No. 848,485.

PATENTED MAR. 26, 1907.

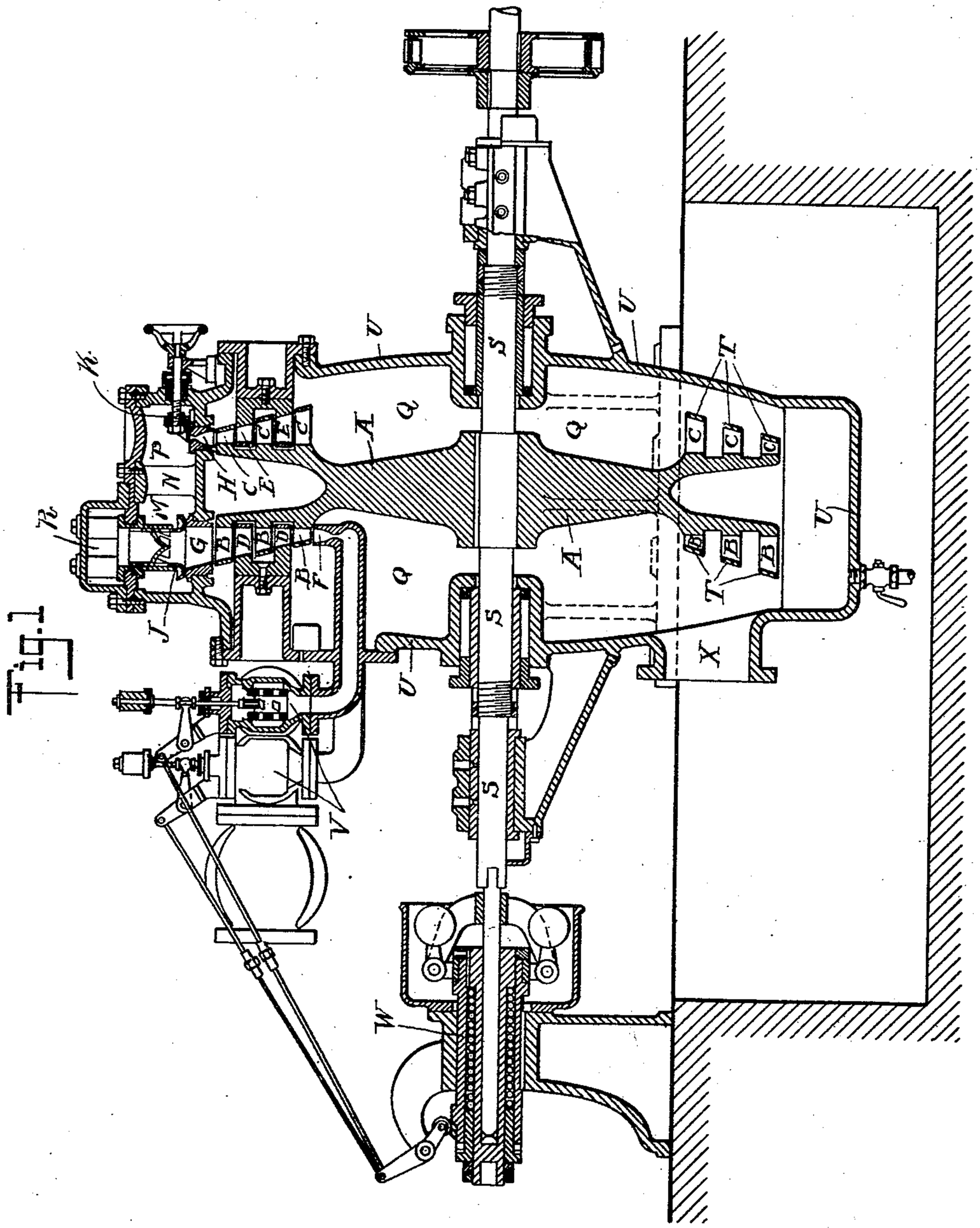
DEN-ICHIRO NISHIZAKI.

ELASTIC FLUID TURBINE.

APPLICATION FILED AUG. 9, 1906.

8 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

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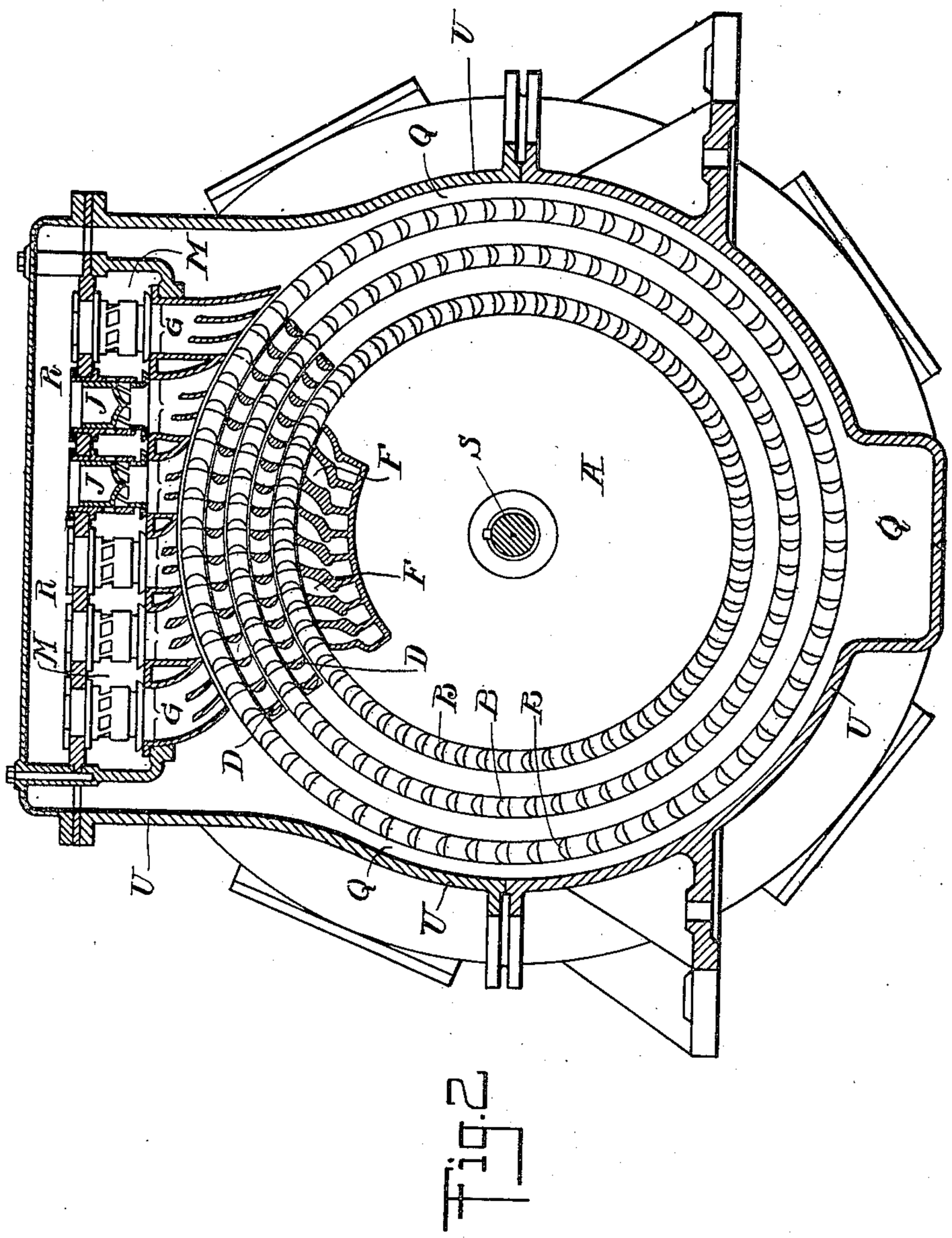

Fig. 2.

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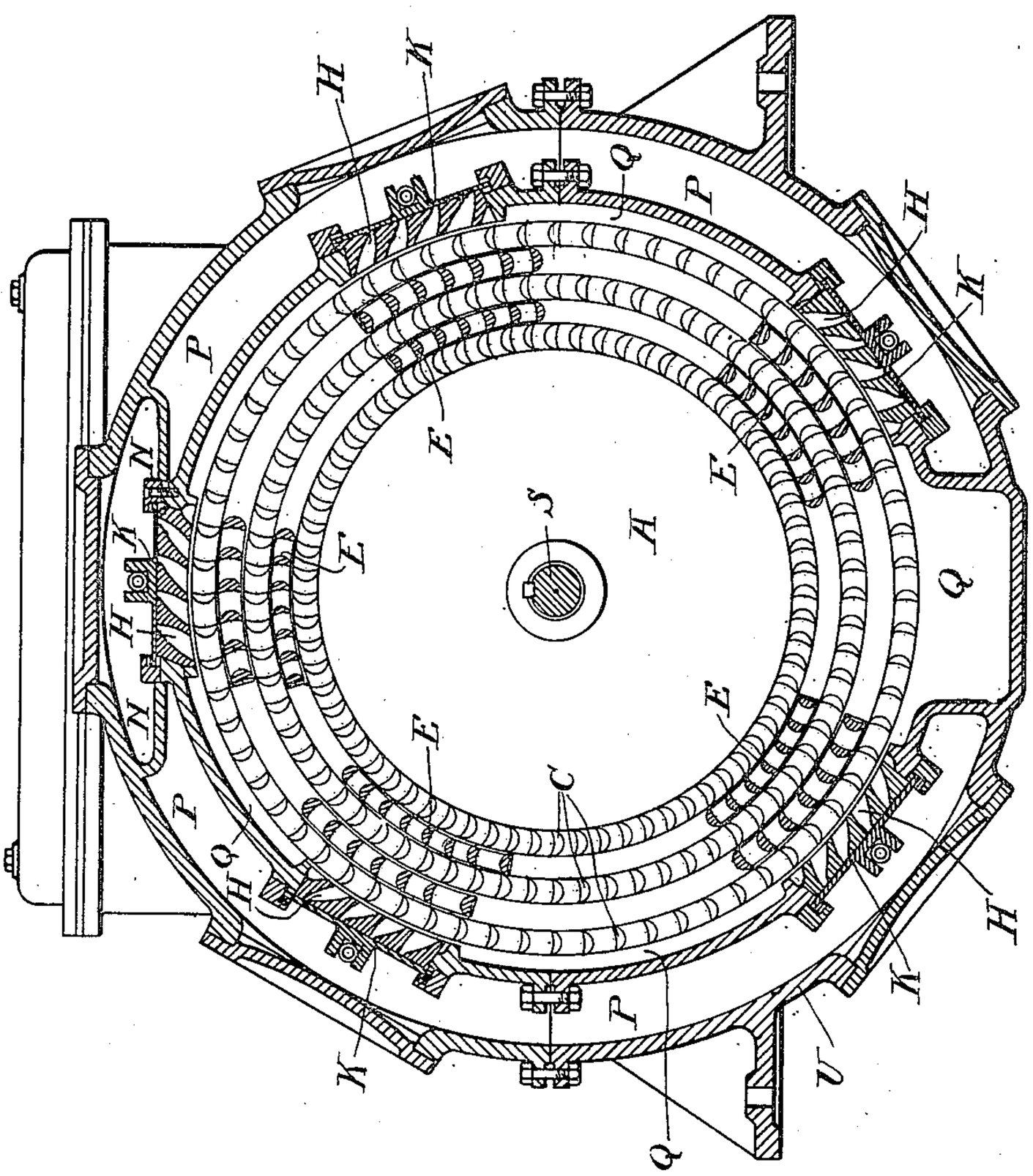
8 SHEETS—SHEET 3.

Fig. 3.



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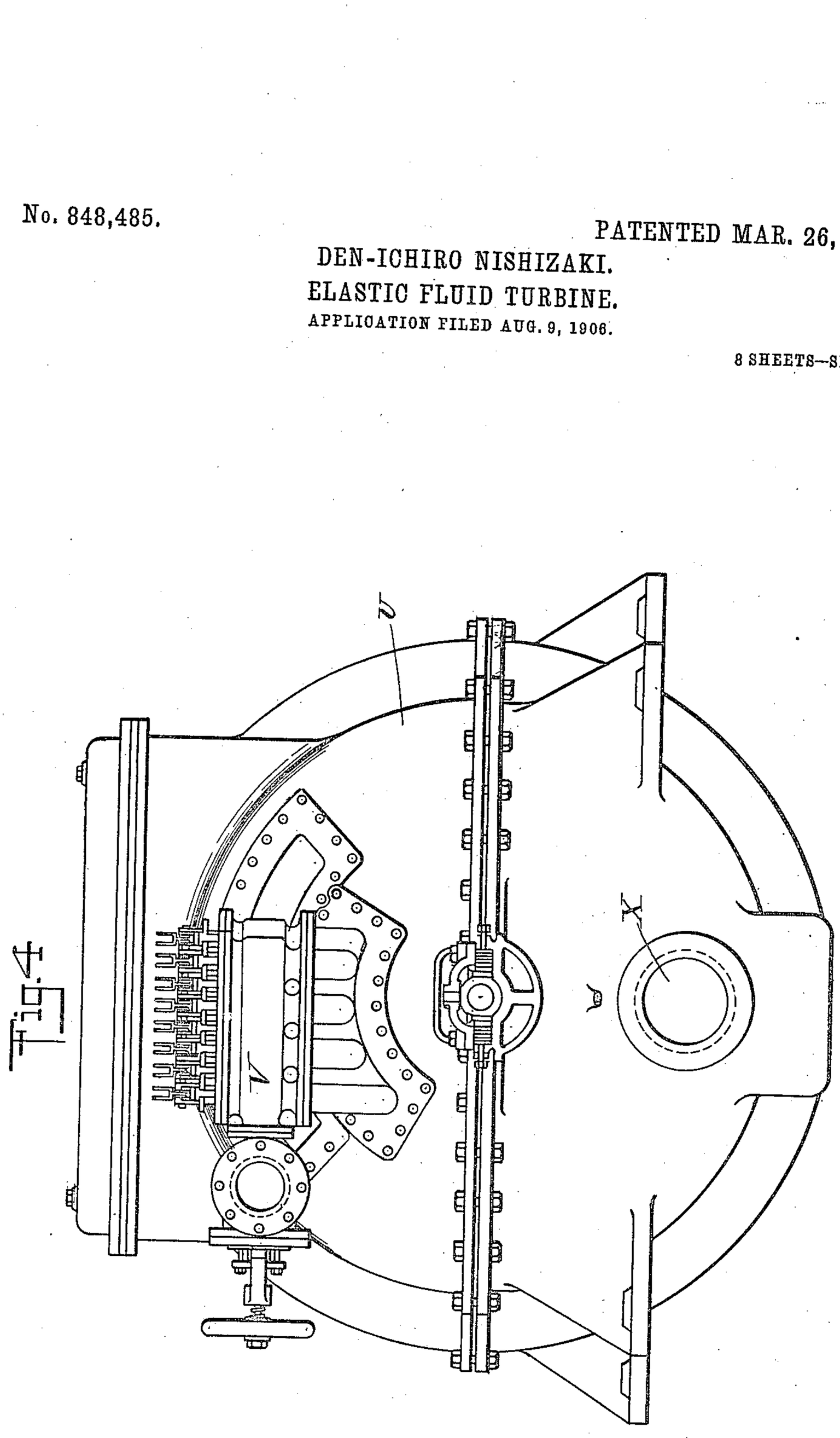

Fig. 4.

WITNESSES

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8 SHEETS—SHEET 5.

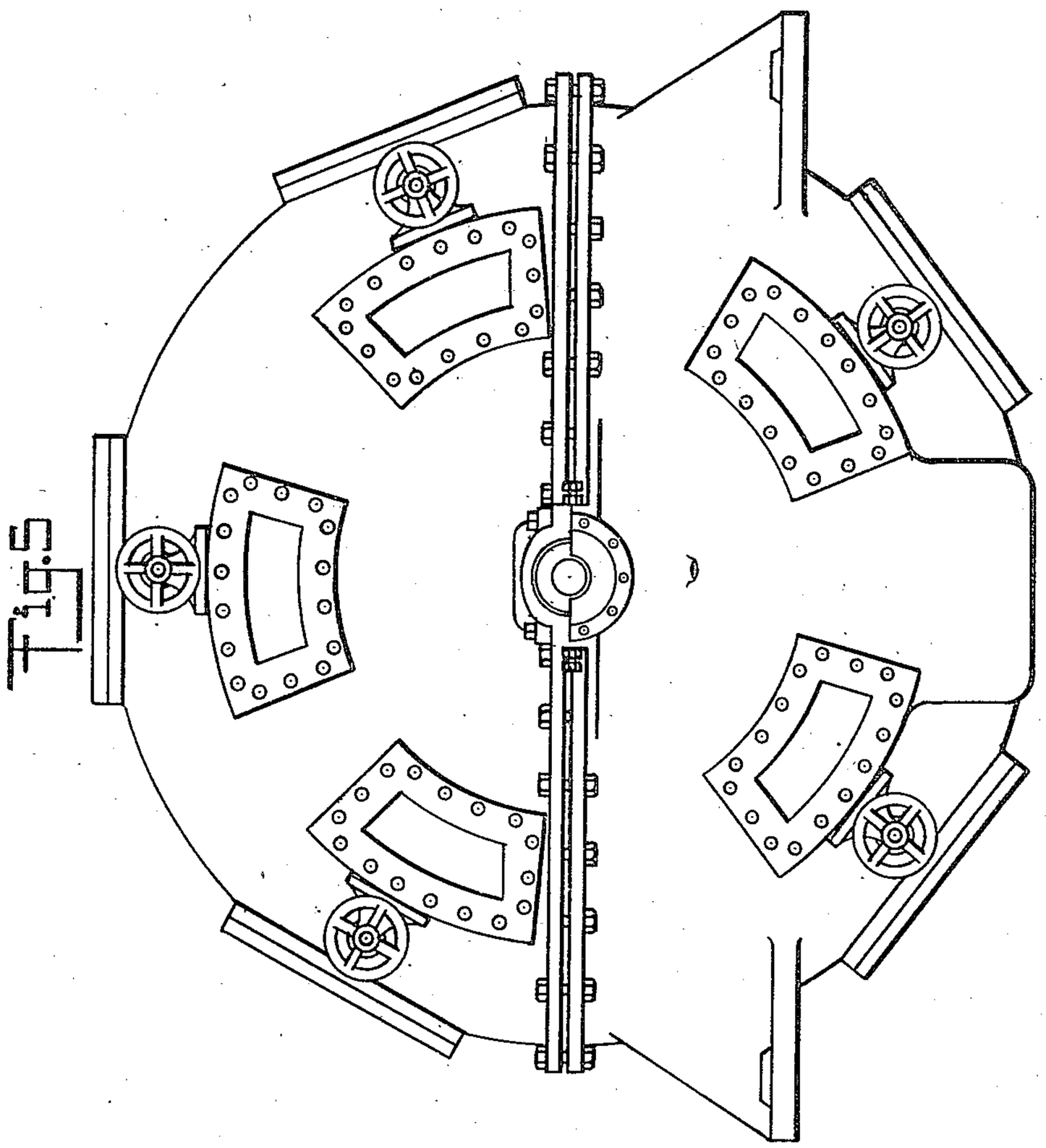

Fig. 5.

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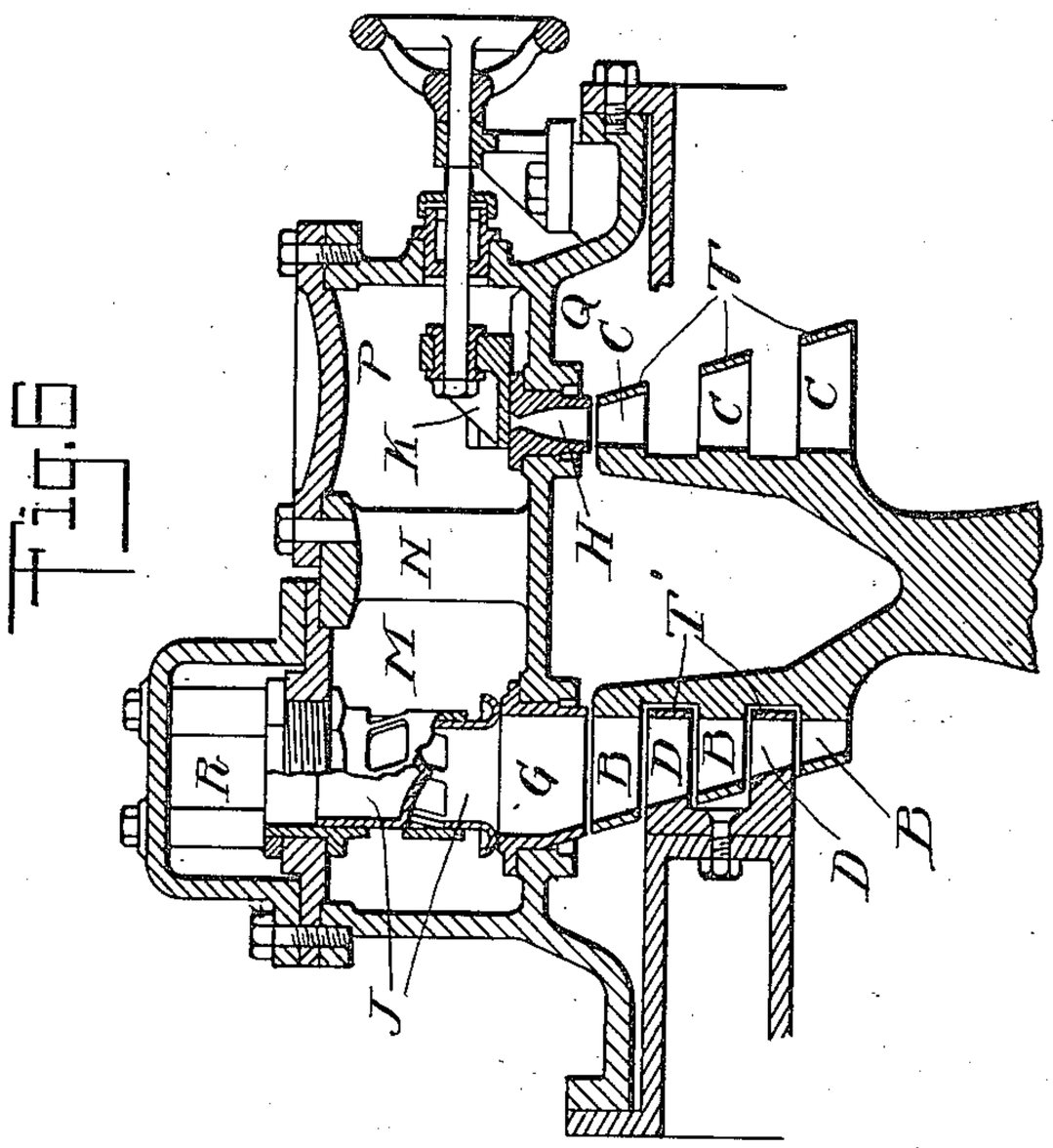
8 SHEETS—SHEET 6.



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8 SHEETS—SHEET 7.

Fig. 7

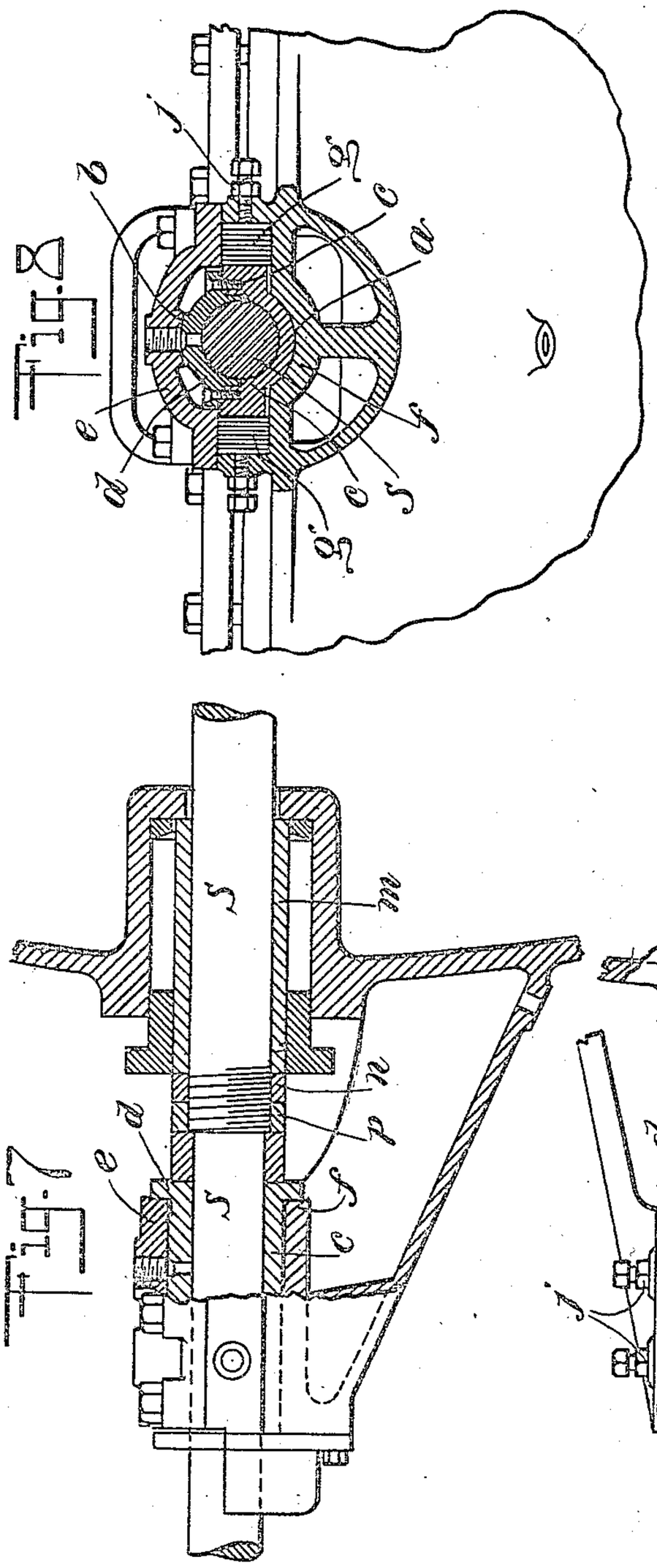
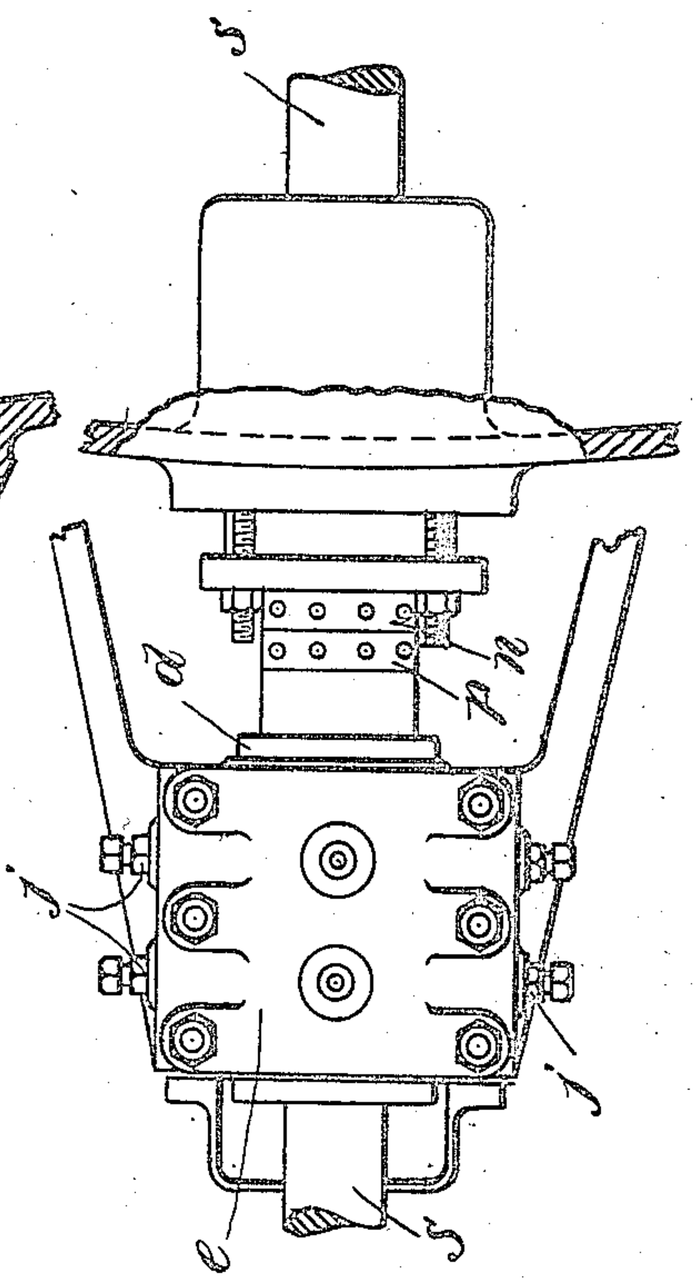


Fig. 8



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8 SHEETS—SHEET 8.

Fig. 11.

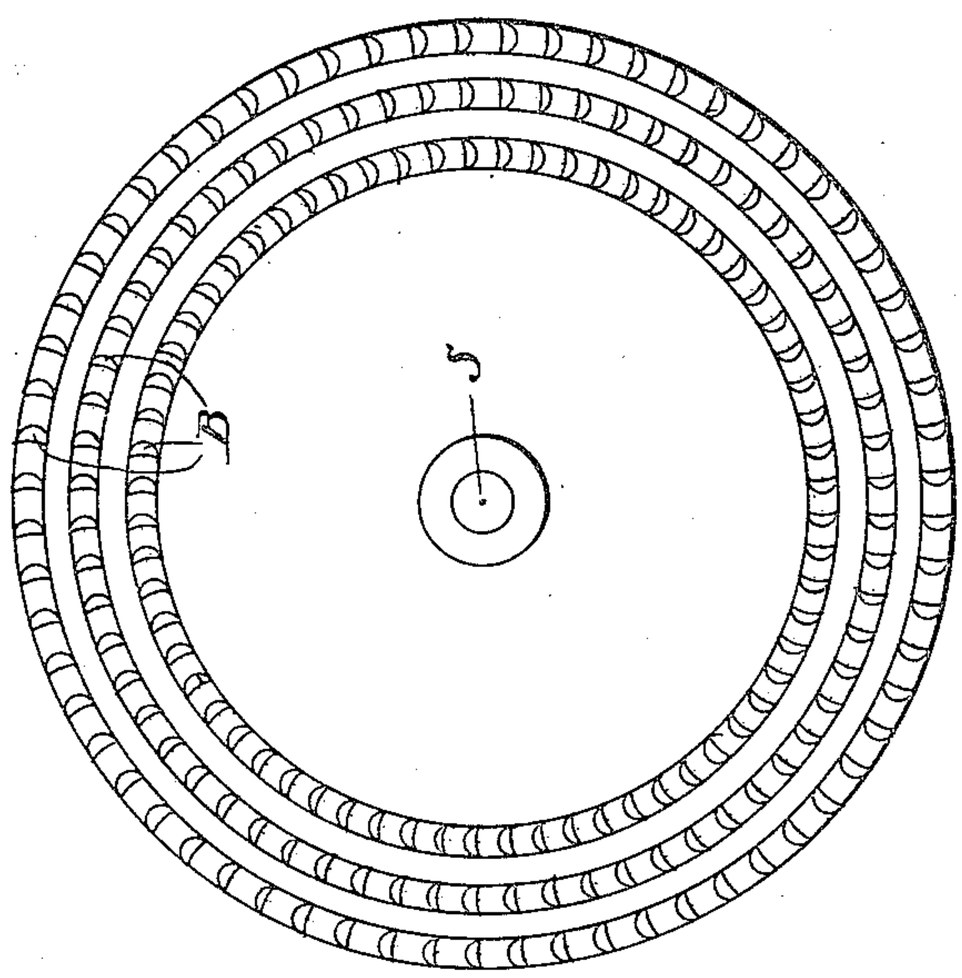
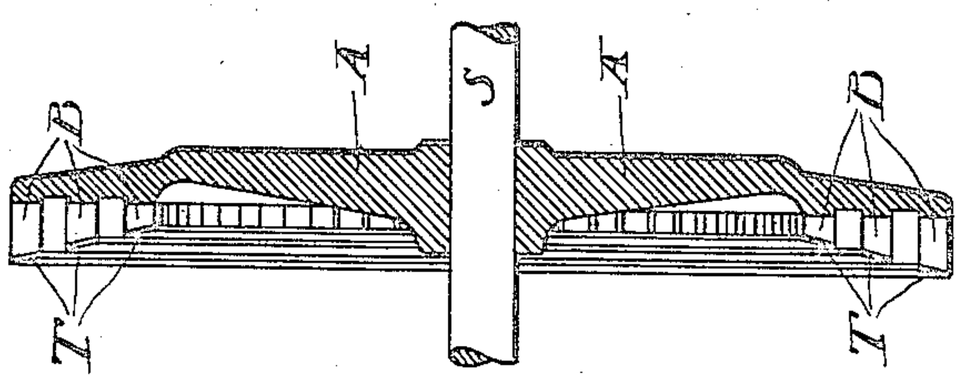


Fig. 10.



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UNITED STATES PATENT OFFICE.

DEN-ICHIRO NISHIZAKI, OF TOKYO, JAPAN.

ELASTIC-FLUID TURBINE.

No. 848,485. Specification of Letters Patent. Patented March 26, 1907.

Application filed August 9, 1906. Serial No. 329,940.

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 a new and useful Improvement 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 turbines; and it 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 longitudinal vertical section through the center line of the shaft of a compound turbine constructed in accordance with my invention. Fig. 2 is a transverse section showing the high-pressure side. Fig. 3 is a similar section showing the low-pressure side. Fig. 4 is an end elevation on the high-pressure side. Fig. 5 is a similar view on the low-pressure side. Fig. 6 is a detail view of part of Fig. 1. Fig. 7 is a longitudinal section of the bearing and stuffing box for the turbine-shaft. Fig. 8 is a transverse section of the same. Fig. 9 is a plan view of the same. Fig. 10 is a cross-section of a simple turbine, showing an arrangement of vanes and guides in accordance with my invention; and Fig. 11 is a front view of the simple turbine.

The turbine-wheel A is mounted upon a shaft S, journaled in bearings in a casing U, in which the turbine-wheel is inclosed. Upon the high-pressure side of the turbine-wheel A is a plurality of rings of blades B, and connected with the casing, at the upper part thereof, is a plurality of sector-shaped series of guides D, the said guides being arranged to receive the fluid from the preceding ring of blades and guide it to the succeeding ring of blades.

A series of nozzles F direct the fluid against the innermost ring of blades near the upper end of the casing, the said nozzles delivering radially of the wheel and extending without the casing, each nozzle F having interposed therein a throttle-valve V, actuated by a governor W, arranged upon the shaft S in the ordinary manner.

After the fluid leaves the last ring of blades on the high-pressure side it passes through a check-valve J and into a chamber R, which is in communication with the interior Q of the casing U. From the chamber R the fluid passes to a chamber M and from thence through a passage N to a chamber P, the last-named chamber being arranged circumferentially of the casing, as clearly shown in Fig. 3.

Upon the low-pressure side of the turbine is arranged a plurality of rings of blades C, and at spaced intervals around the periphery of the casing U are arranged a plurality of sector-shaped series of guides E, for the purpose of guiding the fluid from the outermost ring of blades to the inner ring.

Adjacent to each series of guides is arranged a plurality of passages H, leading from the chamber P to the low-pressure side of the turbine, the said passages H being controlled by valves K, which may be operated by a hand-wheel from the outside of the casing. When the fluid has passed beyond the innermost ring of blades on the low-pressure side, it is within the interior Q of the casing U and passes from thence through the passage X to the condenser, if one be used, or, if a non-condensing turbine, passes to the atmosphere.

In the operation of my invention the fluid enters through the throttle-valves V and by the nozzles F is directed against the innermost series of blades on the high-pressure side of the turbine. After having acted upon the innermost ring the interposed guides D deflect the fluid to the next ring of blades until the outermost ring of blades has been acted upon, after which the fluid is deflected by the guides G toward the axes of the check-valves J, which are lifted, permitting the liquid to pass into the chamber R and from thence through M and N to the chamber P. From this chamber the fluid is admitted by means of the check-valves K through the passages H to the outermost ring of blades on the low-pressure side, and after having acted upon all the rings of blades on the low-pressure side the fluid passes into the interior Q of the chamber U and to the condenser or atmosphere through the opening X.

For the purpose of reducing to a minimum end thrust due to the pressure of the fluid each of the rings of blades on both the high-pressure and low-pressure side is provided with a thin annular shroud T, and each of the sector-shaped series of guide-vanes is provided with a similar shroud T′. By this construction the expanding fluid acts upon the shroud as well as upon the face of the blade, the pressure on the shroud equalizing the pressure on the face of the wheel. It will be noticed that sufficient space is left between

the guide-vanes, shrouds T′, and the turbine-wheel so that the wheel can be perfectly surrounded with space which is at the same pressure as the interior Q of the chamber U. This pressure in a non-condenser would be the atmospheric pressure and in a condensing-turbine would be substantially a vacuum.

In Figs. 7, 8, and 9 is shown a construction of bearing and stuffing-box to be used in connection with my turbine. In these figures the turbine-shaft S is supported by the bearing metals *c d*, which are inclosed within the bearing-block *f* and the bearing-cover *e*. The bearing-block *f* is provided with a recess in the upper face thereof, and the outer surface of the bearing metal *c* is shaped upon the arc of a circle having a smaller radius than the radius of the circle upon whose arc the recess is shaped, so that the said bearing metal may rock within the recess upon the point *a*. The outer surface of the bearing metal *d* is shaped upon the arc of a circle whose center is the point *a*, and the inner surface of the bearing-cover *e* is similarly shaped in order to permit this rocking movement before described. The bearing metals are engaged at each side by the innermost of the series of superimposed thin steel sheets *g*, the outermost sheet being engaged by a set-screw *j*. In this construction the pile of superimposed sheets acts as a buffer when the shaft vibrates, the vibration being absorbed by the sheets, so that but little or no shock is transmitted to the casing. In Fig. 7 a graphite bushing *m* is forced onto a tapered portion of the shaft S and tightly fastened by means of a nut *n*, threaded onto the shaft and a lock-nut *p* also threaded on the shaft, the construction compelling the bushing to rotate with the shaft. By this construction no oil is needed in the stuffing-box, the graphite acting as a lubricant.

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 two-stage expansion elastic-fluid turbines, a turbine-wheel on one face of which one or more rings of blades are affixed in relation to high-pressure nozzles and to guide-vanes, and on the other face of which one or more rings of blades are affixed in relation to low-pressure nozzles and to guide-vanes, in combination with special passage or receiver having non-return valves and guide-vanes next to the final high-pressure blades, so situated as to lead elastic fluid, exhausting from high-pressure side to low-pressure side, said non-return valves being made to keep closed so long as no fluid rushes under to open them, substantially as and for the purpose described.

2. In two-stage expansion elastic-fluid turbines, a turbine-wheel on one face of which one or more rings of blades are affixed in relation to high-pressure nozzles and to guide-vanes, and on the other face of which one or more rings of blades are affixed in relation to low-pressure nozzles and to guide-vanes, in combination with special passage or receiver having non-return valves and guide-vanes next to the final high-pressure blades and with said low-pressure nozzles outside to low-pressure blades so situated as to lead elastic fluid exhausting from high-pressure side to low-pressure side, substantially as and for the purpose described.

3. In two-stage expansion elastic-fluid turbines, a turbine-wheel on one face of which one or more rings of blades are affixed in relation to high-pressure nozzles and to guide-vanes, and on the other face of which one or more rings of blades are affixed in relation to low-pressure nozzles and to guide-vanes, in combination with special passage or receiver having non-return valves next to the final high-pressure blades and with said low-pressure nozzles outside to low-pressure blades so situated as to lead elastic fluid exhausting from high-pressure side to low-pressure side, said rings of blades being fitted with concentric rings or shrouds on the side opposite the wheel itself and said guide-vanes fitted with segments of concentric rings or shrouds on the side toward the wheel and kept quite clear from the wheel, to secure balance of pressure on faces of the wheel, substantially as and for the purpose described.

4. In two-stage expansion elastic-fluid turbines, a turbine-wheel on one face of which one or more rings of blades are affixed in relation to high-pressure nozzles and to guide-vanes, and on the other face of which one or more rings of blades are affixed in relation to low-pressure nozzles and to guide-vanes, in combination with special passage or receiver having non-return valves next to the final high-pressure blades and with said low-pressure nozzles outside to low-pressure blades so situated as to lead elastic fluid exhausting from high-pressure side to low-pressure side; said wheel being secured on a shaft mounted on bearings made to oscillate laterally a little round an axial line at bottom of bearing metal, sliding in contact with bearing-cover on top, and secured on its position with piled-up sheet-steel buffers on both sides, so arranged as to absorb shock of vibrating wheel substantially as and for the purpose described.

5. In two-stage expansion elastic-fluid turbines, a turbine-wheel on one face of which one or more rings of blades are affixed in relation to high-pressure nozzles and to guide-vanes, and on the other face of which one or more rings of blades are affixed in relation to low-pressure nozzles and to

guide-vanes, in combination with special passage or receiver having non-return valves next to the final high-pressure blades and with said low-pressure nozzles outside to low-pressure blades so situated as to lead elastic fluid exhausting from high-pressure side to low-pressure side; said wheels being secured on a shaft fitted with graphite bushing, which is tapered on interior and forced in with nuts, on the portion rotating in stuffing-box, substantially as and for the purpose described.

6. In single-pressure stage elastic-fluid turbines, a turbine-wheel on one face of which one or more rings of shrouded blades are affixed concentric with center of shaft and in relation to nozzles and shrouded guide-vanes, said wheel being secured on a shaft mounted on bearings made to oscillate laterally a little round an axial line at bottom of bearing metal, sliding in contact with bearing-cover on top, and secured on its position with piled-up sheet-steel buffers on both sides, so arranged as to absorb shock of vibrating wheel, substantially as and for the purpose described.

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

DEN-ICHIRO NISHIZAKI.

Witnesses:
JNO. E. JONES,
GENJI KURIBARA.