Nov. 24, 1959 J. W. FOSTEY 2,914,298

REVERSIBLE TURBINE WITH INDEPENDENTLY OPERATED VANES

Filed March 21, 1956 2 Sheets-Sheet 1

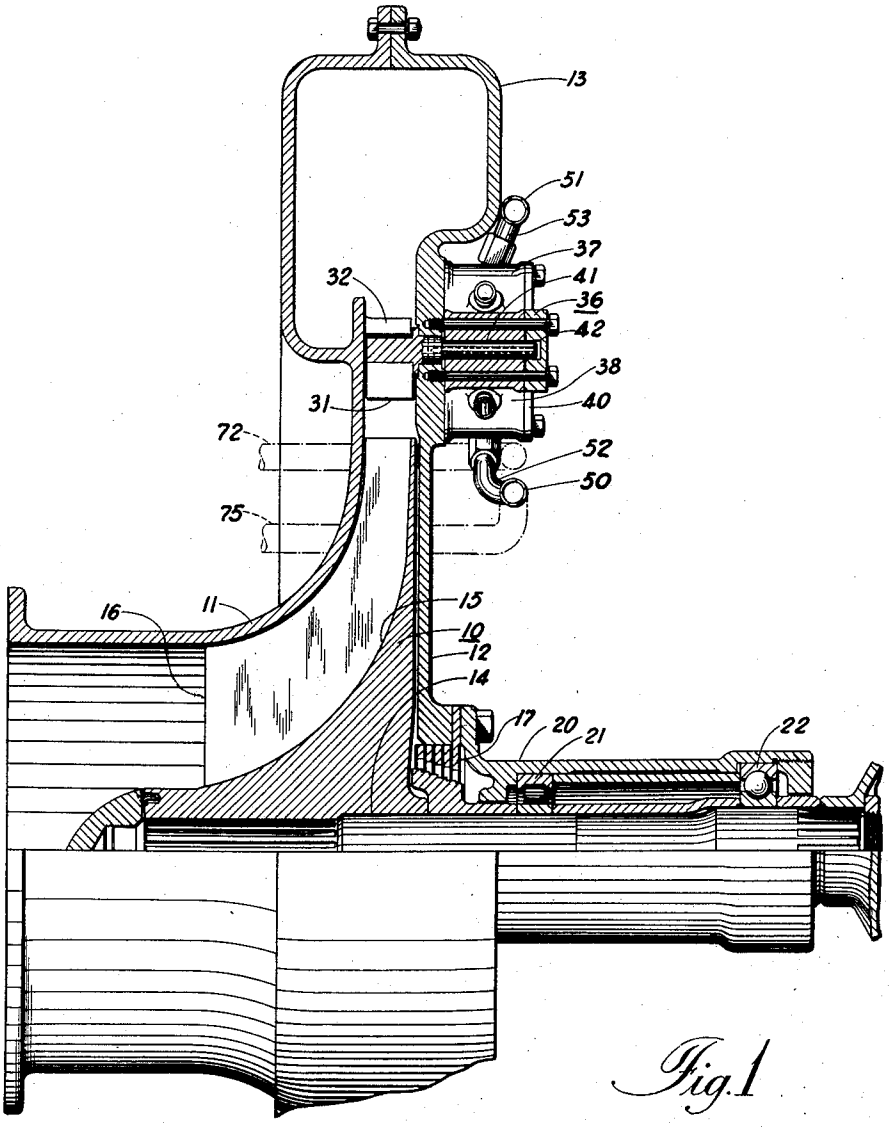

Fig. 1

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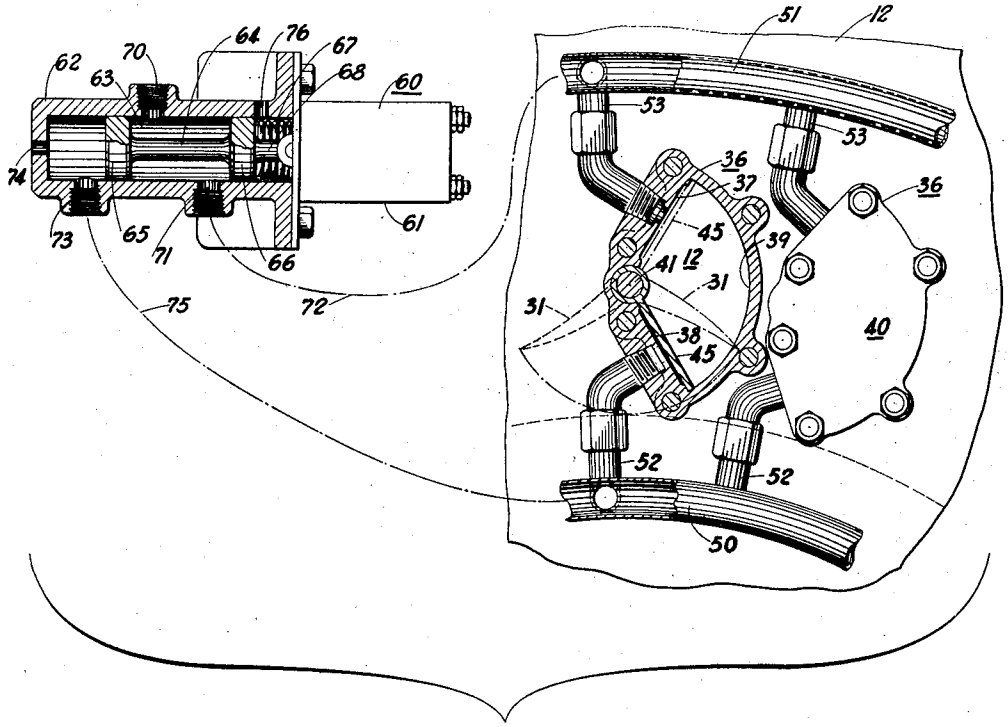

Fig. 2

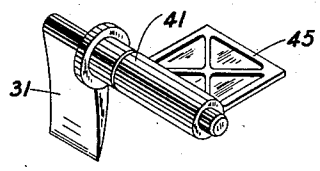

Fig. 3

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REVERSIBLE TURBINE WITH INDEPENDENTLY OPERATED VANES

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5 Claims. (Cl. 253—51)

This invention relates to gas turbines and particularly to reversible gas turbines.

A gas turbine of the type to which the present invention pertains normally has a plurality of circumferentially spaced vanes surrounding the rotor. These vanes form nozzles for directing a driving gas to the rotor. If the turbine is to be reversible, the vanes are mounted for pivotal movement so that all the vanes may be selectively moved to one of two positions to effect rotation of the rotor in the desired direction.

When the vanes of a turbine are connected together by gearing or a mechanical linkage which functions to move the vanes simultaneously, there is encountered an alignment problem which is due to thermal expansion of various parts of the turbine. Thermal expansion of the turbine, and particularly such expansion which is not uniform in all parts of the turbine, causes the distances between gear centers or linkage centers to vary and as a result the gearing or linkage operates erratically because binding and/or looseness between coacting parts of the gearing or linkage occurs.

It is a main object of the present invention to provide a new and improved turbine of the type referred to in which each of the vanes surrounding the turbine rotor is actuated independently of the other vanes, there being provided a separate actuator for each vane.

Other objects of the invention will become apparent from the following specification, the drawing relating thereto, and the appended claims.

In the drawing:

Fig. 1 is an elevational view of a reversible gas turbine embodying the invention with the portion above the longitudinal centerline of the turbine shown in section;

Fig. 2 is a side view partly in section of a portion of the turbine shown in Fig. 1 showing two vane actuating valve mechanisms for two of the vanes and a control mechanism for controlling the valve mechanisms; and

Fig. 3 is a perspective view of one of the valves and a turbine vane to which it is connected.

In Fig. 1 of the drawing there is shown a turbine assembly having a rotor 10 and a generally annularly shaped casing portion having a curved wall 11, a flat wall 12, and a volute portion 13. Rotor 10 is mounted on a shaft 14 and is thereby rotatably disposed between walls 11 and 12. Rotor 10 comprises an annularly shaped member 15 to which radially extending blades 16 are attached, the blades 16 forming passages through which a driving gas may be directed to effect rotation of the rotor. A sleeve 20 is attached to casing wall 12 to provide a support for shaft 14, bearings 21 and 22 being provided between shaft 14 and sleeve 20. A suitable labyrinth seal 17 is provided between wall 12 and shaft 14.

Surrounding rotor 10 is volute casing portion 13 into which a driving gas may be introduced and from which the driving gas is guided by vanes to rotor 10. Disposed between volute 13 and rotor 10, and attached to the turbine casing, are a plurality of circumferentially spaced

vanes 31 which form nozzles through which the driving gas is guided to rotor 10. Vanes 31 are pivotally mounted with their axes parallel to the axis of shaft 14 and are movable so that the driving gas may be selectively guided in a direction as desired. A plurality of circumferentially spaced vanes 32 are rigidly mounted in the turbine casing in radially outward spaced relation to movable vanes 31. Fixed vanes 32 function to guide the flow of driving gas from volute 13 to movable vanes 31.

For each of the movable vanes 31 there is provided a fluid pressure operable means which includes a fluid tight housing 36 having the shape of a sector of a cylinder. Housing 36 is defined by wall 12 of the turbine casing in addition to radial walls 37 and 38, an arc shaped wall 39, and a wall 40 which is parallel to casing wall 12. Housings 36 are attached to casing wall 12 and are arranged in circumferentially spaced relation and in respective axial alignment with the axes of movable vanes 31. Each of the vanes 31 has a shaft portion 41 extending through casing wall 12 and extending to an opposite wall 40 where it is journaled in a bearing 42, the shaft portions 41 being mounted in walls 12 and 40 so that vanes 31 are pivotally movable. Attached to each of the shaft portions 41 is a piston 45, illustrated herein as a square shaped vane, which is movable in response to a fluid pressure to cause pivotal movement of a corresponding vane 31.

Manifolds 50 and 51 and a control device 60 are provided for selectively directing fluid pressure to either side of each of the pistons 45 and venting the other sides to atmosphere. Manifolds 50 and 51 are arranged in concentric relation to the turbine shaft 13 with manifold 50 being spaced radially inwardly of housings 36 and manifold 51 being spaced radially outwardly of housings 36. Short pipe connections 52 connect the interiors of housings 36 to manifold 50 through radial walls 38. Short pipe connections 53 connect the interiors of housings 36 through radial walls 38 with manifold 51. Pipe connections 52 and 53 are connected to the housings 36, in each case, on opposite sides of piston 45 so that when fluid pressure is introduced to housings 36 from manifold 50, and vented to atmosphere through manifold 51, all the pistons 45 move counterclockwise. Conversely, pistons 45 move in a clockwise direction when the functions of the manifolds 50 and 51 are reversed when control device 60 is actuated. Movement of pistons 45 in one direction or the other causes corresponding movement of vanes 31, in unison, to change the direction of flow of the driving gas as it flows from volute 13 to rotor 10 to effect rotation of rotor 10 in the opposite direction.

Control device 60 is illustrated as being actuated by a solenoid 61 although other actuation means may be provided. Control device 60 comprises, in addition to solenoid 61, a housing 62 which defines a cylindrical chamber 63, a spool valve 64 having two spools 65 and 66 disposed in chamber 63, a spring 67 biasing spool valve 64 towards the left end of the chamber 63 and rod means 68 connecting spool valve 64 to solenoid 61.

Openings are provided in housing 62 so that, upon actuation of spool valve 64, fluid pressure may be selectively supplied to one of the manifolds 50 or 51 and the other manifold may be vented to atmosphere. When spool valve 64 is in the position shown, the solenoid being in an "on" position, fluid pressure from any suitable source is admitted to chamber 63 between spools 65 and 66 through an opening 70 and communicates with manifold 51 through an opening 71 and a pipe 72 which extends between opening 71 and manifold 51. Two openings 73 and 74, to the left of spool 65, allow manifold 50 to be vented to atmosphere through a pipe

75 which extends between manifold 50 and opening 73. With solenoid 64 in its "on" position, pistons 45 are in their clockwise positions.

When it is desired to reverse the direction of rotor 10 of the turbine, the solenoid is actuated to effect movement of spool valve 64 all the way to the left. The biasing force of spring 67 is effective to cause this movement when the solenoid 61 is in an "off" position. In this position the spool 66 is between openings 70 and 71 so that the fluid pressure admitted through opening 70 communicates with manifold 50 through opening 73 and pipe 75. Concomitantly, manifold 51 is vented to atmosphere through pipe 72, opening 71 in housing 62, and a vent opening 76 provided in housing 62. With solenoid 64 in its "off" position, pistons 45 are in their counterclockwise positions.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment of the invention is therefore to be considered in all respects as illustrative and not restrictive. The scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

It is claimed and desired to secure by Letters Patent:

1. A turbine comprising a casing, a rotor rotatably mounted within said casing and having driving gas passages, a plurality of circumferentially spaced vanes surrounding said rotor for directing a driving gas to said passages, each of said vanes being movable between at least two positions, a fluid pressure motor for each of said vanes including a chamber and a piston disposed in said chamber, said piston being operably connected to said vane for changing the position of the vane, and a controllable fluid pressure source connected to said chamber for selectively directing fluid pressure to either side of said piston.

2. A turbine comprising a casing, a rotor rotatably mounted within said casing and having driving gas passages, a plurality of circumferential spaced vanes surrounding said rotor for directing a driving gas to said passages, each of said vanes being operably connected to said casing for pivotal movement, a fluid pressure motor for each of said vanes including a chamber and a vane actuating piston disposed in said chamber for changing the position of the vane, said piston being operably connected to said vane, and a fluid pressure source and control means connected to said chamber for selectively directing fluid pressure to either side of said piston and venting the other side of said valve to atmosphere.

3. In a gas turbine having a casing and a rotor received in said casing, gas passages in said rotor, a plurality of spaced vanes for directing gas to said passages, each of said vanes being operably connected to said casing for pivotal movement, fluid pressure means to control the angular position of said vanes, said means including a fluid pressure source, a valve for selectively directing fluid pressure from said pressure source to either of two outlets in said valve, first and second manifolds in mutually exclusive communication with said valve outlets, an actuating device operably connected to each of said vanes, said actuating device having a housing formed with an arcuate chamber therein, a pivotable piston within said chamber, fluid conduits connecting one side of said piston with one of said manifolds and the other side of said piston with the other manifold, said vanes being connected with the respective piston of its actuating device, both said vanes and said pistons having a common axis of rotation, said combination functioning to control the positioning of the vanes by selectively directing fluid pressure to either side of said pistons in the chambers of said actuating devices.

4. A turbine comprising a casing, a rotor rotatably mounted within said casing and having driving gas passages, a plurality of circumferentially spaced vanes attached to said casing in surrounding relation to said rotor for directing a driving gas to said passages, each of said vanes being movable between at least two positions, a fluid pressure motor operably affixed to each of said vanes, a common fluid pressure manifold communicatively joining each of said motors, and a controllable fluid pressure source connected to said manifold.

5. A reversing device for a gas turbine comprising a plurality of circumferentially spaced apart vanes, said vanes being pivotally mounted for movement between two positions, a fluid pressure motor operably connected to each of said vanes for actuating said vanes between said positions, a common fluid pressure manifold communicatively joining each of said motors, and a controllable fluid pressure source connected to said manifolds.

References Cited in the file of this patent

UNITED STATES PATENTS

2,421,445	Waller	June 3, 1947
2,689,680	Lovesey	Sept. 21, 1954

FOREIGN PATENTS

245,744	Great Britain	Apr. 1, 1926
618,193	Great Britain	Feb. 17, 1949
728,815	Great Britain	Apr. 27, 1955