L. R. GUTHRIE.

TURBINE.

APPLICATION FILED FEB. 12, 1920.

1,383,937.

Patented July 5, 1921.

3 SHEETS—SHEET 1.

Fig. 1.

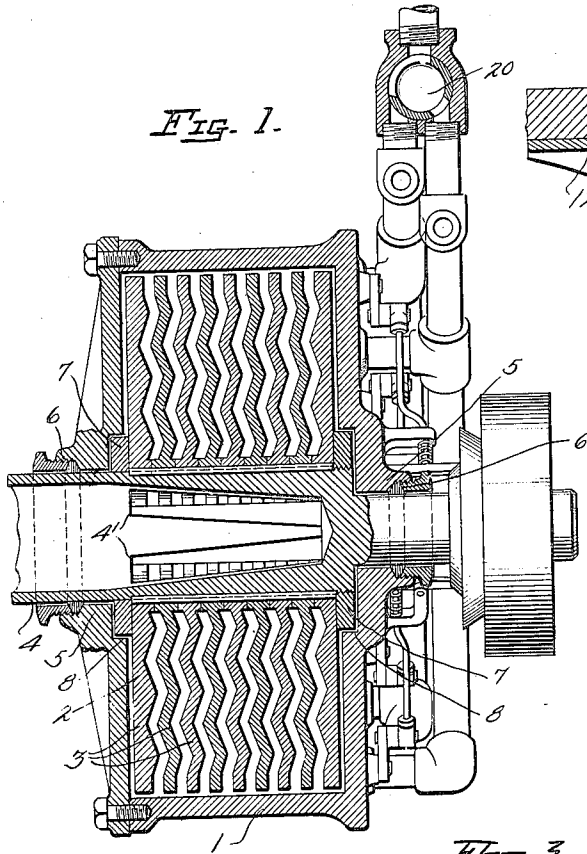


Fig. 2.

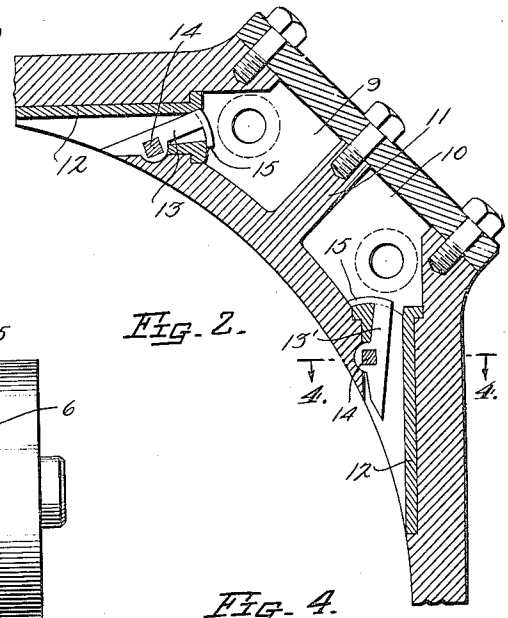


Fig. 4.

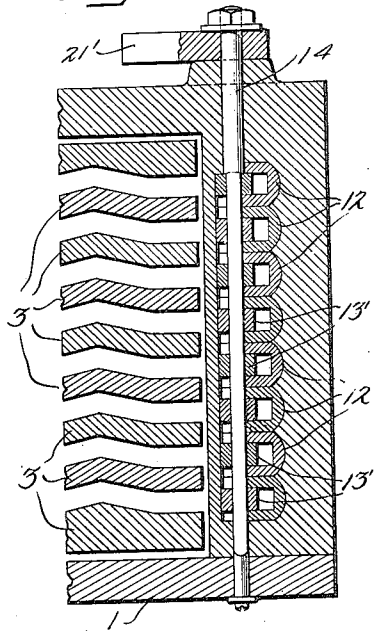
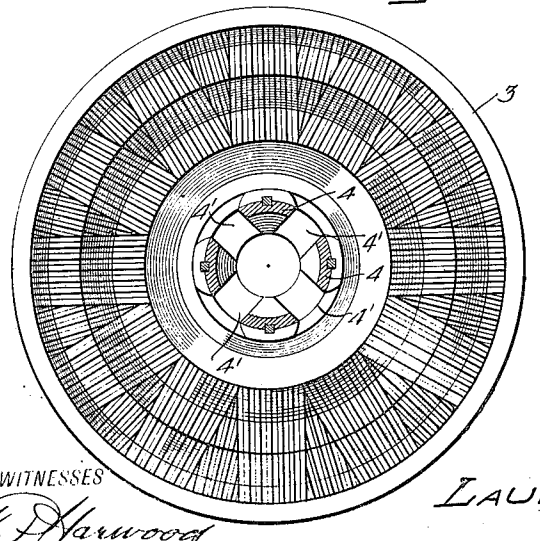


Fig. 3.



WITNESSES

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3 SHEETS—SHEET 2.

Fig. 5.

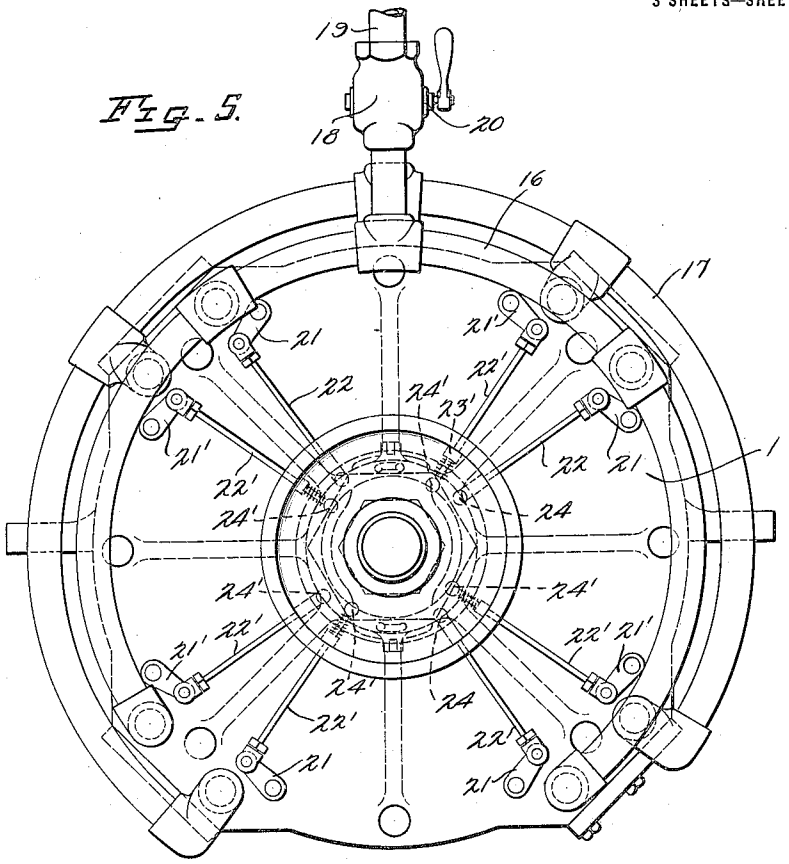
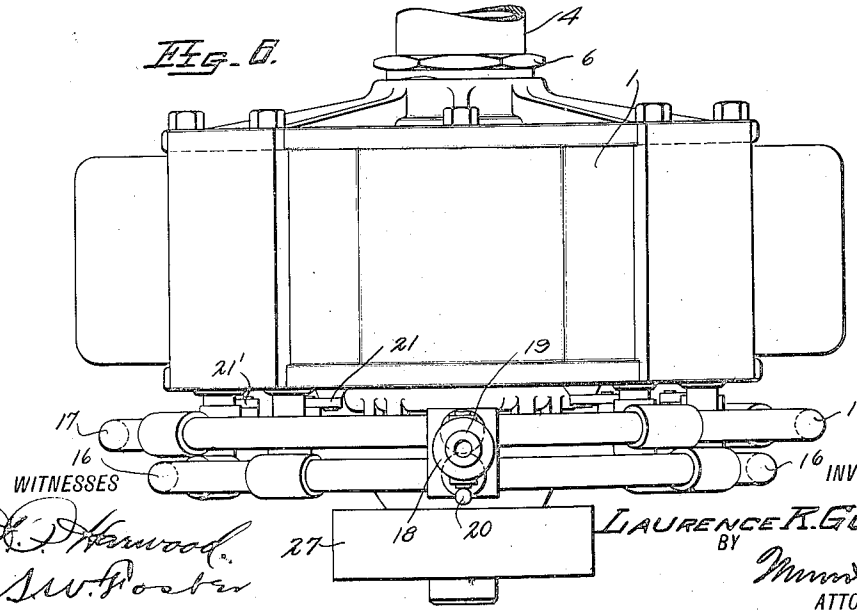


Fig. 6.



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3 SHEETS—SHEET 3.

FIG. 7.

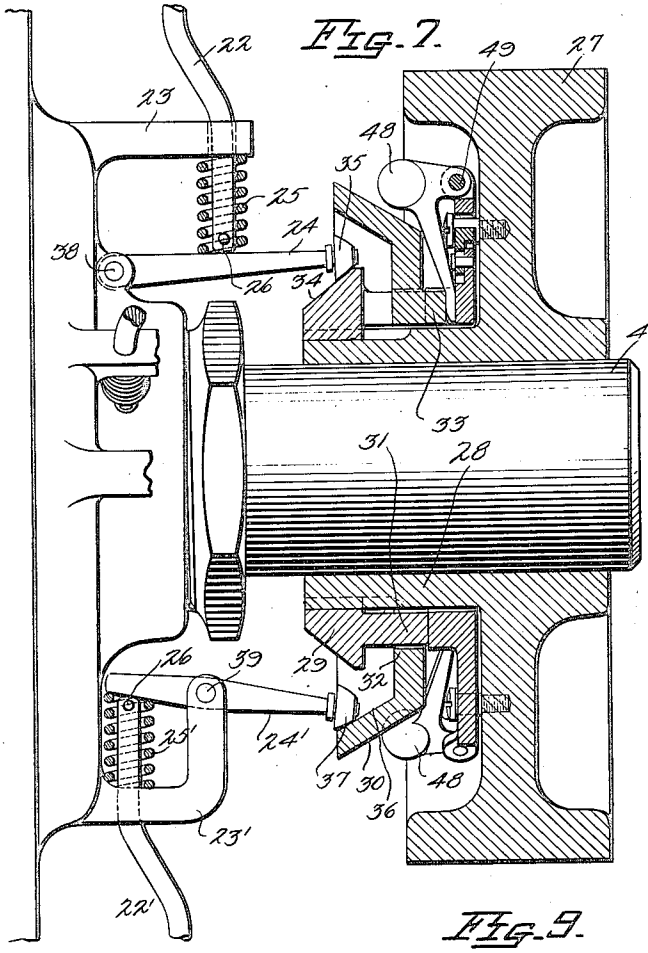


FIG. 8.

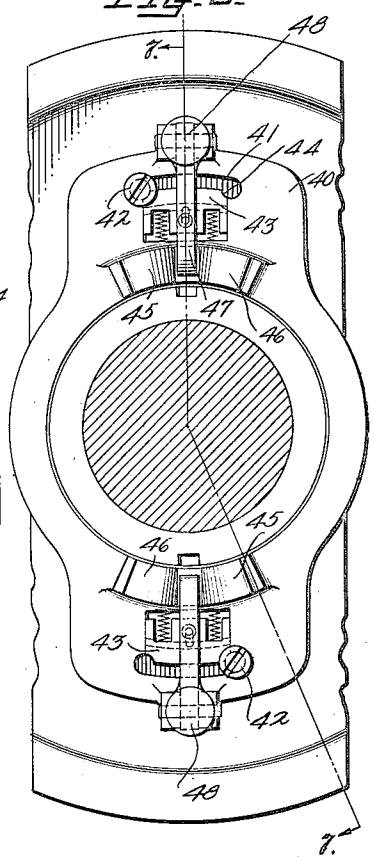
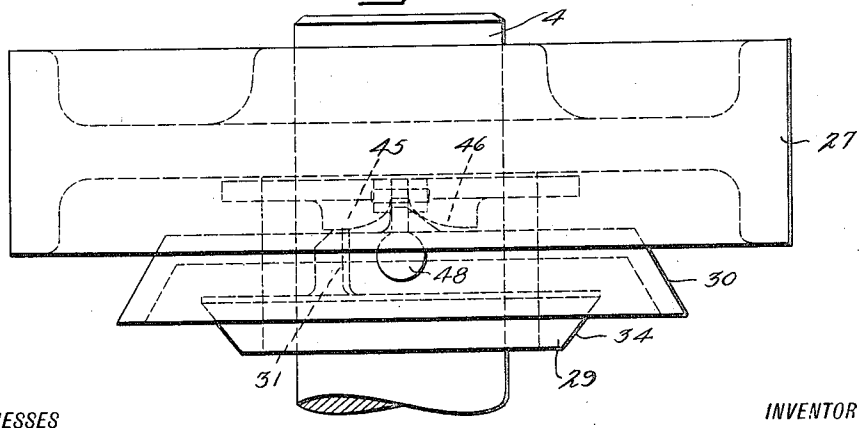


FIG. 9.



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UNITED STATES PATENT OFFICE.

LAURENCE RAWLIN GUTHRIE, OF MIAMI, OKLAHOMA.

TURBINE.

1,383,937. Specification of Letters Patent. Patented July 5, 1921.

Application filed February 12, 1920. Serial No. 358,065.

To all whom it may concern:

Be it known that I, LAURENCE R. GUTHRIE, a citizen of the United States, and a resident of Miami, in the county of Ottawa and State of Oklahoma, have invented a new and Improved Turbine, of which the following is a full, clear, and exact description.

This invention relates to improvements in turbines, an object of the invention being to provide a turbine embodying but relatively few parts which not only simplifies the construction but renders the device so that it can be easily and cheaply manufactured.

A further object is to provide a turbine rotor having an improved arrangement of disks having concentric annular corrugations.

A further object is to provide an improved construction and arrangement of governor for controlling the valves of the turbine and automatically operating in accordance with the direction of flow of the steam or other power fluid.

With these and other objects in view the invention consists in certain novel features of construction, and combinations and arrangements of parts, as will be more fully hereinafter described and pointed out in the claims.

In the accompanying drawings—

Figure 1 is a view in longitudinal section illustrating my improved turbine;

Fig. 2 is an enlarged fragmentary view in vertical section illustrating the construction and arrangement of a pair of valves controlling inlet ports;

Fig. 3 is a view in transverse section through the drive shaft showing a face view of one of the disks of the rotor;

Fig. 4 is a view in section on the line 4—4 of Fig. 2;

Fig. 5 is a fragmentary end elevation;

Fig. 6 is a top plan view;

Fig. 7 is a view partly in elevation and partly in longitudinal section illustrating my improved governor;

Fig. 8 is a view in transverse section through the drive shaft showing an inner face view of the flywheel with parts attached thereto, and other parts omitted for purposes of clearness; and

Fig. 9 is a top plan view of the flywheel and adjacent parts.

1 represents the casing or stator in which my improved rotor 2 is mounted and comprises a series of disks 3 keyed to and spaced along a hollow drive shaft 4 mounted in suitable bearings 5 in the stator and provided with stuffing boxes 6 to render the same steam tight. The drive shaft 4 is hollow and constitutes an outlet for the motive fluid and is provided with exhaust ports 4′ which communicate with the spaces between the disks 3. Collars 7 are positioned on the shaft 4 at the ends of the rotor 2 and turn in recesses 8 in the stator.

The disks 3 of the rotor are made with concentric annular corrugations and while I have illustrated these corrugations as of angular form, it is obvious that their shape might be varied without departing from the invention. The surfaces of the corrugated portions of the disks 3 are roughened so as to afford the maximum of frictional resistance to the passage of the power fluid and this roughening may be accomplished by milling, nurling, or scarifying in any approved manner.

The stator 1 is of somewhat angular or octagonal shape so as to provide at four points around its circumference pairs of steam chests 9 and 10 separated by a partition 11 and having nozzles 12 for directing the fluid tangentially between the disks of the rotor. These nozzles 12 are tapering and of greatest diameter at their inner ends to permit of the expansion of the steam to utilize the full kinetic energy and pressure for the operation. The nozzles 12 are provided with valves 13 and 13′ respectively and these valves 13 and 13′ are secured upon shafts 14 which project outside of the stator and the valves have curved inner ends 15 which operate to cut off or control the flow of fluid. It will be noted that the valves 13 and 13′ are secured between their ends to the shafts 14 and they form walls of the nozzles so that the shifting movement of the valve not only operates to open and close, but also varies the angular shape of the nozzle.

It is to be understood, of course, that the pairs of steam chests with their arrangement of valve nozzles permit the flow of steam to be directed in either direction so as to drive the rotor in the direction desired permitting a reversing of the turbine. To accomplish this, all of the valves 13 are simultaneously operated and all of the valves 13′ are simultaneously operated and the operation of the valves is automatic as will more fully hereinafter appear.

All of the steam chests 9 communicate

with a manifold pipe 16 and all of the steam chests 10 communicate with a manifold pipe 17. These manifold pipes 16 and 17 are preferably of curved form as shown in Fig. 5, an they both communicate with a valve chamber 18 into which a supply pipe 19 discharges. A valve 20 in the chamber 18 controls the flow of steam or other fluid and this valve 20 is of the three-way type so that it can be moved to a position to direct the fluid into either of the manifolds 16 or 17, as shown clearly in Fig. 1.

The shafts 14 of the valves 13 and 13′ project through the end of the stator and are provided with crank arms 21 and 21′ respectively. These crank arms 21 and 21′ are provided with operating rods 22 and 22′ respectively, said operating rods projecting radially of the stator and movably mounted in perforated brackets 23 and 23′ respectively. Operating levers 24 and 24′ respectively are provided for the two sets of valves and engage the ends of the rods 22 and 22′ respectively, and coiled springs 25 and 25′ are provided on the rods 22 and 22′ respectively and are located between the supporting brackets and crossed pins 26 on the rods tending to open the valves.

On the projecting end of the drive shaft 4 a flywheel 27 is secured and is made with a relatively long hub 28 which supports a pair of annular valve operating members 29 and 30. The member 29 is keyed to the hub 28 and provided with a longitudinally projecting lug 31 which extends through an opening 32 in member 30 so that this lug 31 compels the members 29 and 30 to turn together and also permits the independent longitudinal movement of the member 29 as will hereinafter appear. The member 30 also has a longitudinally projecting lug 33 corresponding to the lug 31 of the member 29. The member 29 has an external beveled cam face 34 which engages rollers 35 on the ends of the levers 24 and the member 30 has an internal beveled cam face 36 which engages rollers 37 on the ends of the levers 24′.

It will be noted that the levers 24 are pivotally connected at their ends to the rotor, as shown at 38, while the levers 24′ are pivotally supported between their ends on the brackets 23′, as shown at 39, so that the pivotal movement of these levers caused by the longitudinal movement of the members 29 and 30 respectively, will control the opening and closing of the valves 13 and 13′ compelling all of the valves 13 to operate together and all of the valves 13′ to operate together, thus permitting a reversal of the turbine.

A shifting plate 40 is loosely mounted on the hub of the flywheel 27 and is located against the inner face of said flywheel. This plate 40 is provided at its ends with circumferential slots 41 in which headed pins 42 on the flywheel 27 are located and maintained by centrifugal force. The inner walls of the slots 41 are formed by spring pressed plates 43 having notched ends 44 to provide enlarged ends for the slots to accommodate the pins 42 and by reason of the spring pressed plates 43, the plate 40 is permitted to shift a distance equal to the length of the slots to position the pins 42 in the respective ends of the slots, and during this shifting movement the spring pressed plates 43 move inwardly and then outwardly to hold the plates against accidental movement. This movement of the shifting plate 40 is caused by the rotation of the flywheel so that the plates shift from one position to the other in accordance with the direction of movement imparted to the flywheel.

The plate 40 is provided adjacent the hub 28 of the flywheel with two pairs of opposed cams 45 and 46 and between the cams 45 and 46, fingers 47 integral with weighted governor arms 48 are positioned. These governor arms 48 are pivotally connected to the plate 40, as shown at 49, and the rotation of the flywheel 27 tends to force these governor arms 48 outwardly, as will be readily understood.

The lugs 31 and 33 on the members 29 and 30 respectively are engaged by the cams 45 and 46 to move said members toward and away from the stator. With the parts as shown in Figs. 7, 8 and 9, the lug 33 of the member 30 is positioned between one pair of cams 45 and 46 and engaged by one of the governor arms 48. The lug 31 of the member 29 is engaged by one of the cams 45 causing the member 29 to be moved longitudinally toward the stator and when in this position holding the levers 24 so that the valves 13 are maintained in closed position, the valves 13′ being permitted to open by reason of the position of the levers 24′ and member 30.

When the speed of the flywheel increases to a predetermined point, the governor arms 48 operate to move the member 30 toward the stator and in doing so, the annular cam face 36 of said member causes the pivotal movement of the levers 24′ to partially close the valves 13′, thus automatically regulating the speed. When the flywheel is driven in the opposite direction, the plate 40 will be shifted so that the pins 42 rest in the ends of the slots opposite to the position shown in Fig. 8, and thus moving the plates causes the lug 31 of member 29 to ride into a position between the cams 45 and 46, while the lug 33 of the member 30 is engaged by a cam 45 and moved longitudinally toward the stator. This shifting of the members 29 and 30 automatically closes the valves 13′ and opens the valves 13 and the governor arms 48 control either set of valves as above explained.

It will thus be noted that the shifting of the parts of the governor is controlled by the direction of movement of the flywheel and this direction of movement of the flywheel is controlled by the direction of flow of the steam. The operator can direct the steam through either of the manifolds 16 or 17 by turning the valve 20 and as soon as the steam flows into the rotor to turn the same in one direction, the governor parts will be automatically shifted to open one set of valves and permit the other set of valves to close. Hence, the operator can quickly reverse the engine by quickly turning the valve 20 and the governor will automatically control the rotary speed of the engine in either direction of movement.

The operation of my improved turbine is as follows: The motive fluid entering one set of valve chests 9 or 10 as the case may be, passes through the nozzles 12 and by reason of the shape of said nozzles the motive fluid drops in pressure and increases in velocity or kinetic energy and issues directly between the disks. The motive fluid naturally tends to flow in straight lines. A portion of the steam flow will pass on between the disks and strike obliquely on the casing wall opposite the nozzle where it will be deflected inwardly between the disks and so continuously. The motive fluid issuing from the expansion chambers of the nozzles is not violently disrupted, split up or splashed as is the case where buckets or blades cut across the nozzle-jets. The nature of the passages is such that in no place is the stream abruptly blocked. It does divert its direction, and in this manner by utilizing the friction between the passing gas and the disk surfaces the energy of the jet is transferred from it to the rotor.

As the engine comes up to speed, a zone of compression will be formed around the periphery of the rotor so the stream of the motive fluid is cushioned as it reaches the opposite periphery of the disks from that in which it entered and it is forced to follow a spiral course inwardly which is the only free outlet, namely, the axial exhaust ports 4′. The plurality of nozzles facilitates this action. As the fluid comes around to the successive nozzles, it is swept along with the incoming fluid, but is on the inside of the path. As it follows its spiral course, it crosses diagonally the ridges of the corrugations of the disks which thrust it from one disk face to the opposite continuously. The inward projections and depressions of the faces of the disks receive the force of the particles of the fluid and these impacts as they aggregate throughout the rather long course of the spiral, when the engine is up to speed, form a powerful torque in the direction of rotation. As the fluid approaches the center, its velocity has considerably decreased, but so also has the linear speed of the disk surface so that a proportionate ratio still exists between disk speed and stream velocity. By compounding and condensing a wide range of expansion may be secured and also very low exhaust pressures.

The operation of the governor controlling the valves has been set forth in detail in connection with the above description, but its operation in general is as follows: When the flywheel 27 is turned in one direction, it shifts the plate 40 so as to cause the members 29 and 30 to be moved longitudinally by reason of the engagement of the cams 45 and 46 with the lugs 31 and 33 on said members. This shifting of the members 29 and 30 compels the operation of the levers 24 and 24′ so that one set of valves is open while the other set is closed and the governor arms 48 operate the member 29 or 30, whichever has its lugs in a position to be engaged thereby.

Various slight changes may be made in the general form and arrangement of parts described without departing from the invention, and hence I do not limit myself to the precise details set forth, but consider myself at liberty to make such changes and alterations as fairly fall within the spirit and scope of the appended claims.

I claim:

1. A turbine, comprising a stator and a rotor, said rotor consisting of a tubular shaft forming an exhaust passage and having radial perforations therein within the stator, a series of annularly corrugated disks secured on the shaft and spaced apart and forming passages between them communicating with the radial perforations of the shaft, a pair of tangential nozzles in the stator projecting in opposite directions and discharging into the spaces between the disks, each of said spaces being provided with a pair of said nozzles, and means for controlling the flow of motive fluid through either of the sets of pairs of nozzles in accordance with the direction of rotation desired for the rotor.

2. A turbine, comprising a stator and a rotor, said rotor consisting of a tubular shaft forming an exhaust passage and having radial perforations therein within the stator, a series of annularly corrugated disks secured on the shaft and spaced apart and forming passages between them communicating with the radial perforations of the shaft, a pair of tangential nozzles in the stator projecting in opposite directions and discharging into the spaces between the disks, each of said spaces being provided with a pair of said nozzles, and means for controlling the flow of motive fluid through either of the sets of pairs of nozzles in accordance with the direction of rotation desired for the rotor, said disks having milled

adjacent surfaces, and said corrugations and the corrugations of the disks positioned concentrically with each other, whereby said disks form radial irregular passages between them.

3. A turbine, comprising a stator, a rotor in the stator, inlet nozzles discharging against the rotor, valves in the nozzles, said valves having pivotal supports between their ends and forming walls of the nozzles, whereby the position of the valves controls the angle of the expansion chambers of the nozzles, and curved ends on said valves operating to completely close the ends of the nozzles.

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