

[54] **COMBINED TURBINE NOZZLE AND BEARING FRAME**

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[22] Filed: **Dec. 14, 1970**

[57] **ABSTRACT**

[21] Appl. No.: **97,575**

A turbine engine having a gasifier turbine rotor and a power turbine rotor, a bearing frame providing a bearing support for the shaft of the gasifier turbine rotor, the bearing frame and a turbine nozzle being integrally formed to provide a continuous annular passage between the rotors, support struts extending radially across the annular passage within the bearing frame being integrally formed with respective vanes extending radially across the annular passage within the turbine nozzle to simplify construction of the turbine engine and reduce flow disturbance within the annular passage.

[52] U.S. Cl.**415/68**, 60/39.16

[51] Int. Cl.**F02c 3/10**

[58] Field of Search60/39.16; 415/68, 69, 66

[56] **References Cited**

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4 Claims, 2 Drawing Figures

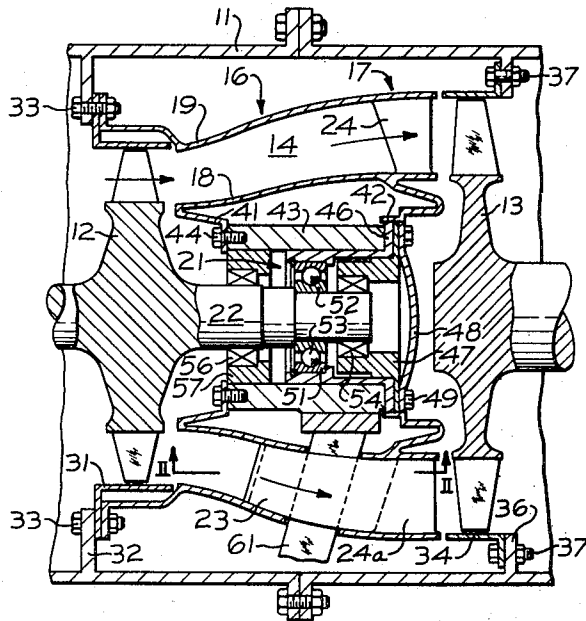


FIG-1

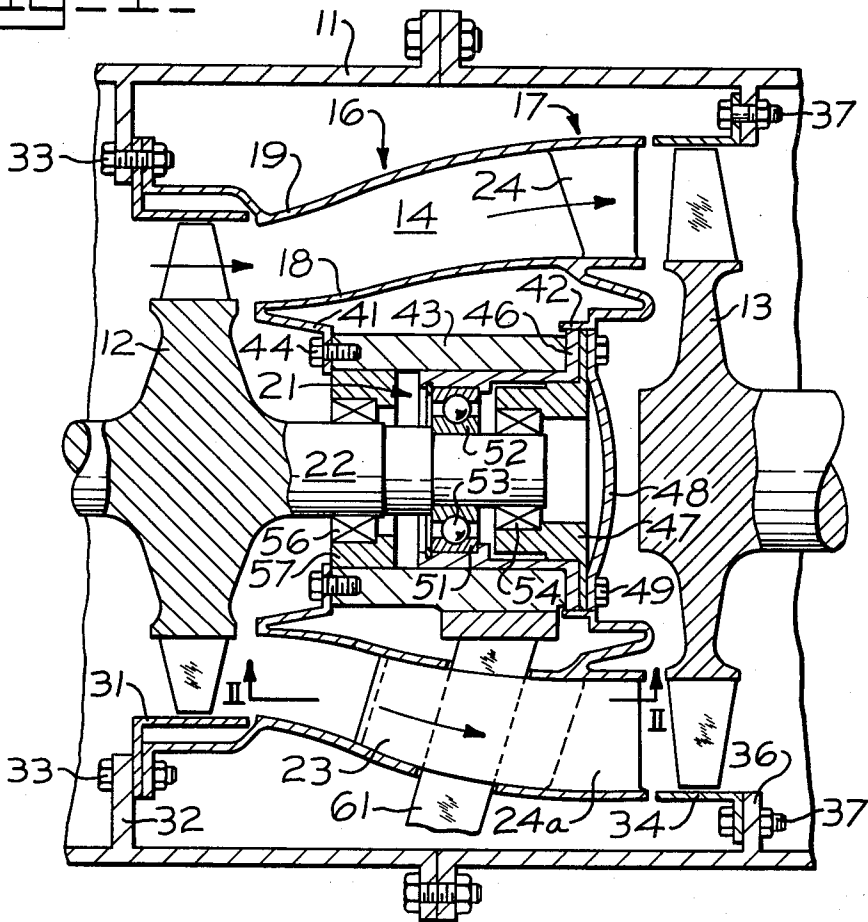
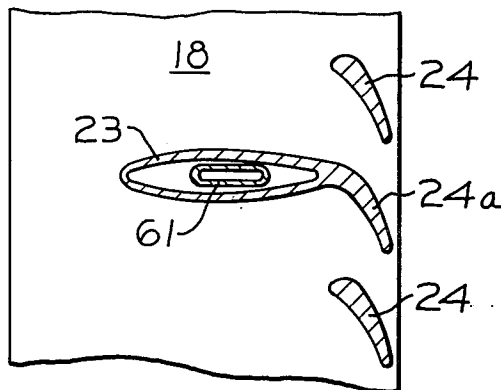


FIG-2



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COMBINED TURBINE NOZZLE AND BEARING FRAME

The present invention relates to a combined nozzle and bearing frame assembly forming an annular passage adjacent either a compressor or turbine rotor, for example, the assembly including a bearing support structure having struts extending radially across the annular passage and a nozzle having vanes extending radially across the annular passage. As contemplated by the present invention, each of the struts is arranged in alignment with a respective one of the nozzle vanes with adjacent edges of each strut and its respective vane being faired toward each other to reduce flow disturbance within the annular passage. Preferably, the bearing support structure and the nozzle are integrally formed to provide greater continuity along the surfaces of the annular passage, the associated struts and vanes also being integrally formed to further reduce flow disturbance and to simplify construction of the assembly.

In conventional or turbine machinery, for example, a first rotor such as a gasifier turbine rotor is arranged at one end of the annular passage with another rotor such as a power turbine rotor being arranged at the opposite end of the annular passage adjacent a power turbine nozzle or guide vanes employed for example in a compressor unit. Support struts for the bearing frame are commonly arranged in axially spaced apart relation from the vanes within the turbine and the power turbine rotors, the spaced apart relation between the struts and the vanes tends to develop a significant flow disturbance or wake downstream of each strut.

In addition to eliminating or minimizing this source of flow disturbance, the preferred integral construction of the bearing support and turbine nozzle also tends to provide greater continuity along the annular passage to further reduce flow disturbance and to simplify construction of the turbine.

An additional advantage of the present invention accrues because of the relatively compact construction of such turbine machinery. In the prior art, the spacing between the two rotors and the separate construction of the bearing support structure and the turbine nozzle may dictate minimum spacing between the struts and the gasifier turbine rotor. Aerodynamic interaction might accordingly occur therebetween giving rise to an additional source of flow disturbance. Through use of the construction contemplated by the present invention, the struts may be placed somewhat further downstream from the first rotor, thus eliminating or minimizing that source of flow disturbance.

Accordingly, it is an object of the present invention to provide turbine machinery having a pair of rotors and an annular passage therebetween with flow disturbance being minimized within the annular passage.

An additional object of the invention is to provide a nozzle integrally formed along with a bearing support structure to provide greater continuity within an annular passage formed thereby and/or to facilitate and simplify construction or assembly.

Still another object of the invention is to provide a combined bearing and nozzle assembly for use in conjunction with either a turbine or compressor rotor, for example, to reduce aerodynamic interference between the rotor and structural components within the bearing and nozzle assembly.

Other objects and advantages of the present invention are made apparent in the following description having reference to the accompanying drawing.

In the drawing:

FIG. 1 is a longitudinally sectioned view of a turbine machine embodying the present invention; and

FIG. 2 is a view taken along section lines II—II of FIG. 1.

Referring now to the drawing, FIG. 1 illustrates a two-shaft gas turbine engine having a housing or shell 11. A gasifier turbine rotor 12 and a power turbine rotor 13 are arranged in axial alignment for rotation within the turbine shell 11. An annular passage 14 is formed between the two rotors by a bearing support structure 16 and a power turbine nozzle 17. The bearing support structure 16 includes inner and outer cylindrical elements 18 and 19 which are spaced apart to form the annular passage 14. The inner cylindrical element 18 also supports a bearing arrangement 21 for the shaft 22 of the gasifier turbine rotor 12.

The inner cylindrical element 18 of the bearing support member 16 is positioned by support struts extending radially across the annular passage 14, one of the struts being indicated at 23. The power turbine nozzle 17 also has a relatively large number of vanes 24 extending radially across the annular passage 14 adjacent the power turbine rotor 13. As may be best seen in FIG. 2, each of the struts 23 is arranged adjacent and in general alignment with one of the power turbine nozzle vanes, such as that indicated at 24a. The trailing edge of the strut 23 and the leading edge of the associated vane 24a are faired toward each other for reducing flow disturbance within the annular passage in a manner described in greater detail above.

Referring also to FIG. 1, it may be noted that the power turbine nozzle 17 is formed integrally for example by casting, together with the bearing support structure 16 with the cylindrical elements 18 and 19 extending continuously along the length of the annular passage 14. Each of the struts 23 is also integrally formed together with the associated vane 24a.

In addition to reducing flow disturbance between the strut 23 and the vanes 24a and facilitating assembly of the turbine machine, it may be noted that the present arrangement of the struts further permits the struts to be placed further downstream from the gasifier turbine rotor 12. Thus, the present invention permits greater design freedom in arranging components within the turbine machine and reduced aerodynamic interference between various elements in the fluid flow path.

Additional structural features of the present turbine machine are also illustrated in FIG. 1. The outer cylindrical element 19 of the bearing support structure 16 and a cylindrical casing 31 arranged about the gasifier turbine rotor 12 are secured to an inwardly extending flange 32 on the turbine shell 11 by bolts such as those indicated at 33. A similar cylindrical casing 34 arranged about the power turbine rotor 13 is secured to another flange 36 on the turbine shell 11 by means of bolts such as those indicated at 37.

The inner cylindrical element 18 of the bearing support structure 16 has inwardly extending flanges 41 and 42 arranged respectively adjacent the upstream and downstream ends of the annular passage 14. A cylindrical housing member 43 is secured to the flange 41 by

means such as screws indicated at 44. An outer bearing support 46 and a seal support 47 together with an end plate 48 are secured to the other end of the housing member 43 by bolts such as those indicated at 49. The outer bearing support member 46, the seal support member 47 and the end plate 48 are also piloted within the flange 42.

Outer and inner races 51 and 52 for bearings 53 are arranged respectively upon the bearing support member 46 and a stepped portion of the shaft 22. A seal 54 is arranged between the seal support member 47 and the stepped portion of the shaft 22. Another seal 56 is arranged between the shaft 22 and a second seal support member 57 to hydraulically isolate the bearing arrangement 21.

To permit lubrication of the bearing means during high speed operation of the turbine, a conduit or tube indicated at 61 (Also see FIG. 2) is arranged within one of the struts 23 to deliver lubricant to the bearing assembly 21. Another conduit similarly arranged within another strut (not shown) may be employed to provide a drain passage for the lubricant.

What is claimed is:

1. In an axial flow fluid turbine engine comprising a power turbine rotor, a gasifier turbine rotor mounted on a shaft extending toward the power turbine rotor, a bearing frame arranged between the two rotors and a power turbine nozzle arranged between the bearing frame and the power turbine rotor, the bearing frame having two generally cylindrical, spaced apart elements forming an annular passage in fluid communication with the gasifier turbine rotor, a plurality of struts extending radially across the annular passage of the bearing frame to support the inner member relative to the outer member, the inner member providing a bearing support for the gasifier turbine rotor shaft, the power turbine nozzle defining an annular passage for fluid communication between the annular passage of the bearing frame and the power turbine rotor, a plurality of vanes extending radially across the annular passage of the power turbine nozzle, the improvement comprising the bearing frame and power turbine nozzle being integrally formed to provide a unitary annular passage between the power turbine rotor and the gasifier turbine rotor, each of the struts being integrally formed

with a respective one of the nozzle vanes, each strut being faired into its integral vane for reducing flow disturbance within the unitary annular passage.

2. The turbine engine of claim 1 wherein conduit means for providing lubricant to a bearing between the inner frame element and the gasifier turbine rotor shaft is disposed within at least one of the struts, a cylindrical housing member being secured within the inner element of the bearing frame, outer bearing support means being fixed within the housing member, inner bearing support means being fixed to the gasifier turbine rotor shaft and means providing a seal between the housing member and shaft on axially opposite sides of the bearing.

3. In a combined nozzle and bearing frame arrangement for use in conjunction with an axially aligned turbine or compressor rotor, the bearing frame having two generally cylindrical, spaced apart members forming an annular passage in fluid communication with the rotor, a plurality of struts extending radially across the annular passage of the bearing frame to support the inner member relative to the outer member, the inner member providing a bearing support for the rotor, the nozzle defining an annular passage for fluid communication between the annular passage of the bearing frame and the rotor, a plurality of vanes extending radially across the annular passage of the nozzle, the improvement comprising the bearing frame and nozzle being integrally formed to provide a unitary annular passage in communication with the rotor, each of the struts being integrally formed with a respective one of the nozzle vanes, each strut being faired into its integral vane for reducing flow disturbance within the unitary annular passage.

4. The nozzle and bearing frame assembly of claim 3 wherein conduit means for providing lubricant to a bearing between the inner frame element and a shaft for the rotor is disposed within at least one of the struts, a cylindrical housing member being secured within the inner member of the bearing frame, outer bearing support means being fixed within the housing member, inner bearing support means being fixed to the rotor shaft with means providing a seal between the housing member and shaft on axially opposite sides of the bearing.

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