No. 848,486.

PATENTED MAR. 26, 1907.

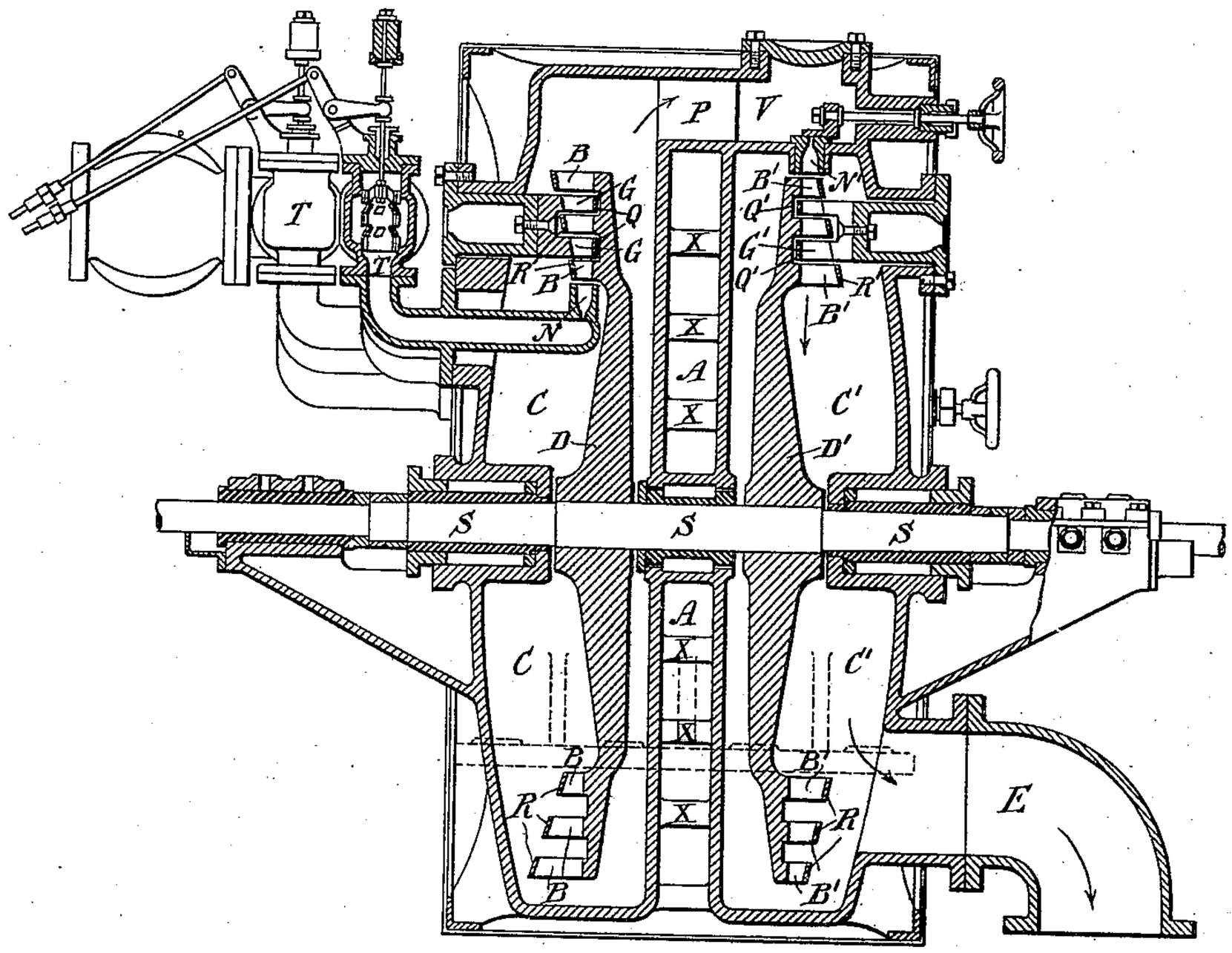
DEN-ICHIRO NISHIZAKI.

ELASTIC FLUID TURBINE.

APPLICATION FILED AUG. 9, 1906.

3 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

Edward Thorpe.

C. W. Fairbank

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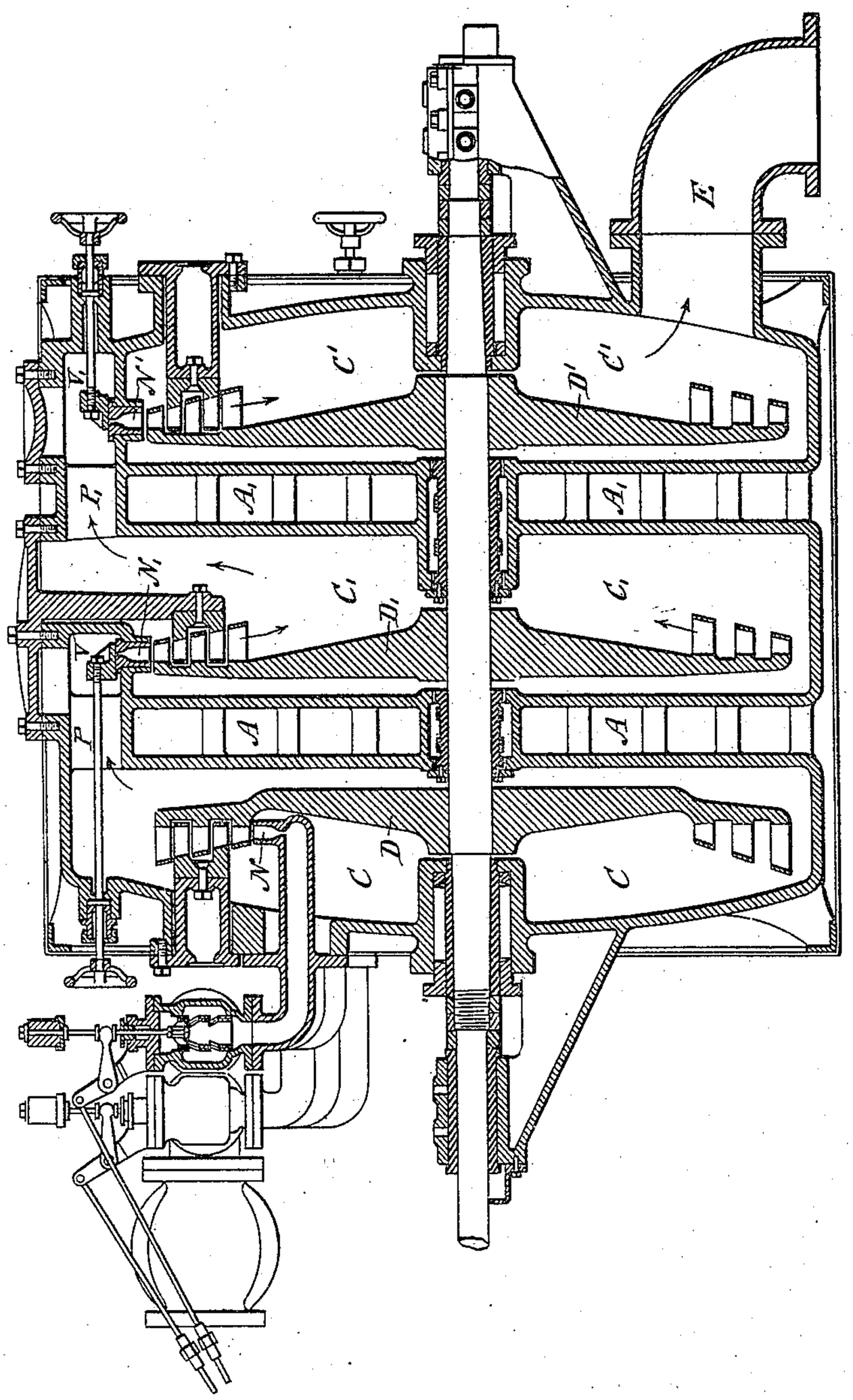
3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 3,

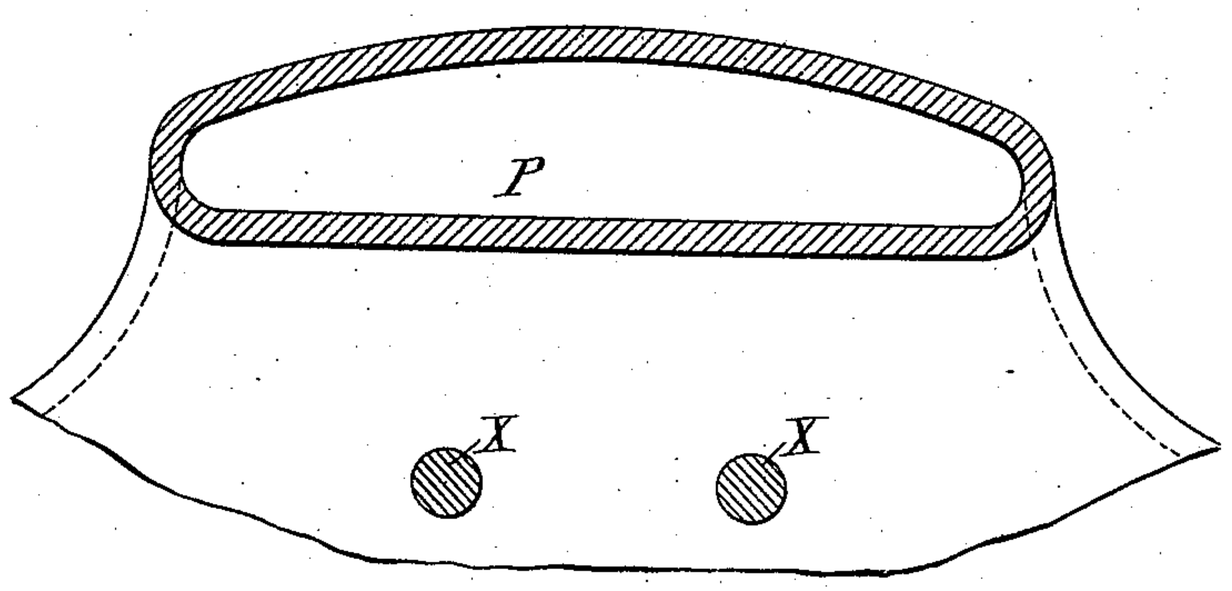


Fig. 4,

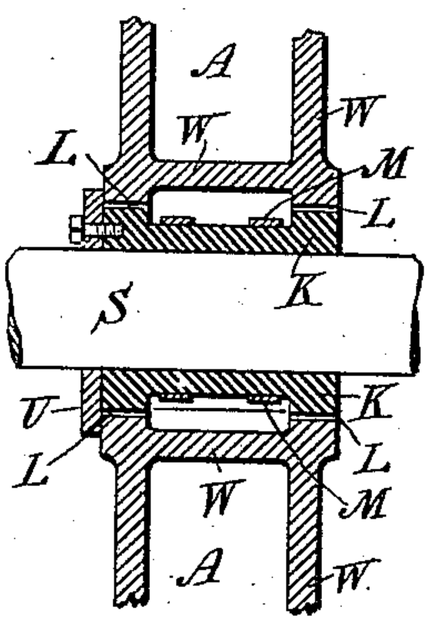


Fig. 5,

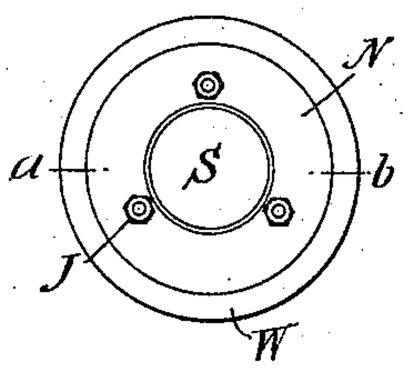
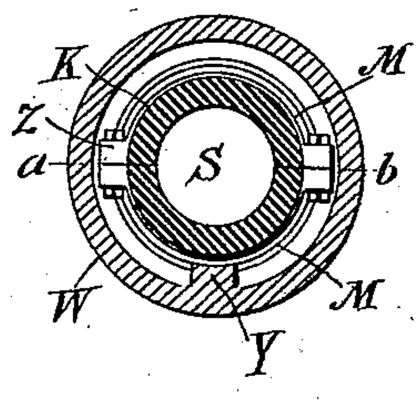


Fig. 6.



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UNITED STATES PATENT OFFICE.

DEN-ICHIRO NISHIZAKI, OF TOKYO, JAPAN.

ELASTIC-FLUID TURBINE.

No. 848,486. Specification of Letters Patent. Patented March 26, 1907.

Application filed August 9, 1906. Serial No. 329,941.

To all whom it may concern:

Be it known that I, DEN-ICHIRO NISHIZAKI, a subject of the Emperor of Japan, residing at No. 1 Tsuna-machi, Mita, Shiba-ku, Tokyo, Japan, have invented certain new and useful Improvements in Systems of Elastic-Fluid Turbines, of which the following, taken in connection with the accompanying drawings, is a specification.

My invention is an improvement in elastic-fluid turbines, and consists in certain novel constructions and combinations of parts hereinafter described and claimed.

Referring to the drawings forming a part hereof, Figure 1 is a vertical longitudinal section of a double-expansion turbine constructed in accordance with my invention. Fig. 2 is a similar view of a triple-expansion turbine. Fig. 3 is a cross-section through the casing on the line of the passage leading from one pressure-chamber to the succeeding one. Fig. 4 is a longitudinal section through a packing for the shaft of the turbine. Fig. 5 is an end view of the same, and Fig. 6 is a cross-section of the same.

My present invention is an improvement on my copending application, Serial No. 329,940, filed July 25, 1906, and is designed especially to diminish losses of heat by radiation through the walls between successive pressure-chambers and to reduce axial thrust and obtain axial balance, as well as to diminish frictional loss to a minimum by reducing the number of running-wheels without sacrificing efficiency.

In Fig. 1 the shaft S of the turbine is journaled within a casing which is divided transversely into two compartments by a double-wall partition W. In one of these chambers C is arranged a turbine-wheel D, provided with concentric rings of blades B, coacting with which are interposed guide-vanes G, the rings of blades being provided with thin annular shrouds R, and the guide-vanes being also provided with shrouds Q of sector shape, as described in my above-mentioned application. The fluid is admitted to the high-pressure chamber C through the throttle-valves T and is discharged axially of the wheel D through the nozzles N, the shrouds R and Q equalizing the thrust on the face of the turbine-wheel, as described in the above-mentioned application. After leaving the outermost ring of blades on the turbine-wheel B the fluid passes through the passage P into the receiver V, from whence it is admitted by check-valves, as in my above-mentioned application, to nozzles N′, which discharge against the outermost ring of a series of rings of blades B′, arranged on the low-pressure wheel D′ in the pressure-chamber C′, guide-vanes G′ being arranged between each ring of blades on the low-pressure wheel in a manner similar to the arrangement of the vanes G on the high-pressure wheel before described.

It will be understood that the wheels D D′ are mounted upon the same shaft S and that the rings of blades B′ and the guide-vanes G′ are provided with shrouds similar to those mentioned in the description of the blades B and the guide-vanes G. After the fluid leaves the ring of blades on the low-pressure turbine-wheel it passes from the chamber C′ out through the opening E to the condenser or to the atmosphere, as the case may be.

In operation fluid is admitted through a throttle-valve T and directed by the nozzles N against the innermost ring of blades, acting upon each ring in turn until the last ring has been passed. The fluid passes from the chamber C through the passage P into the receiver V and from thence by the check-valves and is directed by the nozzles N′ against the outermost rings of blades on the low-pressure wheel. After acting upon each ring in turn upon the low-pressure wheel the fluid is exhausted through the pipe E into the atmosphere or into a vacuum, as the case may be.

In Fig. 2 is shown a triple-expansion turbine differing from the construction shown in Fig. 1 only in that an intermediate-pressure chamber C_1 is arranged between the high-pressure chamber C and the lower-pressure chamber C′. Each of the wheels is constructed like the wheel described in the description of Fig. 1, being provided with a plurality of rings of blades and having interposed between the rings a plurality of sector-shaped series of guides, both blades and guides being provided with shrouds, as before described. From the high-pressure chamber C the fluid passes through the passage P into the receiver V, from whence it is admitted by the check-valve to the nozzles N_1, being discharged through said nozzles against the outermost ring on the intermediate wheel D′. From the chamber C_1 the

fluid passes through the passage E_1 into the receiver V_1 and is admitted by the check-valve to the nozzle N′, from whence it is discharged upon the outermost rings of blades on the low-pressure wheel D′, and after having acted upon each ring of blades the fluid is discharged from the low-pressure chamber C′ through the pipe E to the atmosphere or to a vacuum, as the case may be.

It will be understood that each of the wheels D D_1 D′ is mounted upon the same shaft and that the wheels are similar in every respect to those shown in Fig. 2.

Between each pressure-chamber in both Figs. 1 and 2 a double wall is arranged, a space A being left between the walls and the walls being connected at intervals by space-blocks *x*. In Fig. 2 a double wall A is arranged between the high-pressure and the intermediate-pressure chamber, and a second double wall A_1 is arranged between the intermediate chamber C_1 and the low-pressure chamber C′.

In Figs. 4, 5, and 6 is shown a packing for the shaft arranged in the opening of the double wall through which the shaft passes. This packing K is divided into two pieces along the line *a b* and fitted together and retained in position by straps M, connected by bolts Z. Between the flanges of the walls W and the packing K are arranged annular rubber bands L, there being also a second rubber packing U on one of the flanged vanes of the double wall, this rubber packing being upon that face of the wall toward the higher-pressure chamber, the packing being retained in position by bolts J. The turbine-case is also divided along the line corresponding to the line *a b*, whereby access may be readily had to the interior of the casing and to the packing. A projection Y is provided upon the wall W between the flanges for engaging the packing K, whereby to prevent the rotation of the said packing with the shaft.

Having thus particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, what I claim as new, and desire to secure by Letters Patent of the United States of America, is—

1. In elastic-fluid turbines with two or more pressure stages, running-wheels on one face of which one or more shrouded blade-rings are affixed concentric with center of shaft and in relation to nozzles, and shrouded guide-vanes in combination with double walls between successive-stage rooms, and made fluid-tight about running-shaft between successive-stage rooms with split and flanged graphite packings, with annular rubber packings around the flanges and with a flat rubber packing fitted on one of the flange-faces toward the higher-pressure-stage room, substantially as and for the purpose described.

2. In elastic-fluid turbines, with two or more pressure-stage rooms, split and flanged graphite packings provided with annular rubber packings around the flanges, said packings being arranged in bearing-recesses in the division-walls between successive-stage rooms, and being provided on the flange-face toward the high-pressure-stage room with a flat rubber packing, all substantially as and for the purpose set forth.

In testimony whereof I have hereto signed my name in the presence of two subscribing witnesses.

DEN-ICHIRO NISHIZAKI.

Witnesses:

JOHN E. JONES,

GEUJI KURIBARA.