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Eskeli

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[54] **TURBINE HAVING POWERED INNER ROTOR FOR IMPARTING ADDITIONAL VELOCITY TO ENTERING FLUID**

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[52] **U.S. Cl.** **60/330,** 415/80, 415/63
[51] **Int. Cl.** **F01d 1/18**
[58] **Field of Search** 415/80–82, 415/60, 63, 1, 68; 60/39.35, 330, 407, 201, 352, 366, 412

[56] **References Cited**

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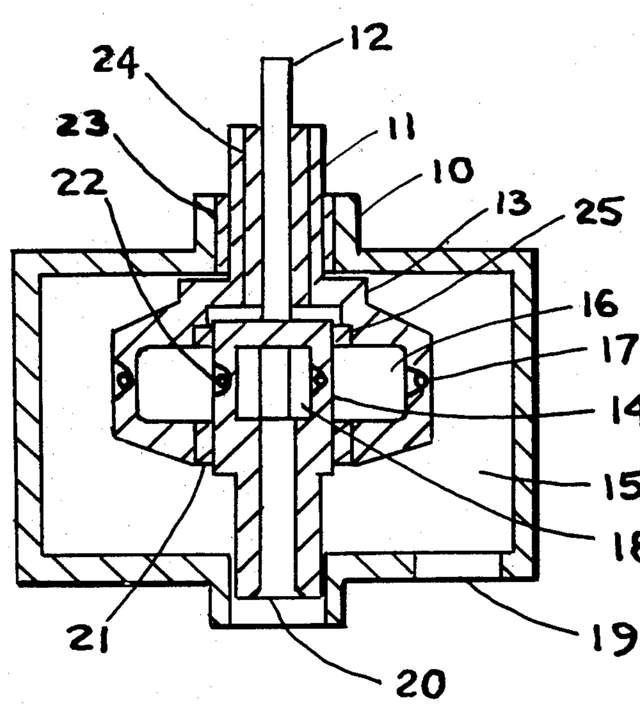
Attorney, Agent, or Firm—Wofford, Felsman & Fails

[57] **ABSTRACT**

A method and apparatus for generating power in response of a fluid flowing from a higher pressure and enthalpy to a lower pressure and enthalpy in a rotating turbine. Turbine has two rotors, with the inner rotor rotated by external power source and the outet rotor being the power output rotor. Work is produced by said outer rotor by a reaction on rotor nozzles by leaving working fluid. Said working fluid is pressurized within said outer rotor cavity by injecting said working fluid to said cavity by nozzles mounted on said inner rotor, with said fluid entering the said outer rotor cavity in the direction of rotation, with the entering velocity of said working fluid being usually higher than the local velocity of said outer rotor in the area of entry. Thus the working fluid is pressurized within said outer rotor cavity, since said fluid will be forced to follow a curved path within said cavity; with the higher pressure, the velocity of fluid leaving said outer rotor nozzles is increased thus producing more torque and more work.

4 Claims, 3 Drawing Figures



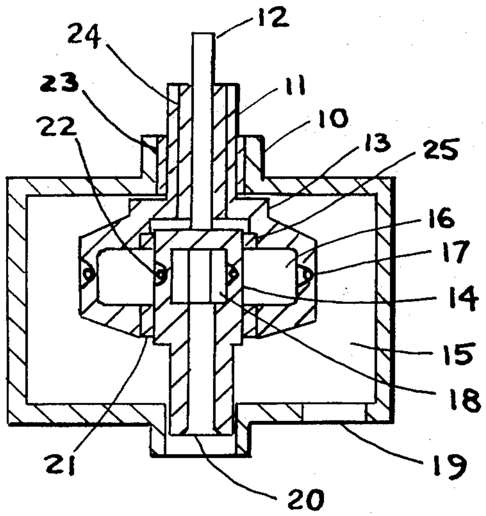


FIG. 1

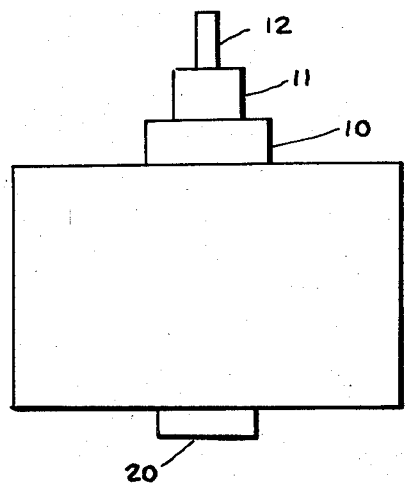


FIG. 2

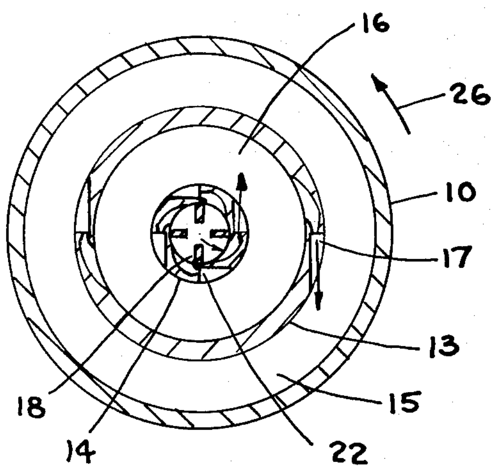


FIG. 3

TURBINE HAVING POWERED INNER ROTOR FOR IMPARTING ADDITIONAL VELOCITY TO ENTERING FLUID

CROSS REFERENCES TO RELATED APPLICATIONS:

The turbine of this invention was used in a patent application titled "Power Generator with Reaction Rotor," filed Feb. 6, 1973, Ser. No. 330,023 by Michael Eskeli.

Also, a turbine similar in part, was the subject of patent application titled "Reaction Rotor Turbine," filed Sept. 30, 1971, Ser. No. 185,060, by Michael Eskeli.

Also, the turbine of this invention was used in application titled "Rotary Power Generator," filed Sept. 20, 1971, Ser. No. 182,021 by Michael Eskeli, now U.S. Pat. No. 3,758,223.

This invention relates to power generation devices of the type where a working fluid is passed from a higher pressure and enthalpy to a lower pressure and enthalpy through a set of reaction nozzles mounted on a rotating rotor.

Various devices have been used in the past for generating power where a fluid is being supplied from a pressurized source and passed through a reaction type rotor. The main disadvantage of these devices has been their low efficiency, especially in the smaller sizes.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross section of the device, and

FIG. **2** is an exterior elevation of the device.

In FIG. **3**, another cross section is shown detailing the nozzles arrangement for the two rotors.

DESCRIPTION OF PREFERRED EMBODIMENTS

It is an object of this invention to provide a power generation turbine of improved efficiency and of simplified construction, capable of employing as the working fluid either gases or liquids, singly or in combination.

Referring to FIG. **1**, therein is illustrated a cross section of the turbine. **10** is the casing. Fluid enters inner rotor **14** via opening **20**, and passes to inner rotor cavity where said fluid is accelerated to the rotor speed with vanes **18** assuring that said fluid will rotate with said rotor. Fluid leaves inner rotor **14** via nozzles **22** arranged to discharge forward. Fluid enters second rotor **13** cavity **16** where said fluid is forced to follow the curved path formed by said cavity, with a pressure increase that is higher near the periphery of said rotor. Said pressurized fluid then leaves said outer rotor via nozzles **17**, arranged to discharge backward, thus producing thrust on said outer rotor which thrust is then passed as torque to rotor shaft **11**, and from thence as the useful work output for the device. Said fluid then enters casing space **15**, and is discharged via opening **19**. Work is supplied to inner rotor shaft **12** to maintain a predetermined speed for said shaft. **24, 23, 25** and **21** are bearings and shafts providing support for the two rotors and rotor shafts.

In FIG. **2**, an elevation showing the exterior of the device is shown. **10** is casing, **11** is outer rotor shaft, **12** is inner rotor shaft, and **20** is fluid inlet.

In FIG. **3**, another cross section of the device is shown, with rotor nozzle arrangement detailed. **10** is casing, **26** indicates direction of rotation for both rotors, **16** is outer rotor cavity, **17** is outer rotor nozzle, **13** is outer rotor, **15** is casing space for fluid collection, **22** is inner rotor nozzle, **14** is inner rotor, **18** is inner rotor vane within said rotor. Arrows from rotor nozzles indicate fluid flow direction.

The discharge nozzles for both rotors may be either converging type, or converging-diverging type, as required for the fluid being used. The exit velocity for the working fluid from these nozzles is highest attainable, and the nozzles are sized and shaped for isentropic expansion of the fluid when passing through said nozzles.

In operation, the pressurized working fluid enters the inner rotor via entry opening **20**, and passes to rotor interior, where said fluid is further pressurized by centrifugal action on said fluid by said inner rotor. This pressurization is obtained by accelerating said fluid to the rotor velocity. The working fluid then leaves via inner rotor exit nozzles **22**, and has an exit velocity relative to said rotor nozzles; said exit velocity being dependent on the pressure and enthalpy differential betweeen entry and exit sides of said inner rotor nozzles. Additional velocity is imparted to said fluid by the rotating inner rotor; thence, the absolute total velocity of the fluid entering said outer rotor is the sum of the inner rotor tangential velocity and the fluid exit velocity from said inner rotor nozzles. This entry velocity to said secondary rotor is usually higher than the tangential velocity of the outer rotor in the area where said fluid enters said outer rotor, and the fluid, when operating in this manner, will have a higher velocity within the outer rotor cavity than the tangential velocity of the rotor, except at the outer rotor periphery, where the fluid may be traveling at the same speed as the outer rotor. This will result in an increased pressure at the outer rotor periphery within said rotor cavity, and this higher pressure in turn will provide for increased exit velocity for the working fluid from the outer rotor exit nozzles, thus providing more torque at the output shaft **11**, and improved efficiency for the machine. Said fluid is discharged from the device, after leaving said outer rotor nozzles. A suitable drive unit is required to maintain inner rotor rotation.

In the turbine shown in FIG. **1**, the inner rotor forms a hub around which the outer rotor rotates. Thence, for the outer rotor cavity the inner diameter is the outer surface of the inner rotor. An alternate method, to increase the fluid depth and to reduce the inner diameter for the outer rotor cavity, is to delete seal **25**, thus allowing the fluid to fill the space to inner rotor shaft **12**, so that the inner diameter of the outer rotor cavity is the diameter of shaft **12**. This arrangement may be desirable with some fluids to obtain added fluid pressure at outer rotor periphery.

Various devices, such as gauges, governors and the like, are used with the device of this invention. They do not form any part of this invention and are not further described herein.

I claim:

1. A turbine stage for generating power and having high efficiency and high power output on a power output shaft, comprising:

a. a casing for enclosing an outer reaction rotor and an inner inlet rotor and providing support for their respective power output and power input shafts;

b. a driven power input shaft rotating in bearing means rotatably supported in said casing; said power input shaft rotating in a first direction and supplying power to rotate an inner inlet rotor in said first direction;

c. an inner inlet rotor rotatably supported on said power input shaft so as to rotate in unison therewith; said inner inlet rotor having an inlet aperture that is connected in fluid communication with a source of fluid and having peripheral feeder nozzles that are oriented to discharge said fluid forwardly and substantially tangentially in said first direction; said feeder nozzles serving as inlet for an outer reaction rotor; said inner inlet rotor being equipped with partitions within said inner rotor to assure that said fluid will rotate with said inner inlet rotor and effect sufficient centrifugal compression of said fluid to a first pressure immediately upstream of said feeder nozzles that is higher than the absolute pressure at the inlet aperture; said feeder nozzles being designed for effecting a high first velocity stream of said particular fluid being flowed therethrough under the differential pressure existing between said first pressure immediately upstream and a second pressure immediately downstream of said feeder nozzles;

d. a power output shaft rotating in bearing means rotatably supported in said casing; said power output shaft rotating in said first direction and delivering power from an outer reaction rotor rotating in said first direction;

e. an outer reaction rotor rotatably supported on said power output shaft so as to rotate in unison therewith and deliver torque thereto; said reaction rotor being disposed concentrically about said inner inlet rotor; said outer rotor having reaction nozzles mounted near the periphery of said outer reaction rotor; said reaction nozzles being oriented to discharge said fluid backward in a second direction that is away from the direction of rotation of said outer rotor and opposite said first direction; said outer rotor being hollow and having a first cross sectional area at any radial distance that is greater than a second cross sectional area of said reaction nozzles and rotating at a rotational speed high enough to effect centrifugal compression of said fluid and effect a peripheral third pressure that is greater than said second pressure at the inlet to said outer reaction rotor immediately downstream of said feeder nozzles; said reaction nozzles being sized and shaped for effecting a high second velocity of said fluid under the differential pressure existing between said third pressure immediately upstream of and a fourth pressure immediately downstream of said reaction nozzles; and

f. a fluid being flowed through said turbine stage; said fluid being flowed into said inner inlet rotor, being compressed by centrifugal compression therewithin and discharged outwardly and substantially tangentially in said first direction at said first velocity that is higher than the velocity of the outer reaction rotor at the same radial distance from a central longitudinal axis; said fluid having high said first velocity because of the additive effects of the pressure velocity of the fluid under the differential pressure existing between said first and second pressures plus the tangential velocity due to the velocity of said feeder nozzles effected by powered rotation of said inner inlet rotor.

2. The turbine stage of claim **1**, wherein said fluid is a liquid.

3. The turbine stage of claim **1**, wherein said fluid is a gas.

4. A method of generating power in a reaction turbine comprising the steps of:

a. feeding an entering fluid to a reaction rotor in said reaction turbine by centrifugally compressing it in a powered rotating inner inlet rotor and discharging the compressed said fluid from feeder nozzles that are peripherally disposed on said powered rotating inner inlet rotor and that are rotating in the same direction as said reaction rotor such that said fluid entering said reaction rotor has a high first velocity that is the sum of the pressure velocity of its own flow through said feeder nozzles because of the differential pressure thereacross and the tangential velocity of the feeder nozzles on the rotating inner inlet rotor;

b. passing the accelerated fluid at said first high velocity into the concentrically arranged outer reaction rotor; said first high velocity being greater than the tangential velocity of the outer reaction rotor at the same radial distance from the central axis thereof;

c. causing said fluid to flow in an arcuate path with sufficient angular velocity to cause sufficient centrifugal compression to pressurize said fluid within said outer reaction rotor such that the pressure of said fluid at the periphery of said outer reaction rotor is greater than the pressure at the inlet to said outer reaction rotor;

d. discharging said fluid from said outer reaction rotor through reaction nozzles that are mounted at the outer periphery of said rotor; said fluid being discharged in a direction that is opposite to the tangential direction of rotation of said outer reaction rotor for producing thrust and generating torque on the outer rotor shaft for producing power; and

e. delivering power via said outer rotor shaft; the amount of power delivered by said outer rotor shaft being greater than the amount of power being supplied by a power input shaft rotating said inner inlet rotor and said feeder nozzles in the same direction as said outer reaction rotor.

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