# United States Patent

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## [54] TURBINE STRUCTURE


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[52] **U.S. Cl.**.....**415/65,** 415/68, 415/122

[51] **Int. Cl.**.....**F01d 1/24,** F04d 19/00

[58] **Field of Search**.....415/65, 66, 67, 68, 69, 70, 415/122



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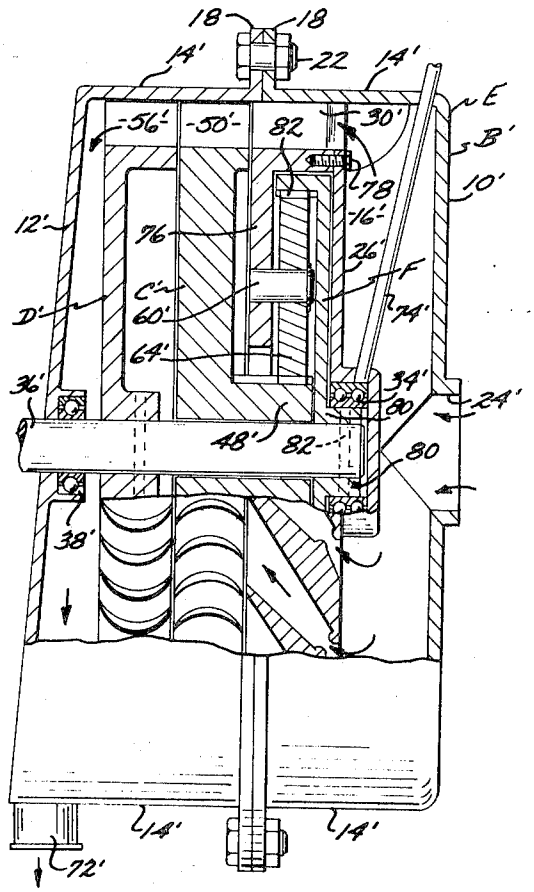
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[57] **ABSTRACT**

A multiple-stage turbine that may be of either the axial-flow or radial-flow-type, and is of improved efficiency in that no stationary blades or vanes are employed to direct the flow of fluid from one shaft to another. The turbine employs at least two rotating rotors that are connected by planetary gears with the rotors being sequentially subjected to the action of the pressurized fluid. The planetary gear not only cooperates with the rotors to transfer the torque generated by each to the drive shaft, but also reduces the rate of rotation of the drive shaft to a range where it is usable without recourse to an external gear reduction unit.


**13 Claims, 9 Drawing Figures**



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SHEET 1 OF 3

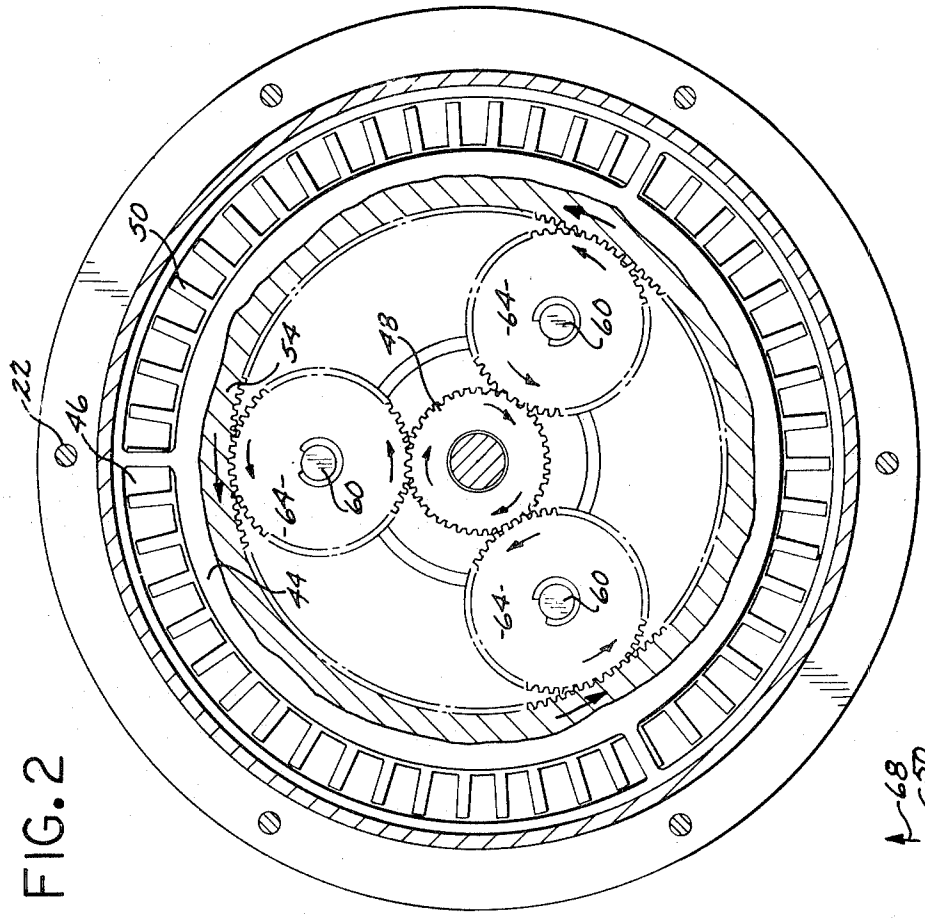


FIG. 2

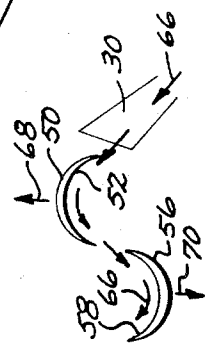


FIG. 3

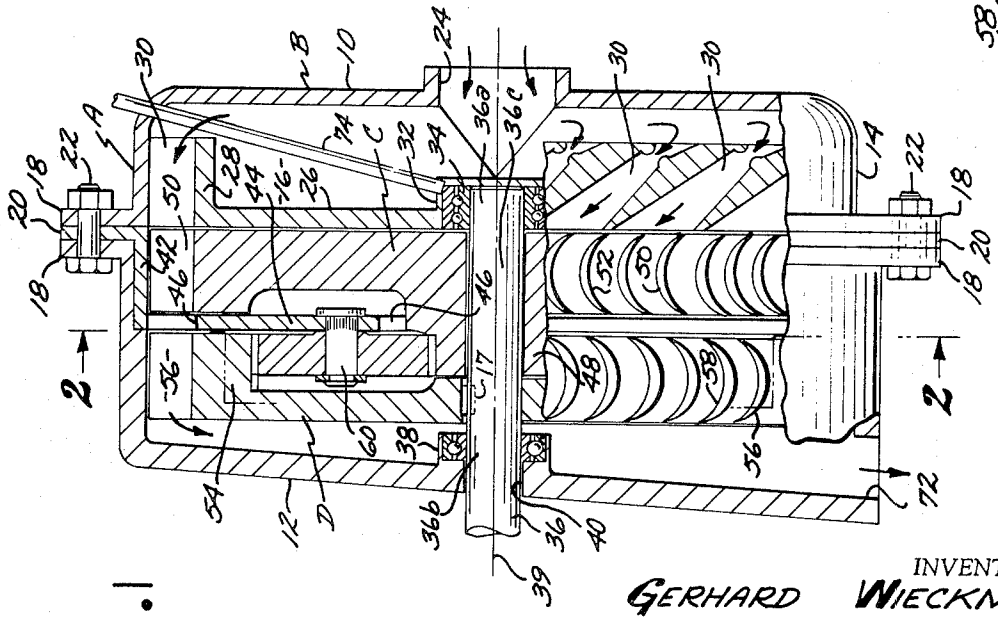


FIG. 1

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FIG. 4

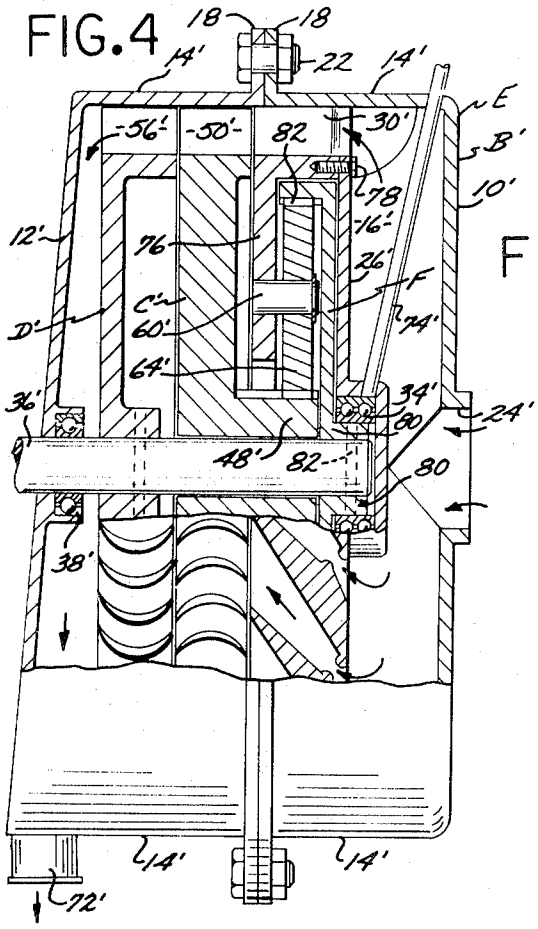



FIG. 5

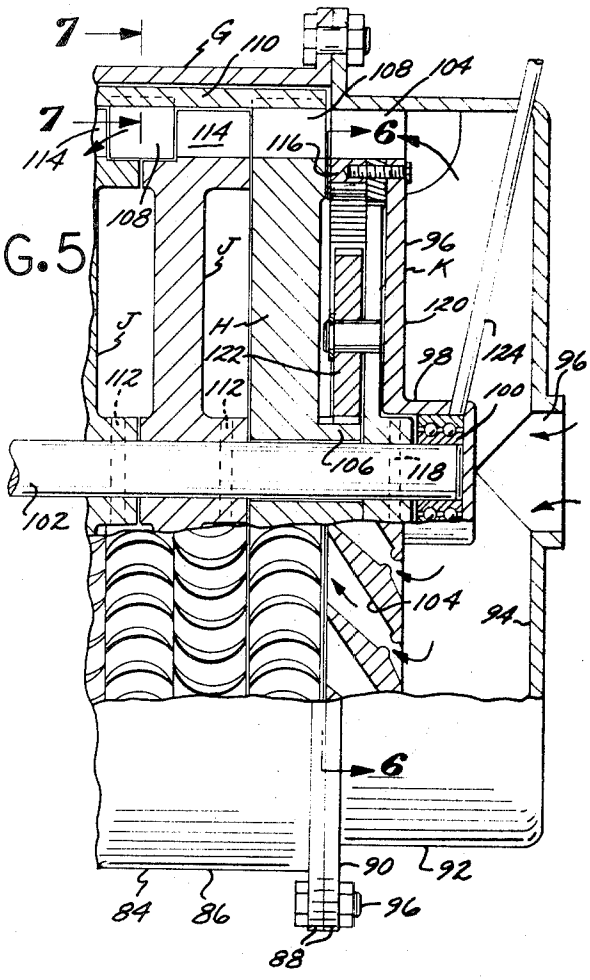



FIG. 6

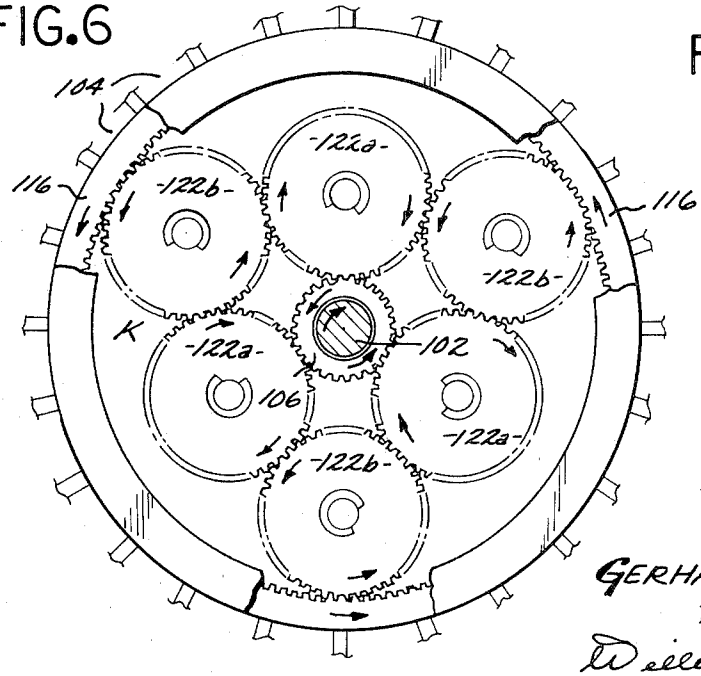
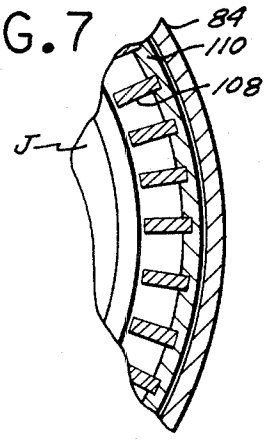



FIG. 7




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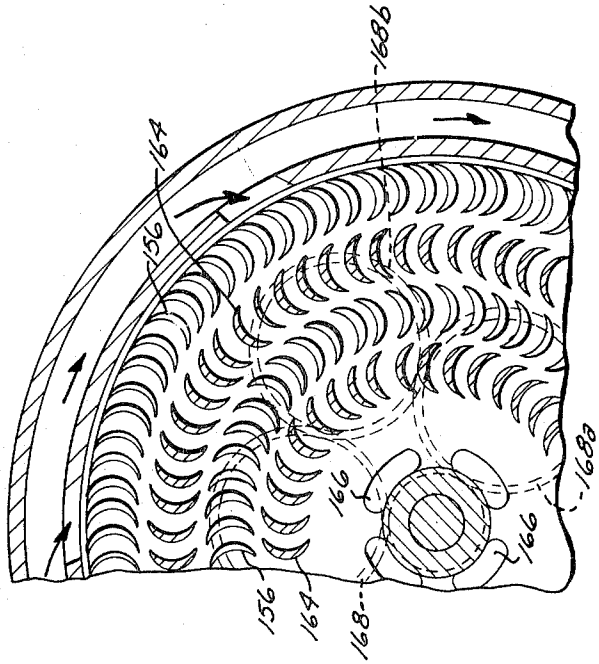



FIG. 9

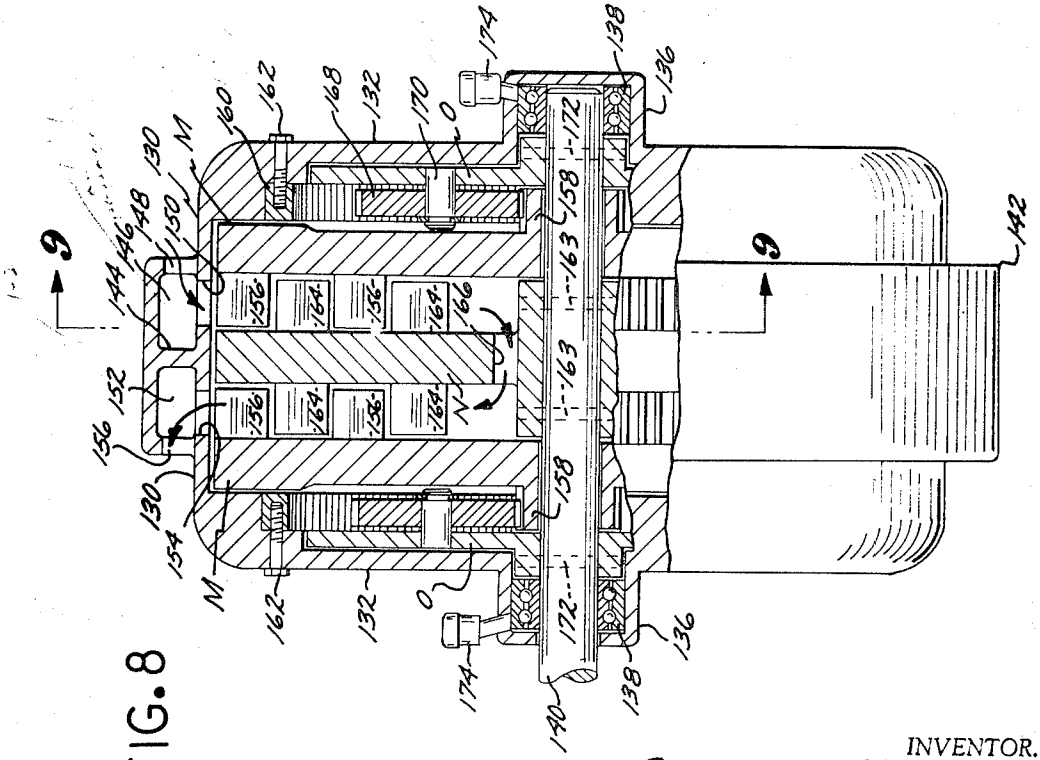



FIG. 8

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# TURBINE STRUCTURE

## BACKGROUND OF THE INVENTION

1. Field of the Invention

Multiple Stage Turbine Structure.

2. Description of the Prior Art

In prior art turbines, each contact of the pressurized fluid stream with a set of stationary blades, results in said stream losing one half of its kinetic energy.

The purpose of the present invention is to overcome this operational disadvantage of conventional prior art turbines by providing a turbine that has no stationary blades, and accordingly operates at a higher degree of efficiency than has been possible to achieve with prior art devices of this nature. Also the present invention results in the drive shaft rotating at a speed substantially less than that of one of the rotors in the turbine structure, and the drive shaft capable of rotating at a substantially low rate as to be usable without recourse to an external gear reduction unit.

## SUMMARY OF THE INVENTION

A multiple-stage turbine of either the axial compound or radial compound type that is free of stationary blades, and in which at least the first and second stage bladed rotors are driven in opposite directions by a pressurized stream of fluid. The rotors are connected by planetary gearing means in such a manner that the kinetic energy of the oppositely rotating rotors is transfered to a drive shaft, minus the frictional loss resulting from the rotating gear means. Also, due to the gear means the rate of rotation of the drive shaft may be lowered to a point where a gear reduction unit is not necessary.

A major object invention the present invention is to provide a multiple stage turbine that has no stationary blades, is of simple mechanical structure, has a higher degree of operating efficiency than conventional prior art turbines, and rotates a drive shaft thereof at a substantially lesser rate of rotation than that of a portion of the rotors in the turbine.

Another object of the invention is to supply a turbine that requires little or no maintenance due to the relatively low rate of rotation of the drive shaft, and a turbine that is adapted to many applications for which a conventional turbine is not suited due to the necessity of using an external gear box with the latter.

## DESCRIPTION OF THE DRAWINGS

FIG. **1** is a longitudinal cross-sectional view of a first form of an axial flow turbine;

FIG. **2** is a transverse cross-sectional view of the device taken on the line **2—2** of FIG. **1**;

FIG. **3** is a diagrammatic view of the path of fluid flow through the device;

FIG. **4** is a longitudinal cross-sectional view of a second form of an axial flow turbine;

FIG. **5** is a longitudinal cross-sectional view of a third form of an axial flow turbine;

FIG. **6** is a transverse cross-sectional view of the third form of turbine taken on the line **6—6** of FIG. **5**;

FIG. **7** is a fragmentary transverse cross-sectional view of the third form of turbine taken on line **7—7** of FIG. **5**;

FIG. **8** is a longitudinal cross-sectional view of a radial flow compound turbine; and

FIG. **9** is a transverse cross-sectional view of the turbine shown in FIG. **8** taken on the line **9—9** thereof.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

The first form A of the turbine, as may best be seen in FIG. **1**, includes a housing B that has first and second end walls **10** and **12** that are joined by a sidewall **14**. The end walls **10**, **12** and sidewalls **14** cooperate to define a confined space **16** of cylindrical shape. Housing B is preferably of two part structure, and has first flanges **18** projecting from the sidewalls **14**. The first flanges **18** have a second ring-shaped flange sandwiched therebetween, with the flanges **18** and **20** being held together in abutting contact by a number of bolts and nuts **22**.



First end wall **10** has a fluid inlet opening **24** defined therein. Fluid under pressure from a source (not shown) may be discharged into confined space **16** through opening **24**. A transverse circular member **26** is disposed in a fixed position inside housing B adjacent first end wall **10** as may best be seen in FIG. **1**. Member **26** has an outer circumferential portion **28** in which a number of circumferentially spaced, angularly positioned fluid discharge orifices **30** are formed. Member **26** supports a tubular hub **32** at the center thereof in which a ball or roller bearing assembly **34** is disposed.

A drive shaft **36** extends longitudinally through confined space **16** and is axially aligned with the center line **39** thereof. One end portion **36***a* of shaft **36** is journaled in bearing **34**. Another shaft portion **36***b* is journaled in a second bearing **38** supported by second end wall **12**, and in axial alignment with an opening **40** therein.

A shaft portion **36***c* extends outwardly from housing B, and serves as a source of rotational power. The shaft **36** is prevented from moving axially relative to bearing **34** and **38** by conventional means (not shown). Flange **20** supports a short cylindrical shell **42** on the inner end thereof, and the shell in turn serving as a support for a ring-shaped plate **44** that is transversely disposed in space **16**. Plate **44** has a number of circumferentially extending openings **46** formed therein as shown in FIGS. **1** and **2**.

A first rotor C is freely supported for rotation on shaft **36** to the left of member **26** as viewed in FIG. **1**. First rotor C includes an externally toothed hub **48**. The outer peripheral portion of first rotor C has a number of circumferentially spaced first blades **50** formed thereof, which blades have transverse concave surfaces **52** as may be seen in FIG. **3**. When jets of fluid under pressure from openings **30** impinge on surfaces **52**, first rotor C and hub **48** are driven clockwise in a first direction as viewed in FIG. **2**. The outer portion of first rotor C is disposed between member **26** and plate **44**.

A second rotor D of substantially the same diameter as first rotor C is rotatable supported by shaft **36** between the first rotor and second end wall **12** as shown in FIG. **1**, and is secured to the shaft by a key **17** or other fastening means. The second rotor D includes a projecting internal ring gear **54** on the peripheral portion thereof, which ring gear is transversely aligned with the hub gear **48**. Second rotor D also has a number of circumferentially spaced blades **56** on the periphery thereof. Blades **56** have transverse concave surfaces **58** which cause the second rotor to rotate in a counterclockwise second direction when fluid under pressure impinges on the surfaces. In FIG. **3** it will be seen that fluid after striking surfaces **52** is deflected therefrom to impinge on surfaces **58**.

Plate **44** supports a number of circumferentially spaced stub shafts **60** that extend towards second rotor D and are disposed in an annulus-shaped space **62** defined between the first and second rotors. The stub shafts **60** rotatably support a number of planetary gears **64** that are in toothed engagement with hub gear **48** and internal ring gear **54**.

The operation of the first form A of the turbine is extremely simple. Fluid under pressure from a source (not shown) after entering housing B flows to the left thereof as viewed in FIG. **1**, and through orifices **30** to impinge as jets of fluid on the surfaces **52** of first blades **50**. The impinging jets of fluid rotate first rotor C and gear **48** on shaft **36** in a clockwise direction as viewed in FIG. **2**.

The torque developed by the rotating first rotor C is transferred to the second rotor D through the planetary gears **64**. The jets of fluid are deflected from the surfaces **52** onto the surfaces **58** as shown in FIG. **3**, and with the path of flow of the jets being indicated by the arrows **66** in FIG. **3**. The impinging jets of fluid drive the first rotor D in a first direction **68** as shown in FIG. **3** and the second rotor D in a second direction indicated by the arrow **70**. Second rotor D is secured to drive

shaft 36. The second rotor D transfers not only the torque developed by it to drive shaft 36, but the torque of the first rotor C as well. Due to the structure of the first form A of the turbine, the normal 50 percent power loss of the fluid in flowing from a stationary blade to a moving blade is eliminated.

It will be apparent that for the first form B of the turbine to operate at optimum efficiency, the pressure of the fluid delivered to space 16 must be such that the velocity of the jets impinging on surfaces 58 is greater than the velocity at which the second blades 56 rotate. The planetary gears 64 in addition to serving to transfer torque of first rotor C to second rotor D, also act as a gear reduction unit to lower the rate of rotation of drive shaft 36 to the extent that it provides usable power, and no external gear reduction unit is necessary. Fluid after impinging on blade surfaces 52 and 58, exhausts from housing B through an opening 72 as may best be seen in FIG. 1.

An oil supply tube 74 extends from the bearing 34 to a source of lubricant (not shown) exteriorly of the housing B as may best be seen in FIG. 1.

A second form E of an axial flow compound turbine is shown in FIG. 4 that is similar to the first form B. The second form E differs from first form B in the manner by which torque is transmitted from the first rotor to the drive shaft. Elements in the second form E of the turbine that are common to the first form B are identified in FIG. 4 by the same numerals, but with primes being added thereto.

In the second form E, the hub 48' extends to the right as can best be seen in FIG. 4, rather than to the left as in the first form A of the turbine. The circular member 26' has a ring 76 of transverse L-shaped cross section secured to the outer peripheral portion thereof by screws 78 or other conventional fastening means. The ring 76 serves as a mounting for the circumferentially spaced stub shafts 60', which shafts extend to the right as shown in FIG. 4. Stub shafts 60 support a number of planetary gears 64, preferably three, that are in engagement with the toothed hub 48', and arranged in the same manner as the gears 60 shown in FIG. 2. Third rotor F includes a hub 80, which hub is secured to the shaft 36' by a pin 82 or other conventional fastening means. The hub 80 is rotatably supported by the bearing 34'. The third rotor F on the outer peripheral portion thereof develops into an internal ring gear 82 that extends to the left as may best be seen in FIG. 4, and is transversely aligned with at least a portion of the toothed hub 48'. Internal ring gear 82 is in toothed engagement with the pinions 64'.

When fluid under pressure is discharged into the housing B', the fluid flows through the orifices 30' and emerges therefrom as jets of fluid that sequentially impinge on the blades 50' and 56' to drive the first and second rotor C' and D' in opposite directions. The rotor C' is freely rotatable on the shaft 36', and in rotating on the shaft the first rotor C' rotates the planetary gears 64'. The rotating planetary gears C' that remain at fixed positions relative to housing B', rotate the third rotor F, which rotor is rigidly connected to the shaft 36' by the pin 82. The second form E of the turbine operates in substantially the same manner as the first form A, but with the torque from first rotor C' being transmitted in opposite direction to the drive shaft 36' through the third rotor F, rather than the second rotor D as occurs in the operation of the first form. The fluid after it has impinged on the first and second blades 50' and 56' discharges from the housing B' through the opening 72' as may be seen in FIG. 4.

A third form G of an axial flow turbine is shown in FIG. 5, 6, and 7, that includes a housing 84. The housing 84 is preferably defined by a cylindrical shell 86 that has flanges 88 on the ends thereof, and each flange 88 being in abutting contact with a flange 90 that projects outwardly from a cup-shaped end member 92. Each end member 92 includes an end wall 94 as a part thereof. Each of the cup-shaped end members 92 is of identical structure and only one thereof is shown in FIG. 5. The flanges 88 and 90 on each end of the third form G of the turbine are held in abutting contact by a number of bolts 96 or other conventional fastening means. The end wall 94 on the right-hand end of the third form G of the turbine as viewed in FIG. 5 has an opening 96 therein through which fluid under pressure is discharged into the confines of the housing 84 from a source (not shown) exteriorly of the housing. Each of the end member 92 has a transverse circular member 96 secured to the interior thereof as may best be seen in FIG. 5, with the member 96 in the peripheral portion on the intake side thereof defining a number of orifices 104 through which pressurized fluid entering the interior of the third form G of the invention can flow to the left and emerge from the orifices as a plurality of jets. Each of the members 96 has a cup-shaped hub 98 at the center thereof in which a ball or roller bearing assembly 100 is mounted. The two roller bearing assemblies 100 serve to rotatably support the end portions of a drive shaft 102. The drive shaft 102 on the left-hand end of the third form G of the turbine projects outwardly from the housing 84, to provide a source of rotational power.

The first rotors H are rotatably supported on the end portions of the drive shaft 102 adjacent the members 96, with each first rotor including a toothed hub 106. The peripheries of the two first rotors H develop into a plurality of circumferentially spaced curved blades 108 that are longitudinally aligned with the orifices 104 as can be seen in FIG. 5. The outer extremities of the blades 108 are rigidly secured to the interior end portion of a cylindrical shell 110 that is longitudinally disposed within the housing 84 and rotatable relative thereto. A number of second rotors J are mounted on the drive shaft 102 between the two longitudinally spaced first rotors H, with each of the second rotors J being secured to the drive shaft 102 by pins 112 or other suitable fastening means.

The second rotors J have a number of circumferentially spaced blades 114 that are longitudinally aligned with the blades 108 of the first rotors H. The second blades 114 as may best be seen in FIG. 5 are longitudinally spaced from one another. The blades 114 are of such curvature as to cause the second rotors J and the drive shaft 102 to rotate in a second direction when subjected to jets of fluid. The shell 110 also supports a sequence of rings of circumferentially spaced blades 108, and these blades being of such curved configuration as to tend to cause the shell 110 and first rotors H to rotate in a first direction when fluid impinges on the blades 108.

The two transverse members 96 each support an internal ring gear 116 on the interior surface thereof, with each internal ring gear being transversely aligned with at least a portion of the toothed hubs 106 most adjacent thereto. The drive shaft 102 has two third rotors K secured to the ends thereof by pins 118 or other suitable fastening means. Each of the third rotors K has a number of transversely positioned, circumferentially spaced stub shafts 120 projecting therefrom that serve to rotatably support a number of planetary gears 122*a* and 122*b* in the relationship shown in FIG. 6. In FIG. 6 it will be seen that the planetary gears 122*a* and 122*b* are in toothed engagement with one another, and with three of the planetary gears 122*a* engaging the hub 106, and the other three planetary gears 122*b* being in toothed engagement with the internal ring gear 116. The bearings 100 as may best be seen in FIG. 5 are each supplied with lubricant through a tube 124 that extends from the bearing to a position exteriorly of the housing 84 to a source of lubrication (not shown).

The use and operation of the third form G of the axial compound turbine is as follows. Fluid is discharged into the right-hand end portion of the housing 84 through the opening 96, and flows through the orifices 104 to emerge therefrom as a plurality of jets that impinge on the first blades 108 of first rotor H and tend to cause the first rotor H at the right-hand end of the third form G of the turbine to rotate in a first direction. The jets of fluid (not shown) are deflected from the first set of first blades 108 on first rotor H to the second blades 114 to the left thereof, which second blades form a part of one of the second rotors J. The jets of fluid after leaving the second blades 114 are deflected to a second group of first

blades 108 that are secured to the interior surface of the shell 110 which shell may be a cylinder or other surface of revolution. The jets of fluid continue to flow to the left in the second form G of the invention alternately impinging on first blades 108 and second blades 114 until the jets have traversed the length of housing 84 and discharge from an opening (not shown) in the left-hand portions of the housing 84 to the ambient atmosphere.

The first rotors H as they rotate, rotate the hubs 106 which are in toothed engagement with the three pinion gears 122*a*. The planetary gears 122*a* are also in engagement with planetary gears 122*b* as may be best seen in FIG. 5, which planetary gears 122*b* are also in engagement with the internal ring gear 116. Due to the planetary gearing arrangement above described, the torque developed by the stream of fluid impinging on the first blades 108 to rotate the first rotors H and shell 110 in the first direction is transferred to the drive shaft 102 to assist in driving the same in a second direction. Torque from the second rotors J is delivered directly to the drive shaft 102 in a direction to rotate the shaft in the second directions.

A radial turbine L is shown in FIGS. 8 and 9 that includes a housing 130. The housing 130 is defined by two end walls 132 and a connecting cylindrical sidewall 134. The end walls have cylindrical bosses 136 extending outwardly therefrom in opposite directions, and the bosses serving to support roller or ball bearing assemblies 138. The bearing assemblies 138 rotatably support a drive shaft 140. A member 142 of channel-shaped transverse cross section extends circumferentially around the sidewall 134. Member 142 has a center partition 144 therein that cooperates therewith to define an annulus-shaped passage 146 into which fluid under pressure can be discharged through one or more openings 148 as shown in FIGS. 8 and 9. The passage 146 is in communication with a number of openings 150 that extend through the sidewall 134 to communicate with the interior of the housing 130. An annulus-shaped fluid discharge passage 142 is formed in the left portion of the channel shaft member 142 as illustrated in FIG. 8, and this passage being in communication with the interior of the housing 130 by a number of openings 154 formed in the sidewall 134. Fluid that has flowed through the interior of the housing 130 may discharge from the passage 152 through one or more openings 156 formed in the left-hand portion of the member 142 as viewed in FIG. 8.

Two longitudinally spaced first rotors M are freely and rotatably supported on the shaft 140 within the confines of the housing 100. The first rotors M have a number of radially spaced rings of first blades 156 that extend towards one another as shown in FIG. 8. The two first rotors M have toothed hubs 158 that extend away from one another. The toothed hubs 158 are transversely aligned with internal ring gears 160 that are secured to the end walls 132 of the housing 130 by bolts 162 or other suitable fastening means. A second rotor N is secured to the shaft 140 by pins 163, and is situated between the first rotors M. The second rotor N has a number of radially spaced rings of second blades 164 that project from opposite sides thereof. The first blades 156 are of such curved configuration as to cause the first rotors M to rotate in a first direction when fluid discharges from the passage 146 through the openings 150 to sequentially contact first blades 156 and 164 on the right-hand side of the second rotor N, and then flow through one or more transversed openings 166 formed in the inner portion of the second rotor to sequentially contact the second blades 164 and first blades 156 to the left of the second rotor end as viewed in FIG. 8. The fluid after traversing and contacting the blades 156 and 164 discharges into the passage 152 and flows therefrom to the ambient atmosphere through openings 156.

The toothed hubs 158 are in engagement with a number of circumferentially spaced planetary gears 168*a* that are rotatably mounted on stub shafts 170, which shafts are secured to third rotors Q. The third rotors 0 are connected to drive shaft 140 by pins 172 or other suitable fastening means. Planetary gears 168*a* are also in toothed engagement with a number of planetary gears 168*b* that are supported by stub shafts from the third rotors 0, and the planetary gears 168*b* being in engagement with the ring gears 160 as shown in FIG. 9. The planetary gears 168*a* and 168*b* are aligned relative to the toothed hubs 158 and internal ring gears 160 in the same manner as the planetary gears 122*a* and 122*b* are aligned relative to the hub 106 and ring gear 116 in the third form K of the turbine as shown in FIG. 6. Fluid as it discharges radially through the turbine L rotates the first and second rotors M and N in opposite directions, and the planetary gears transferring the torque developed by the first rotors M to the third rotors O. Thus, as in the others of the turbines described herein, there are no stationary vanes, or blades in the radial turbine L, and all loss of energy of the fluid in moving radially through the turbine is either transferred to the drive shaft 140 or used in overcoming frictional resistance between the drives shaft 140 and bearings 138, as well as frictional resistance that occurs as the planetary gears 168 rotate relative to the hubs 158 and internal ring gears 160. The operation of the radial turbine L as above described will be apparent from the previous description thereof and need not be repeated. Lubrication for the bearings 138 is provided by suitable lubricating fixtures 174 of a conventional nature.

I claim:

1. An axial flow compound turbine for delivering rotational power at a desired rate of rotation that comprises:

a. a housing that includes two spaced first and second end walls and a connecting sidewall that cooperate to define a cylindrical confined space;

b. a drive shaft journaled in said first and second end walls and extending longitudinally through said housing;

c. first means for discharging a stream of fluid under pressure into said confined space whereupon it is subdivided into a plurality of circumferentially spaced longitudinally moving jets;

d. at least one first rotor in said confined space rotatably supported on said shaft, said first rotor including a plurality of circumferentially spaced first blades of such configuration as to rotate said first rotor in a first direction at a predetermined high speed of rotation when said jets impinge on said first blades;

e. at least one second rotor in said confined space that is mounted on said drive shaft and secured thereto, said second rotor including a plurality of circumferentially spaced second blades of such configuration and so situated as to drive said second rotor in a second direction when said jets impinge thereon after having previously impinged on said first blades;

f. gear means operatively associated with said first rotor for transferring the torque developed thereby to said shaft to rotate the latter in said second direction and at a desired rate of rotation that is substantially less than said predetermined high speed at which said first rotor rotates; and

g. second means for discharging said fluid from said confined space to a location exteriorly thereof after said fluid has impinged on said first and second blades.

2. A turbine as defined in claim 1 in which said first means is a circular member disposed at a fixed position in said confined space between said first rotor and said first end wall, said circular member having a plurality of circumferentially spaced passages therein through which said stream of fluid flows as a plurality of jets to impinge on said first blades, and said housing having an opening therein through which said stream of fluid is delivered into the portion of said confined space situated between said first end wall and said circular member.

3. An axial flow turbine as defined in claim 2 in which said gear member includes:

h. a third rotor mounted on said shaft and secured thereto;

i. a ring gear supported from said circular member in said confined space;

j. a gear secured to said first rotor and transversely aligned with said ring gear; and

k. at least one planetary gear rotatably supported from said third rotor and in engagement with said gear and ring gear.

4. An axial flow turbine as defined in claim 3 that includes two first rotors longitudinally spaced on said shaft and a plurality of said second rotors situated therebetween, and said turbine in addition including:

l. a cylindrical shell in said confined space that extends between said first rotors and is secured to the outer circumferential portions thereof; and

m. a plurality of circumferentially spaced blades secured to the interior surface of said shell and against which said jets impinge as they flow longitudinally through said housing.

5. A turbine as defined in claim 1 in which said second means includes:

h. a ring gear secured to said second rotor;

i. a gear secured to said first rotor and transversely aligned with said ring gear, with said gear having an external diameter substantially less than the internal diameter of said ring gear; and

j. at least one planetary gear that occupies a fixed position relative said housing and engages said gear and ring gear.

6. An axial flow turbine as defined in claim 1 in which said gear means includes:

h. a third rotor mounted on said shaft and secured thereto;

i. a ring gear secured to said third rotor;

j. a gear secured to said first rotor and transversely aligned with said ring gear; and

k. at least one planetary gear rotatably supported from said first rotor and in engagement with said gear and ring gear.

7. A turbine structure that includes:

a. a housing that includes two spaced first and second end walls and connecting sidewall that cooperate to define a cylindrical confined space;

b. a drive shaft journaled in said housing and extending through said confined space on the longitudinal axis thereof;

c. a first rotor in said confined space rotatable supported on said shaft, adjacent said first end wall, said first rotor including a plurality of circumferentially spaced first blades of such curved configuration as to rotate said first rotor in a first direction when a stream of fluid under pressure impinges on said first blades;

d. a second rotor in said confined space that is secured to said drive shaft and is situated between said first rotor and said second end wall, said second rotor including a plurality of circumferentially spaced second blades of such curved configuration as to rotate said second rotor and drive shaft in a second direction opposite from said first direction when said stream of fluid impinges on said second blades;

e. first means for discharging a stream of fluid under pressure into said confined space for said fluid to first impinge on said first blades and be deflected from said first blades to impinge on said second blades, with said impingement imparting torque to both said first and second rotors;

f. a third rotor in said confined space secured to said drive shaft and disposed between said first rotor and said first end wall;

g. gear means in said confined space for rotatably connecting said first rotor to said third rotor to cause concurrent rotation thereof, said gear means serving to transmit torque generated by said first rotor to said third rotor and drive shaft to rotate said drive shaft in said second direction.

8. A turbine structure as defined in claim 7 in which said gear means includes:

i. a toothed hub that extends from said first rotor towards said third rotor;

j. an internal ring gear that extends from said third rotor towards said first rotor, said hub and ring gear at least partially transversely aligned;

k. a plurality of circumferentially spaced stub shafts that extend from said first rotor towards said third rotor an are situated in a spaced defined between said first and third rotors; and

l. a plurality of planetary gears rotatably supported on said stub shafts in said space between said first and third rotors, said planetary gears in engagement with said hub and internal ring gear, and said planetary gears, hub and ring gear serving as a gear reduction unit to cause said third rotor and drive shaft to rotate at a speed less than the speed at which said first rotor rotates and in an opposite direction.

9. A turbine as defined in claim 8 in which said first means is a circular member disposed at a fixed position in said confined space between said third rotor and said first end wall, said circular member having a plurality of circumferentially spaced passages therein through which said stream of fluid flows as a plurality of jets that impinge on said first blades, and said housing having an opening therein through which said stream of fluid is delivered into the portion of said confined space situated between said first end wall and said circular member.

10. A turbine as defined in claim 9 which in addition includes:

h. a bearing supported at substantially the center of said circular member and in which bearing one end of said drive shaft is rotatable supported.

11. A turbine as defined in claim 10 which in addition includes:

i. third means for lubricating said bearing from a source exteriorly of said housing.

12. An axial flow compound turbine structure that includes:

a. a housing that includes two spaced first and second end walls and a connecting sidewall that cooperate to define a cylindrical confined space;

b. first and second longitudinally spaced transverse circular members that occupy fixed positions in said confined space, said first number having a member of circumferentially spaced openings therein that divide a stream of fluid discharged into the portion of said confined space most adjacent said first end wall into a plurality of jets that flow towards said second member, and said second member having at least one opening therein through which said fluid from said confined space may flow through an opening in said housing to the ambient atmosphere;

c. a drive shaft in said confined space and axially aligned with the longitudinal axis thereof, said shaft of sufficient length as to project outwardly through a center opening in said second end wall;

d. first and second bearings supported from said first and second members, which bearings rotatably support said drive shaft;

e. two longitudinally spaced first rotors in said confined space adjacently disposed to said first and second members, each of said first rotors including a plurality of circumferentially spaced blades of such curved configuration as to rotate said first rotor in a first direction when a stream of fluid impinges on said first blades;

f. a plurality of second rotors in said confined space that are disposed between said first rotors and secured to said drive shaft, said second rotors including a plurality of circumferentially spaced second blades of such curved configuration as to rotate said second rotors and drive shaft in a second direction opposite said first direction when said jets of fluid impinge on said second blades, said second blades of such dimensions that a longitudinally extending space is defined between each pair thereof;

g. a cylindrical shell that extends longitudinally in said confined space and is secured to the outermost portions of said first blades on said first rotors;

h. a plurality of rings of circumferentially spaced first blades that are secured to the inner surface of said shell and project into said spaces between said pairs of second blades;

i. two longitudinally spaced third rotors connected to opposite ends of said shell, and said third rotors mounted on said shaft and secured to portions thereof adjacent said first and second transverse circular members; and

j. gear means in said confined space for rotatably connecting said first rotors to said third rotors to cause concurrent rotation thereof, with said jets as they discharge longitudinally in said confined space alternately impinging on said first and second blades to impart torque to said first rotors and shell to rotate the same as an assembly in said first direction and said second rotors and drive shaft in said second direction, and said gear means cooperating with said first rotors, said shell, and said first blades to transfer torque developed by them as an assembly to said drive shaft to assist in rotating said drive shaft in said second direction.

13. A turbine structure as defined in clam 12 in which said gear means includes:

k. two toothed hubs that extend from said first rotors towards said third rotors most adjacent thereto;

l. two internal ring gears that extend from said third rotors towards said first rotors most adjacent thereto, said hubs and ring gears at least partially in transverse alignment;

m. a plurality of circumferentially spaced stubs shafts that extends from said third rotors towards said first rotors and are situated in spaces defined between said first and second rotors; and

n. a plurality of planetary gears rotatably supported on said stub shafts in said spaces between said first and third rotors, said planetary gears in engagement with said hub gears and internal ring gears, and said planetary gears, hubs and ring gears serving as gear reduction units to cause said third rotors and drive shaft to rotate in opposite directions at a speed less than the speed at which said first rotors rotate.

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