No. 853,563.

PATENTED MAY 14, 1907.

P. PHILLIP.

TURBINE.

APPLICATION FILED JUNE 22, 1906.

3 SHEETS—SHEET 1.

Fig. 1.

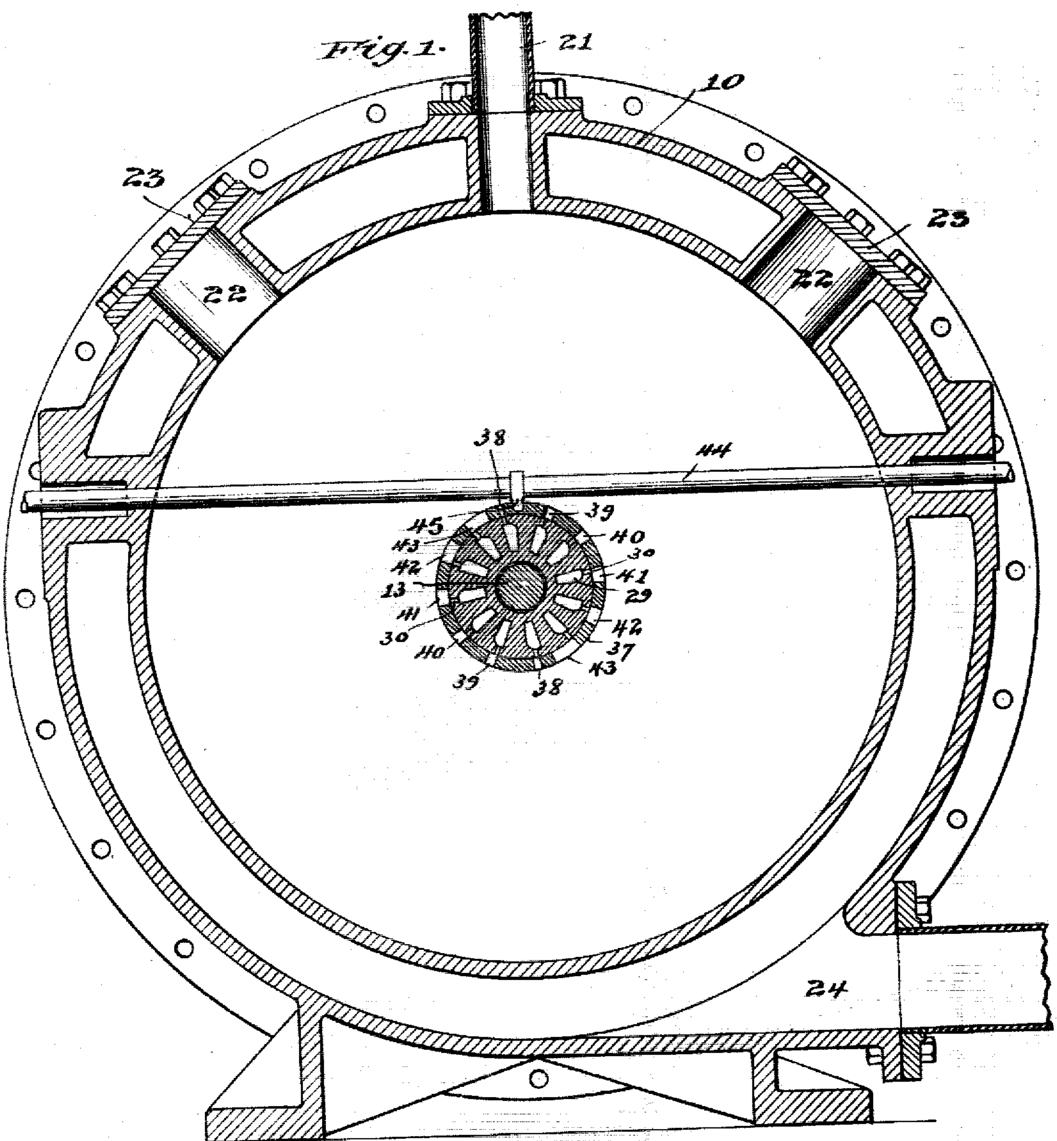
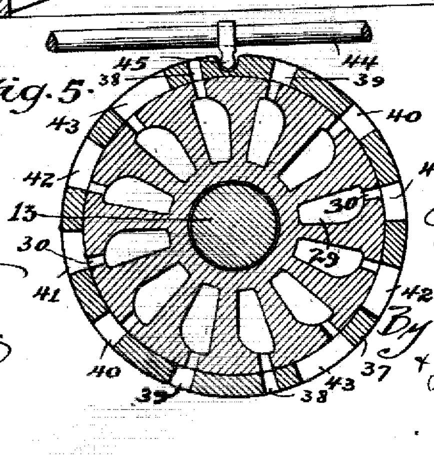


Fig. 5.



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3 SHEETS—SHEET 2.

Fig. 2.

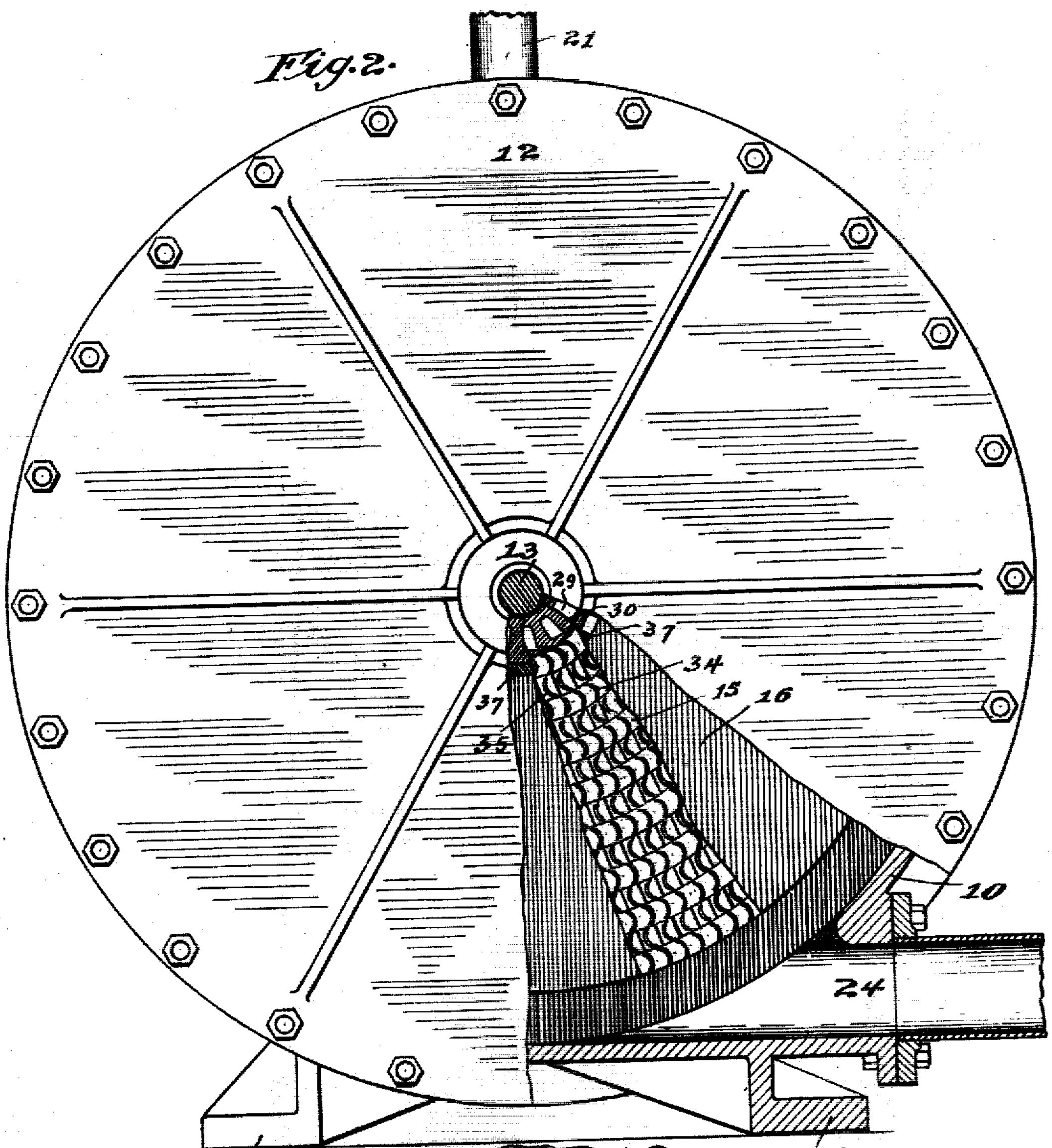
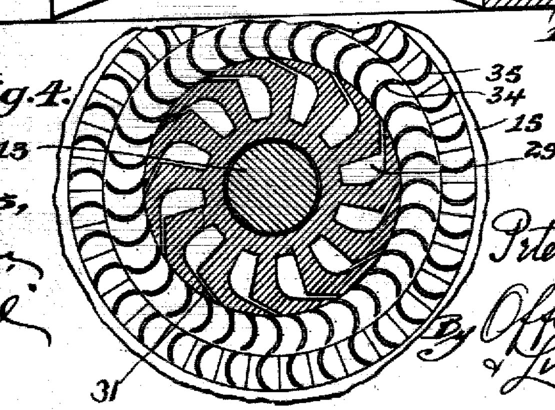


Fig. 4.



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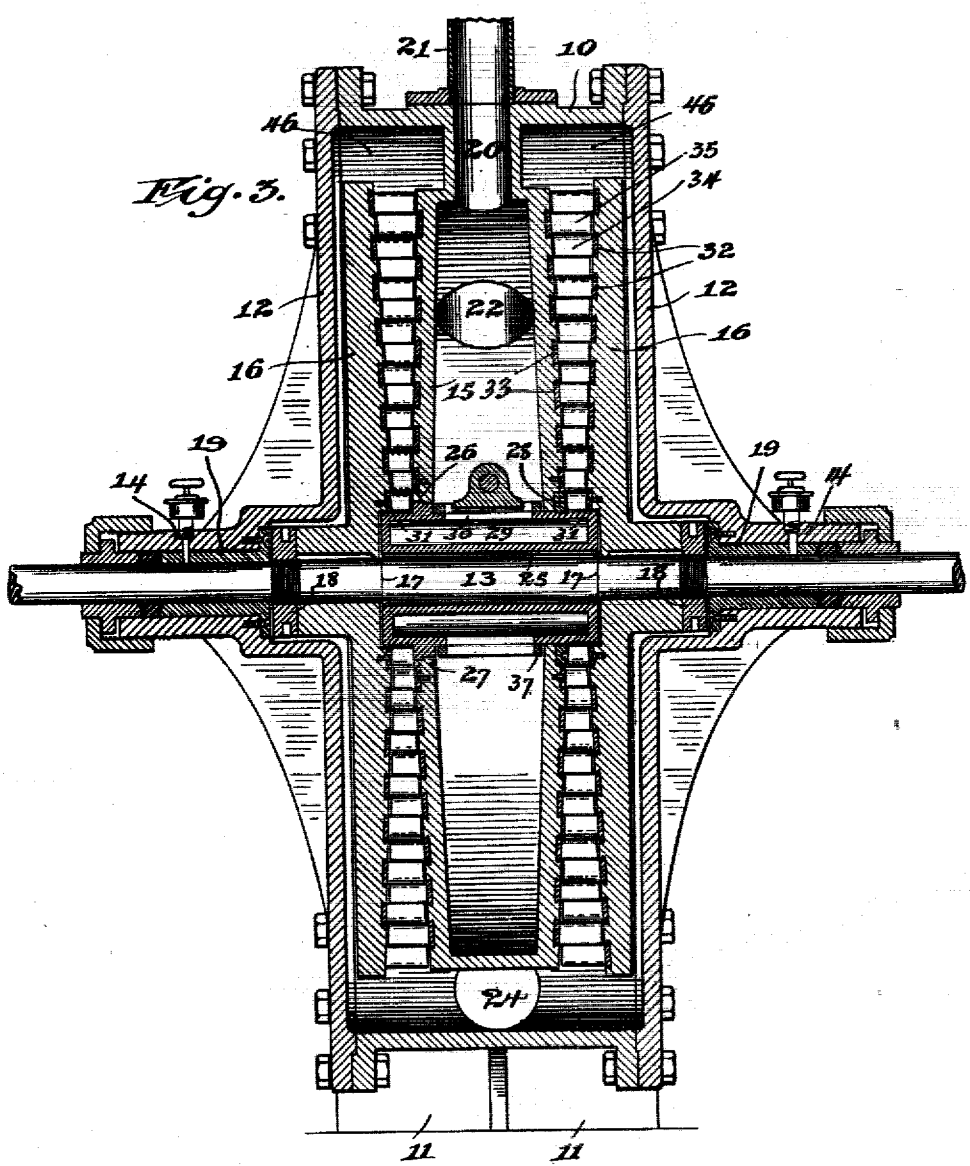
3 SHEETS—SHEET 3.

Fig. 3.



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UNITED STATES PATENT OFFICE.

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TURBINE.

No. 853,563. Specification of Letters Patent. Patented May 14, 1907.

Application filed June 22, 1906. Serial No. 322,899.

To all whom it may concern:

Be it known that I, PETER PHILLIP, a citizen of the United States, residing at Rogers Park, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Turbine-Engines, of which the following is a specification.

This invention relates to turbine engines, and has reference more particularly to that class or type of such engines wherein the flow of the motive fluid is radial.

This type of engine comprises essentially a driven shaft, a casing, and a rotor and stator both mounted with their centers coincident with the axis of the shaft, and each provided with radial groups of buckets or vanes between which the motive fluid flows from the center to the periphery, impelling the rotor through impact with its buckets or vanes and re-acting against the stationary buckets or vanes of the stator.

The object of this invention is to provide an improved and simplified turbine of this type, wherein the maximum impact and expansive efficiency of the steam or other motive fluid is utilized, and wherein the speed of the motor may be nicely and automatically adjusted by controlling the amount or volume of steam admitted.

The invention will be readily understood when considered in connection with the accompanying drawings showing an approved mechanical form thereof, wherein,—

Figure 1 is a central vertical section through the motor transversely of the shaft; Fig. 2 is a side elevation, partly broken out to disclose interior parts; Fig. 3 is a central vertical section longitudinally of the shaft; Fig. 4 is a detail cross-sectional view through the shaft and steam-distributing chest; and Fig. 5 is an enlarged cross-sectional detail through the shaft, steam-distributing chest, and annular valve which controls the admission of steam to said distributing chest.

Referring to the drawings, 10 designates the cylindrical casing of the motor, which is mounted on feet 11 preferably cast integral therewith.

12 designates the sides or covers which center on and are bolted to the cylindrical casing 10, and which carry the driven shaft 13 in suitably packed and lubricated bearings 14. Within the cylinder 10 and preferably cast integral therewith is a hollow or chambered disk 15 serving the function of a stator or abutment member.

16 represents each of the rotors, which are located one on either side of the stator 15 and which are keyed to the shaft 13 and held rigid against shoulders 17 on the shaft by means of nuts 18. The shaft 13 and rotors 16 are held in a fixed relation to the stationary frame members 10 and 15 by the nuts 18 bearing against brass sleeves 19 which take the end thrust of the rotors through the nuts 18 as well as the weight of the shaft and rotors, thereby maintaining the revolving parts central with the stationary frame members. An opening 20 connecting the cylinder 10 with the chamber of the stator 15 constitutes an inlet for the steam or other motive fluid, an inlet pipe 21 being shown as connected to the casing 10 coincidentally with the opening 20; and other openings 22 (Fig. 1) closed by caps or covers 23 permit inspection of the internal parts.

24 represents the exhaust opening herein shown as tangentially communicating with the lower end of the cylinder 10.

The stator 15 is formed with a central opening to accommodate a bronze casting 25 that surrounds the driven shaft 13 and constitutes the steam-distributing chest. This casting is confined in place by an integral collar 26 formed on one end thereof engaging an annular counter-sunk shoulder 27 on one side of the stator 15, and a nut 28 screwing into the other end of the casting and bearing against the opposite side of the stator. The casting 25 has formed therein a series of radially disposed steam-pockets 29, each of which is provided with a radial inlet port 30, and with approximately tangential outlet ports 31 at the ends. The inlet ports 30 lie in the transverse plane of the central chamber of the stator 15; while the outlet ports 31 are coincident with the spaces between the inner faces of the rotors 16 and the adjacent outer sides or faces of the stator 15. These opposed surfaces are made slightly divergent from the center outwardly, as clearly shown in Fig. 3; and in dovetailed grooves 32 and 33 on these diverging surfaces of the rotors and stator are secured buckets or vanes 34 and 35, respectively, the inner surfaces of which are concave and so disposed that adjacent buckets in a radial direction have their inside surfaces substantially tangential to each other and to the discharge ports or nozzles 31, allowing the steam or gas to leave one for the other without shock and in such a way as to impart the greatest work to the buckets with minimum friction.

Surrounding the distributing chest 25 within the chamber of the stator 15 and concentric with said distributing chest is a loose fitting valve sleeve 37 (see in particular Fig. 5), each longitudinal half of which is provided with a series of radial slots of successively increasing width; said slots being marked 38, 39, 40, 41, 42, and 43, from the narrowest to the widest. These slots are designed to be thrown into and out of registration with the inlet ports 30 of the steam-distributing chest by a relative rotary movement of the valve sleeve upon said distributing chest.

It will be observed that as the valve sleeve 37 is turned in the direction indicated by the arrow in Fig. 5, the inlet ports 30 served by the ports 38 of the valve sleeve will be first cut-off; a continued movement in the same direction next cutting off the ports served by the valve-ports 39; and a still further movement next cutting off the two diametrically opposite ports served by the valve ports 40, and so on until all of the inlet ports 30 have been closed. In this latter condition, a reverse movement of the valve sleeve 37 effects a gradual opening of the inlet ports in the manner described.

Any suitable means for actuating the valve sleeve 37 in the manner described either manually or automatically may be employed; a simple means for that purpose herein shown consisting of a rod 44 passing through suitable stuffing boxes in the walls of the cylinder and provided with a key 45 engaging the valve sleeve. The rod 44 may be connected externally of the motor casing with manual means for moving the same longitudinally, or with an automatic governor so arranged that as the speed of the turbine goes above normal the valve sleeve will revolve in a direction to cut off the steam, and when the speed goes below normal the sleeve is moved in the opposite direction to admit more steam.

In operation, the steam enters the inlet port 20 and fills the chamber of the stator 15, whence it passes through the valve-ports 38, 39, 40, 41, 42 and 43 of the valve sleeve and the inlet ports 30 of the distributing chest into the pockets 29 of the latter and thence out through the discharge ports 21, striking the first or innermost row of vanes which are attached to the rotors. After leaving these vanes its direction is changed by the vanes in the stator until it strikes tangentially the second set of rotor vanes, and so on to the last row of rotor vanes, whence it exhausts from the cylinder casing through the discharge outlet 24. The speed of the rotors and the ratio of the nozzle area to the effective area of the outer row of buckets should be such that with an assumed initial pressure and vacuum the final velocity of the steam with reference to the casing shall be *nil*, and with reference to the peripheral speed of the outer rotor vanes the same. If these conditions are obtained, the exhaust steam should flow in both directions from a point opposite the exhaust outlet to the exhaust through the passageways 46 on either side of the stator and opposite the peripheries of the rotors. In order to know, while the turbine is in operation, that these ideal conditions are maintained, consistently with the highest efficiency, a floating vane 47 is fastened to the shaft 48 located diametrically opposite to the exhaust outlet 24 and supported in bearings and suitable stuffing boxes in the sides or covers 12 of the cylinder. The vane 47 is held normally radial by a weighted handle or lever 49 on the outside of the casing. The action of the vane is as follows. If the rotor runs too slow, then the velocity of the steam issuing from the last row of pockets will be greater than the velocity of the buckets, and the folding vane 47 will be deflected in a direction opposite to that in which the rotor is running. And conversely, if the rotor runs too fast, the folding vane will lean the way the rotor runs. A change of governor adjustment or of the initial or terminal pressure of the steam will rectify abnormal conditions.

It is evident that modifications and variations in respect to minor details might be made by those skilled in the art without departing from the spirit or sacrificing any of the advantages of the invention.

I claim:

1. In a radial flow elastic fluid turbine, the combination with a driven shaft, of a stationary casing comprising a cylindrical wall, side walls or covers, and an internal chambered disk having an inlet port and outlet ports constituting discharge nozzles, the direction of which is in a plane perpendicular to the shaft and tangential to the curve of the rotor vanes at the point of admission, of a rotor fast on said shaft within said casing, and alternate rows of vanes on said rotor and chambered disk, respectively, the inner row of vanes on said rotor closely surrounding said discharge nozzles and receiving the impact of the motive fluid directly therefrom, substantially as described.

2. In a radial flow elastic fluid turbine, the combination with a driven shaft, of a stationary casing comprising a cylindrical wall, side walls or covers, and an internal chambered disk having an inlet port and two annular rows of outlet ports constituting discharge nozzles, the direction of which is in a plane perpendicular to the shaft and tangential to the curve of the rotor vanes at the point of admission, of a pair of rotors fast on said

shaft within said casing and on either side of said chambered disk, respectively, and alternate rows of vanes on said rotors and the opposed sides of said chambered disk, respectively, the inner rows of vanes on said rotors closely surrounding said discharge nozzles and receiving the impact of the motive fluid directly therefrom, substantially as described.

3. In a radial flow elastic fluid turbine, the combination with a driven shaft, of a stationary casing having an inlet port and an outlet port for the motive fluid and bearings for said shaft, a stationary annular motive fluid chest within said casing and surrounding said shaft, said chest having a plurality of inlet ports communicating with the inlet port of said casing, and an annular row of outlet ports constituting discharge nozzles, a rotor fast on said shaft within said casing, and alternate rows of vanes on said casing and rotor, respectively, the inner row of vanes on said rotor closely surrounding said discharge nozzles and receiving the impact of the motive fluid directly therefrom, substantially as described.

4. In a radial flow elastic fluid turbine, the combination with a driven shaft, of a stationary casing having an inlet port and an outlet port for the motive fluid, and bearings for said shaft, a stationary annular motive fluid chest within said casing and surrounding said shaft, said chest having an annular row of inlet ports communicating with the inlet port of said casing and an annular row of outlet ports constituting discharge nozzles an annular valve surrounding said chest opposite and controlling the inlet ports thereof, a rotor fast on said shaft within said casing, and alternate rows of vanes on said casing and rotor, respectively, the inner row of vanes on said rotor closely surrounding said discharge nozzles and receiving the impact of the motive fluid directly therefrom, substantially as described.

5. In a radial flow elastic fluid turbine, the combination with a driven shaft, of a stationary casing having an inlet and an outlet for the motive fluid and comprising a cylindrical wall, side walls or covers, and an internal chambered disk having an inlet port communicating with the inlet port of said casing, a stationary annular motive fluid chest within and axially coincident with said internal chambered disk, said chest having an intermediate annular row of inlet ports communicating with the interior of said chambered disk and two annular rows of outlet ports constituting discharge nozzles disposed in planes outside of said chambered disk, respectively, a pair of rotors fast on said shaft within said casing and on either side of said chambered disk, respectively, and alternate rows of vanes on said rotors and the opposed sides of said chambered disk, respectively, the inner rows of vanes on said rotors closely surrounding said discharge nozzles and receiving the impact of the motive fluid directly therefrom, substantially as described.

6. In a radial flow elastic fluid turbine, the combination with a driven shaft, of a stationary casing having an inlet and an outlet for the motive fluid and comprising a cylindrical wall, side walls or covers, and an internal chambered disk having an inlet port communicating with the inlet port of said casing, a stationary annular motive fluid chest within and axially coincident with said internal chambered disk, said chest having an intermediate annular row of inlet ports communicating with the interior of said chambered disk and two annular rows of outlet ports constituting discharge nozzles disposed in planes outside of said chambered disk, respectively, an annular valve surrounding said chest opposite and controlling the inlet ports thereof, a pair of rotors fast on said shaft within said casing and on either side of said chambered disk, respectively, and alternate rows of vanes on said rotors and the opposed sides of said chambered disk, respectively, the inner rows of vanes on said rotors closely surrounding said discharge nozzles and receiving the impact of the motive fluid directly therefrom, substantially as described.

7. In a radial flow elastic fluid turbine, the combination with a stationary casing having an inlet port and an outlet port for the motive fluid, and a driven shaft suitably journaled therein, of a rotor mounted on said shaft within said casing, co-operating vanes on said rotor and casing, respectively, an annular distributing chest within said casing surrounding the shaft, said chest having an annular row of inlet ports and an annular row of outlet ports constituting discharge nozzles, and an annular valve surrounding said chest and provided with ports co-operating with the inlet ports of the latter, said valve ports being so formed and distributed as to successively cut off the inlet ports of the distributing chest when turned continuously in one direction, substantially as described.

8. In a radial flow elastic fluid turbine, the combination with a stationary casing having an inlet port and an outlet port for the motive fluid, and a driven shaft suitably journaled therein, of a rotor mounted on said shaft within said casing, co-operating vanes on said rotor and casing, respectively, an annular distributing chest within said casing surrounding the shaft, said chest having an annular row of inlet ports of uniform cross-sectional area and an annular row of outlet ports constituting discharge nozzles, and an annular valve surrounding said chest and provided with ports co-operating with the inlet ports of the latter, said valve ports being of successively increased cross-sectional area whereby they successively cut off the in-

let ports of the distributing chest when said annular valve is turned continuously in one direction, substantially as described.

9. In a radial-flow elastic fluid turbine, the combination with a stationary casing having an inlet port, an exhaust passage, and a discharge port, of a driving shaft suitably journaled in said casing, a rotor fast on said shaft, co-operating vanes on said rotor and casing, respectively, means for directing and distributing motive fluid to said vanes from the center of the casing outwardly or radially, a pivoted floating vane in the exhaust passage, and a handle or pointer on the pivot of said floating vane outside the casing serving to both hold said floating vane in a normally radial position and to indicate the position of the vane when the velocity of the steam relatively to the velocity of the vanes deflects it, substantially as described.

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