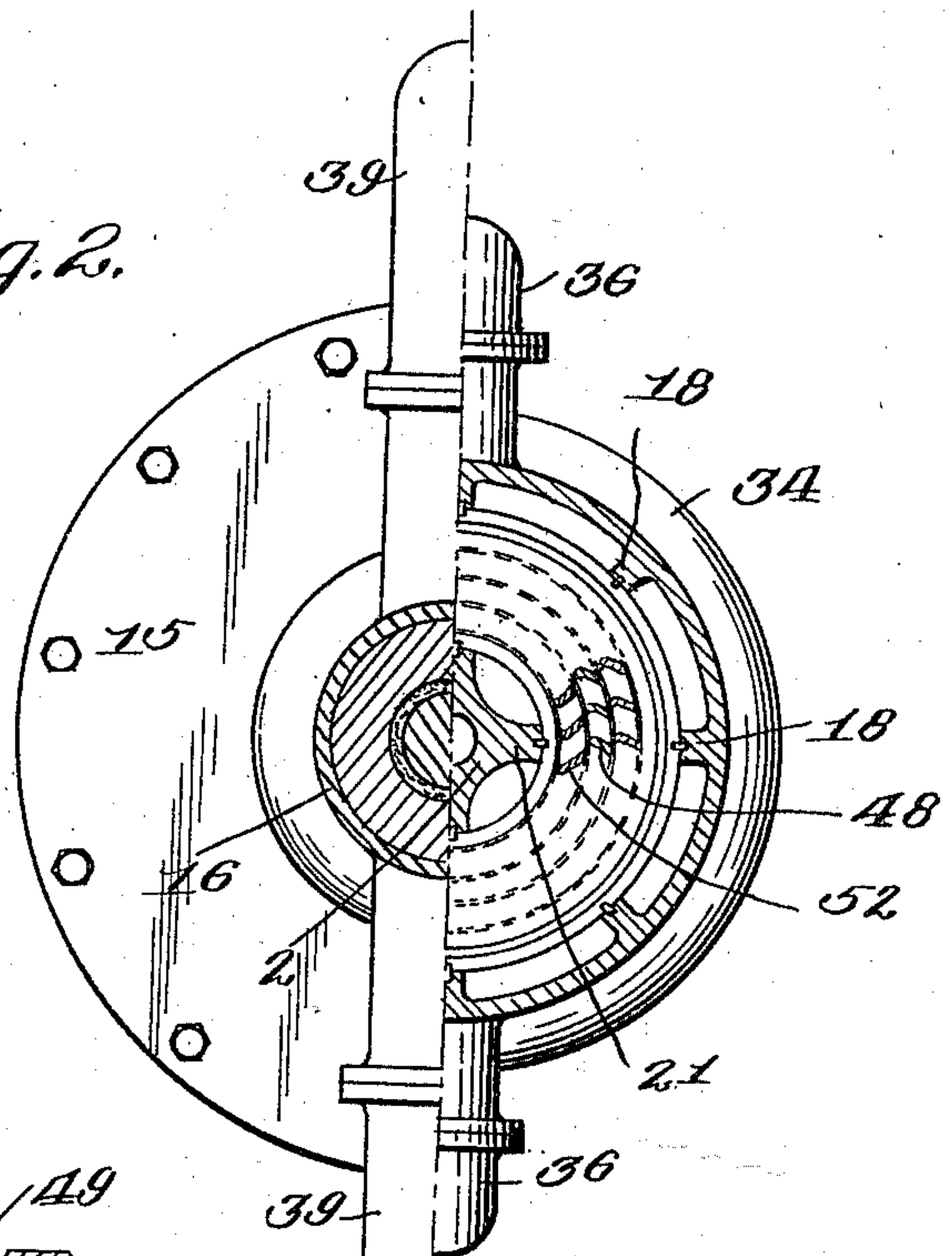


Fig. 3.

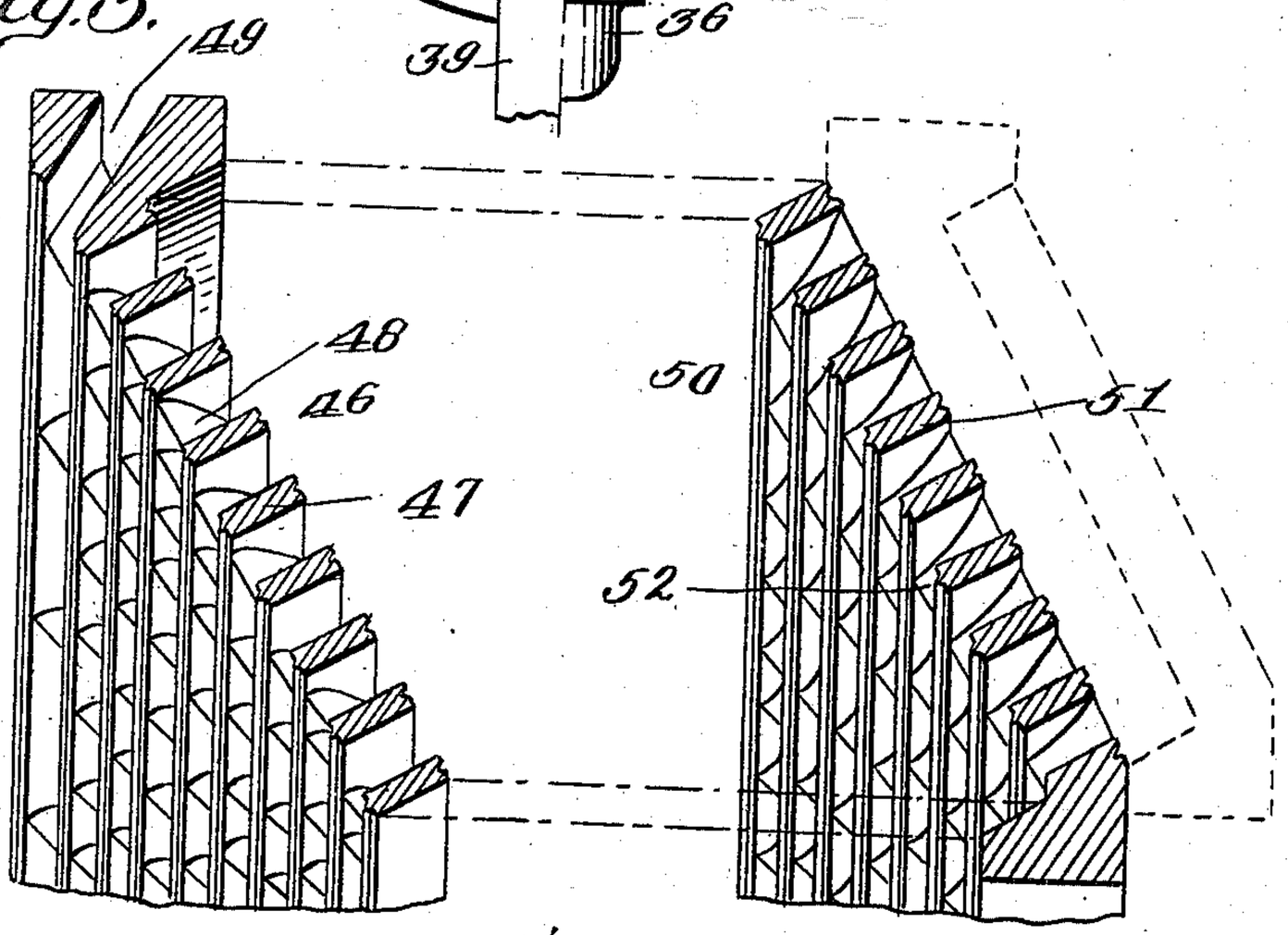
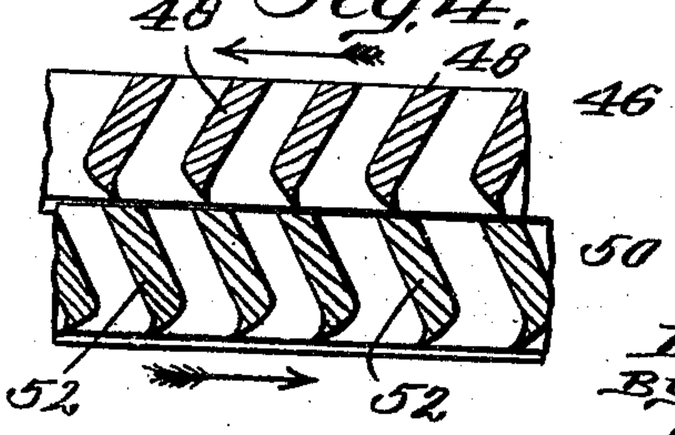


Fig. 4.



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UNITED STATES PATENT OFFICE.

DORSEY F. ASBURY, OF MORGANTOWN, NORTH CAROLINA.

TRIPLE-EXPANSION FLUID-PRESSURE TURBINE.

SPECIFICATION forming part of Letters Patent No. 719,295, dated January 27, 1903.

Application filed August 9, 1902. Serial No. 119,098. (No model.)

To all whom it may concern:

Be it known that I, DORSEY F. 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 Triple-Expansion Fluid-Pressure Turbines, of which the following is a specification.

My invention relates to fluid-pressure turbines, the same being designed as an improvement upon the construction shown and described in my pending application for patent, Serial No. 112,681, filed June 21, 1902.

The object of the invention is to provide a novel construction of triple-expansion turbines for marine use, whereby greater efficiency may be obtained than has heretofore been accomplished.

Other objects of the invention will hereinafter appear, and that which I regard as new will be set forth in the claims.

In the drawings forming part of this specification, Figure 1 is a longitudinal sectional view of a triple-expansion turbine constructed in accordance with my invention. Fig. 2 is a part section on the line 2 2 and a part section on the line 2^a 2^a of Fig. 1. Fig. 3 is a sectional perspective view of two of the diaphragms separated from each other, and Fig. 4 is a detail sectional view of two of the diaphragms in coöperative relation to each other.

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

In carrying out my invention I employ an outer shell or casing 1 and a shaft 2, extending longitudinally through the center of the casing and having suitable bearings therein. It is proposed that the casing 1 shall be stationary, while the shaft 2 is capable of rotation within the same. It is obvious, however, that the shaft 2 may be stationary and the casing 1 mounted to rotate thereon or that both of these parts may be mounted for rotation in opposite directions. The interior of the casing is divided up into a high-pressure chamber 3, a low-pressure chamber 4, and an intermediate-pressure chamber 5, the inwardly-extending annular shoulder 6 on the casing 1 and the annular shoulder 7 on the shaft 2 separating the high-pressure chamber from the intermediate-pressure chamber, and the inwardly-extending annular shoulder 8 on the casing 1 and the annular shoulder 9 on the shaft 2 separating the intermediate-pressure chamber 5 from the low-pressure chamber 4. The low-pressure chamber 4 is of greater dimensions than the high-pressure chamber 3 or the intermediate-pressure chamber 5, to effect which the casing 1 is enlarged from the rib or shoulder 8 to the rear end of the same, forming an enlarged cylindrical portion 10 and an inclined or cone-shaped wall 11, which connects the cylindrical portion 10 with the cylindrical portion 12, which surrounds the high-pressure chamber 3 and the intermediate-pressure chamber 5.

The casing 1 is provided at one end with a cone-shaped head 13, which merges into a hollow cylindrical portion 14, through which the shaft 2 passes and between which and said shaft suitable bearings are provided, as clearly shown. The opposite end of the casing 1 is provided with a head 15, having a cylindrical portion 16 secured thereto or formed integral therewith, through which cylindrical portion the shaft 2 passes and between which cylindrical portion and said shaft suitable bearings are provided. The bearings between the shaft 2 and the cylindrical portions 14 and 16, respectively, are such as to prevent any leakage between these parts. Between the head 13 and the annular shoulder 6 the casing 1 is provided with longitudinally-extending ribs 17, forming passages between them, as will hereinafter appear. Between the annular shoulders 6 and 8 said casing 1 is provided with longitudinally-extending ribs 18, forming passages between them, and between the tapering or cone-shaped wall 11 and the head 15 the enlarged cylindrical portion 10 of the casing 1 is provided with longitudinally-extending ribs 19, forming passages between them. The ribs referred to also serve to strengthen the walls of the casing, so as to enable them to withstand the pressure to which the same are subjected. The shaft 2 is also provided with longitudinally-extending ribs 20, forming passages between them, the said ribs and passages extending from the contracted end of the cone-shaped head 13 to the shoulder 7 on said shaft. Between the shoulders 7 and 9 on the shaft 2 the said shaft is further provided with longitudinally-extending ribs 21,

forming passages between them. Between the shoulder 9 on the shaft 2 and the shoulder 22 on said shaft, between which and the cylindrical portion 16 of the head 15 a bearing-ring 23 is interposed, said shaft is provided with longitudinally-extending ribs 24, forming passages between them. The said shaft 2 is in addition provided with a central bore or passage 25, extending from the outer end thereof to a point adjacent to the shoulder 9. Between the bore 25 and the passages formed by the ribs 21 are ports 26, the same being located directly within the shoulder 7, and between the bore 25 and the passages formed by the ribs 21 are the ports 27 28, the same being located between the ports 26 and the shoulder 9. The ports 26, 27, and 28 constitute a means of communication between the bore or passage 25 in the shaft 2 and each of the passages formed by the ribs 21.

Located within the enlarged cylindrical portion 10 of the casing 1, adjacent to the head 15, is a support 29, made up of a cone-shaped portion 30, which lies parallel to the cone-shaped head 13 at the opposite end of the casing 1, and an integral cylindrical portion 31, which surrounds the shaft 2 and which is keyed or otherwise secured to said shaft.

Between the cone-shaped portion of the head 13 and the cylindrical portion 14 thereof said head is formed with an annular enlargement, producing an annular passage 32, into which the inlet-pipe 33 for the admission of high-pressure steam from the boiler to the high-pressure chamber 3 communicates. The said passage 32 is located at the outer ends of the passages between the ribs 20 on the shaft 2 and communicates with all of said passages.

Formed upon the casing 1, between the head 13 and the shoulder 6, is an annular enlargement 34, forming an annular passage 35, which extends completely around the cylindrical portion 12 of the casing 1 and communicates with all of the passages between the ribs 17. Leading from the passage 35 are one or more pipes 36, which communicate at their opposite ends with the bore or passage 25 in the center of the shaft 2. Formed upon the casing 1, between the shoulders 6 and 8, is an annular enlargement 37, producing an annular passage 38, which extends completely around the cylindrical portion 12 of the casing 1 and communicates with all of the passages between the ribs 18. A pipe or series of pipes 39 lead from the passage 38 and communicate with a nipple or series of nipples 40, formed integral with the head 15, between the body portion thereof and the cylindrical extension 16, the said nipple or nipples 40 themselves communicating with an annular passage 41, surrounding the shaft 2 and communicating with the passages between the ribs 24 on said shaft. One or more annular enlargements 42 43, producing annular passages 44 45, are formed on the enlarged cylindrical portion 10 of the casing 1, the said passages extending completely around the casing and communicating with all of the passages between the ribs 19. The passages 44 45 are provided for the exhaust of the motive fluid from the low-pressure chamber 4, and the same may, if desired, have connected with them a suitable exhaust-pipe. The cylindrical enlargements 34 and 37 and 42 and 43 in addition to the functions above ascribed to them serve to stiffen and strengthen the casing of the device, so as to assist further in enabling said casing to withstand the internal pressure to which it is subjected.

Keyed to the ribs 17 and to the conical portion of the head 13 are the cone-shaped diaphragms 46 46, the same having enlarged bases and somewhat narrower web portions 47. The web portions of said diaphragms are parallel to but separated from each other, the same extending at substantially right angles to the cone-shaped portion of the head 13. In said diaphragms transverse ports or passages are provided having blades or vanes 48 therein. Said vanes 48 all extend in the same direction with each other. The ports or passages in which said vanes are located all lie in line with each other, as clearly shown. The bases of the alternate diaphragms 46, which are keyed to the ribs 17, are provided with inclined ports 49, which communicate with the passages between said ribs 17. The said ports 49 also communicate with the ports in which the vanes 48 are formed.

Keyed to the shaft 2 are the cone-shaped diaphragms 50, the same being provided with enlarged bases and with contracted web portions 51, the said web portions being parallel to but separated from each other and extending at substantially right angles to the cone-shaped portion of the head 13. The web portions 51 of the diaphragms 50 are located between and in close contact with the web portions 47 of the diaphragms 46. The said web portions 51 are further provided with transverse ports adapted to register with the ports in the web portions 47 of the diaphragms 46, and in the ports in said diaphragms 50 are located the blades or vanes 52. All of the vanes 52 extend in the same direction, but extend in a direction opposite that of the vanes 48. The alternate bases of the diaphragms 50 are provided with ports 53, which communicate with the transverse ports in the web portions of said diaphragm and which also communicate with the passages between the ribs 20 on the shaft 2. The diaphragms 46 and 50 in the intermediate-pressure chamber 5 are of exactly the same construction as the diaphragms 46 and 50 in the high-pressure chamber 3, except that all of the diaphragms 46 in the intermediate chamber 5 are keyed to the ribs 18 and the ports 49 therein communicate with the passages between the latter ribs and except that the ports 53 in the diaphragms 50 communicate with the passages between the ribs 21 on the shaft 2. In the low-pressure chamber the diaphragms 46

are keyed to the ribs 19 and to the cone-shaped wall 11, which connects the enlarged cylindrical portion 10 of the casing 1 with the contracted cylindrical portion 12 of said casing. Furthermore, the diaphragms 50 in the low-pressure chamber are keyed partly to the cone-shaped portion 30 of the support 29. The construction, arrangement, and location of all of the diaphragms 46 and 50 and the ports and vanes therein are identical with each other, with the exceptions above noted, throughout the whole device.

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: Upon admitting steam or other motive fluid into the inlet-pipe 33 the same passes through the annular passage 32 into the passages between the ribs 20 on the shaft 2. From the latter passages the same passes through the ports 53 of the diaphragms 50 in the high-pressure chamber 3 and thence through the transverse ports in the web portions 47 and 51 of the diaphragms 46 and 50, respectively. In so doing it acts upon the blades or vanes 48 and 52, with the result that the shaft 2 is rotated with respect to the casing 1. After acting upon the vanes in the high-pressure chamber 3 the steam passes through the ports 49 into the passages between the ribs 17 and thence into the annular passage 35. From the latter passage it passes through the pipe or pipes 36 into the hollowed-out portion or bore 25 within the shaft 2. Thence the steam passes through the ports 26, 27, and 28 into the passages formed by the ribs 21 between the shoulders 7 and 9 and through the ports in the web portions of the diaphragms 46 and 50 in the intermediate-pressure chamber 5. After leaving the ports in the diaphragms in the intermediate-pressure chamber the steam passes into the passages between the ribs 18 and thence into the annular passage 38, which extends around the casing 1. From the annular passage 38 the steam passes through the pipe or pipes 39 into the nipple or nipples 40 and from the latter into the annular passage 41 and thence into the passages between the ribs 24 on the shaft 2. The steam thence passes through the transverse ports in the web portions of the diaphragms 46 and 50 in the low-pressure chamber 4, acting upon the blades 48 and 52 and serving to rotate the shaft 2 in the same direction that it was rotated by the passage of the steam through the high-pressure chamber 3 and through the intermediate-pressure chamber 5. After the steam has acted within the low-pressure chamber 4 it passes into the passages between the ribs 19 and exhausts from the annular passages 44 and 45.

From the foregoing it will be observed that the steam or other motive fluid acts in the high-pressure chamber 3, in the intermediate chamber 5, and finally in the low-pressure chamber 4 to rotate the shaft 2 with respect to the casing 1. All of the energy of the steam is thus utilized and a high degree of efficiency thereby obtained.

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

1. In a triple-expansion fluid-pressure turbine, a casing having high-pressure, low-pressure and intermediate-pressure chambers therein, a shaft mounted in said casing and extending therethrough, one of said parts being rotatable, parallel angularly-arranged diaphragms secured to said casing and having transverse ports therein, vanes in said ports all extending in the same direction, parallel angularly-arranged diaphragms secured to said shaft, located between the diaphragms on said casing and having transverse ports therein adapted to register with the ports in the adjacent diaphragms, vanes in the latter ports all extending in the same direction but in an opposite direction to the vanes in the ports of the adjacent diaphragms, means for admitting live steam to the high-pressure chamber, means for conducting the exhaust from the high-pressure chamber to the intermediate-pressure chamber, means for conducting the exhaust from the intermediate-pressure chamber to the low-pressure chamber, and an exhaust-passage for the latter chamber.

2. In a triple-expansion fluid-pressure turbine, a casing having high-pressure, low-pressure and intermediate-pressure chambers therein, a shaft mounted in said casing, extending therethrough, and having passages therein communicating respectively with said chambers, one of said parts being rotatable, parallel angularly-arranged diaphragms secured to said casing and having transverse ports therein, vanes in said ports all extending in the same direction, parallel angularly-arranged diaphragms secured to said shaft, located between the diaphragms on said casing and having transverse ports therein adapted to register with the ports in the adjacent diaphragms, vanes in the latter ports all extending in the same direction but in an opposite direction to the vanes in the ports of the adjacent diaphragms, means for admitting live steam to the passages in said shaft which communicate with said high-pressure chamber, means for conducting the exhaust from the high-pressure chamber to the passages in said shaft which communicate with the intermediate-pressure chamber, means for conducting the exhaust from the intermediate-pressure chamber to the passages in said shaft which communicate with the low-pressure chamber, and an exhaust-passage for the latter chamber.

3. In a triple-expansion fluid-pressure turbine, a casing having a cone-shaped head at one end, and having high-pressure, intermediate-pressure and low-pressure chambers therein, a shaft mounted in said casing, extending therethrough, and having passages

therein communicating respectively with said chambers, one of said parts being rotatable, a support secured to said shaft within said casing and having a cone-shaped portion parallel to said cone-shaped head, parallel cone-shaped diaphragms secured to said casing and to said cone-shaped head, and having transverse ports in the web portions thereof, vanes in said ports, all extending in the same direction, parallel cone-shaped diaphragms secured to said shaft and to the cone-shaped portion of said support, located between the diaphragms on said casing and on said head, and having transverse ports in the web portions thereof adapted to register with the ports in the adjacent diaphragms, vanes in the latter ports all extending in the same direction but in an opposite direction to the vanes in the ports of the adjacent diaphragms, means for admitting live steam to the passages in said shaft which communicate with said high-pressure chamber, means for conducting the exhaust from the high-pressure chamber to the passages in said shaft which communicate with the intermediate-pressure chamber, means for conducting the exhaust from the intermediate-pressure chamber to the passages in said shaft which communicate with the low-pressure chamber, and an exhaust-passage for the latter chamber.

4. In a triple-expansion fluid-pressure turbine, a casing having heads at its opposite ends, one of which is cone-shaped, and having high-pressure, intermediate-pressure and low-pressure chambers therein, the said casing being further provided with inwardly-extending annular shoulders between the adjacent chambers, and with longitudinally-extending ribs in the different chambers, forming passages, a shaft extending through said casing and having bearings in said heads, the said shaft being further provided with annular shoulders between the different chambers in said casing, with longitudinally-extending ribs between and on opposite sides of the latter shoulders, forming passages which communicate respectively with said chambers, and with a longitudinally-extending bore which communicates with the passages in said shaft which lead to said intermediate-pressure chamber, a support secured to said shaft having a cone-shaped portion lying parallel to said cone-shaped head, an annular passage surrounding and communicating with the passages in said shaft which lead to said high-pressure chamber, an inlet-pipe for live steam communicating with said annular passage, an annular passage extending around said casing and communicating with the passages between the ribs on said casing in said high-pressure chamber, a pipe leading from the latter annular passage to the bore in said shaft, an annular passage surrounding said casing and communicating with the passages between the ribs on said casing in said intermediate-pressure chamber, a pipe leading from the latter annular passage and communicating with the passages between the ribs on said shaft which lead to said low-pressure chamber, an exhaust-passage leading from the low-pressure chamber, parallel diaphragms secured to said casing and to said cone-shaped head, and having transverse ports therein, vanes in the latter ports all extending in the same direction, parallel diaphragms secured to said shaft and to the cone-shaped portion of said support located between the diaphragms on said casing and having transverse ports thereon adapted to register with the ports in the adjacent diaphragms, and vanes in the latter ports all extending in the same direction but in an opposite direction to the vanes in the ports of the adjacent diaphragms.

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

DORSEY F. ASBURY.

Witnesses:
WILLIAM E. ROSE,
ROSCOE M. WAGSTAFF.