



TURBINE NOZZLE SUPPORT

The present invention relates to a mounting support for a turbine nozzle, and more particularly to a mounting support of a turbine guide-vane ring connected to a gas channel, especially to a hot gas scroll, in the end section of a turbo group which is axially yieldingly connected to this end section with an adjacent structural group by way of a plug-in connection.

Since one aims in modern gas turbine engines at high operating temperatures, the components of the hot gas conduction are subjected to corresponding high thermal stresses. The strength of the used materials thereby decreases to a considerable extent, whence one attempts to relieve turbine nozzles and more particularly turbine guide-vane rings exposed to hot gases as much as possible from loads and stresses caused by forces acting upon the same. The simplest way for such a far-reaching relief is a clamping of the nozzle guide vanes on the casing side both at the root thereof (inner diameter) as well as at the tip thereof (outer diameter). However, this solution is meaningful only if the inner shroud and the outer shroud of the guide-vane ring are disposed in a fixed housing connection that does not permit any relative movements between these shrouds, especially in the axial direction. However, this condition does not exist with the arrangement of the general type described above because the housing portion within which is located the turbine nozzle and more specifically the turbine guide-vane ring, is an end piece that is to be connected with the adjacent structural group axially movably by way of a plug-in connection. If one were to connect the outer ring or shroud of the turbine guide ring rigidly with this end flange, relative movements between the outer ring or shroud and the inner ring or shroud of the guide ring might occur by reason of thermal expansions of the gas channel connected upstream of the guide ring, which would cause a considerable bending stress of the blades or vanes. An axially resilient connection between the outer ring or shroud of the guide ring and the housing end piece would relieve the guide ring from the described stresses. However, in practice it would lead again to a guide-blade arrangement clamped on one side only, namely at the inner diameter thereof whereby the guide vanes would be exposed to considerable bending stresses due to the gas forces acting upon the same.

Accordingly, it is an object of the present invention to so construct a mounting support of the general type described above of a turbine nozzle and more particularly of a guide-vane ring in a turbine that the guide blades are not exposed to high stresses caused either by thermal expansions or by gas forces.

As solution to the underlying problem, it is proposed according to the present invention that the guide ring is rigidly connected at its inner ring or shroud with a housing of the turbo group whereas it is held axially movably with its outer ring or shroud in a collar of the gas channel which itself is supported at the adjacent structural group, whereby the outer ring or shroud in the collar forms together with an annular piston a structural unit whose end surface facing upstream is acted upon by the gas pressure prevailing upstream of the guide ring whereas in part a high compressor end-pressure and in part the pressure prevailing downstream of the turbine acts on the end surface facing downstream. The subdivision of the piston area is

thereby so selected in an advantageous manner that a support force results at the outer ring or shroud which is oppositely directed to the axial load of the blades by the pressure decrease at the cascade. A force equilibrium is created thereby at the outer ring or shroud of the guide ring so that the mounting of the turbine guide ring represents in practice a clamping of the guide blades on both sides. The adaptation of the piston ring areas to the three pressures can thereby take place both by calculation as well as by experiments.

These and further objects, features and advantages of the present invention will become more apparent from the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, one embodiment in accordance with the present invention, and wherein

The single FIGURE is a partial longitudinal axial cross-sectional view through a mounting support of a turbine guide-blade ring in accordance with the present invention.

Referring now to the single figure of the drawing, the rear end of a gas producer assembly 1 is partially shown in this figure, which is connected by a plug-in connection of conventional type with a power turbine assembly 2. Working gases flow out of a hot gas channel or duct 9 through a turbine nozzle, i.e., the guide-vane ring provided with guide blades 6 and act upon a turbine wheel 11 from where they are fed to the power turbine assembly 2. The hot gas duct 9 is securely connected at its inner diameter to an internal flange 8 of the gas producer housing. At its outer diameter, the hot gas duct 9 is supported by way of a collar 3 at a flange 12 of the power turbine assembly 2. The guide vanes 6 arranged downstream of the hot gas duct 9 form together with an inner ring or shroud 7, which is rigidly connected with the housing flange 8, a turbine nozzle and more particularly a guide-vane ring. An outer ring or shroud 5 of this guide ring is held radially slidably with its nose portion 15 in a groove 16 of a flange constructed as a piston 13. The piston 13 is axially movable in the collar 3. The piston 13 terminates in a connecting ring 14, by means of which the plug-in connection with the housing 4 of the power turbine assembly 2 is established. Piston rings 10 are thereby provided as sealing elements. Due to the axially displaceable arrangement of the piston 13 in the collar 3, no axial loads or stresses stemming, for example, from the thermal expansion are transmitted from the housing of the gas producer 1 to the outer ring or shroud 5. The guide blades 6 are stressed in bending due to the differing pressures upstream and downstream of the guide ring by a distributed load which acts over the blade height $d_1 - d_0$. An additional load on the blades results from the loading of the piston ring surface 18 (annular area between d_1 and d_3) caused by the pressure P_{BK} upstream of the guide ring. According to the present invention, these loads are equalized in such a manner that the piston surface 17 facing downstream is acted upon by a high compressor end-pressure P_c in that a connection 16 to a pressure space of the compressor end-pressure P_c is provided. The piston ring surface 17 acted upon by this compressor end-pressure P_c extends from d_2 to d_3 . The axial area between d_1 and d_2 is acted upon by the low pressure P_T downstream of the turbine. The dimensions d_0 , d_1 , d_2 and d_3 of the guide ring support are so matched to one another and to the pressures P_{BK} , P_V and P_T that a total axial load results in the nor-

mal operating range at the outer ring or shroud 5 which is equal to zero so that neither bending nor shear loads are transmitted to the blades 6.

While I have shown and described only one embodiment in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of numerous changes and modifications as known to those skilled in the art and I, therefore, do not wish to be limited to the details shown and described herein but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

What I claim is:

1. An arrangement for supporting turbine guide vane means in position on a turbo-assembly between a gas duct and a rotatable turbine unit of said turbo assembly such that said guide vane means guides the flow of gases from said gas duct to said turbine unit, wherein said guide vane means includes a plurality of guide vane blades rigidly connected to and supported between inner and outer guide vane rings; said arrangement comprising:

relatively fixed housing means,

first connecting means rigidly connecting one of said inner and outer guide vane rings to said housing means,

collar means on said gas duct,

second connecting means interposed between the other of said inner and outer guide vane rings and said collar means for supporting said other of said inner and outer guide vane rings at said collar means, said second connecting means including piston means axially fixed to said other of said inner and outer guide vane rings and axially movably supported in said collar means, said piston means having respective upstream and downstream facing end surfaces with respect to gas flow through said turbo-assembly, said upstream facing end surface being acted upon by the gas pressure prevailing immediately upstream of said guide vane means, at least a portion of said downstream facing end surface being acted upon by the gas pressure prevailing immediately downstream of said turbine unit, and

high pressure communicating means for communicating high pressure gas under a pressure higher than the pressure prevailing immediately downstream of said turbine unit directly with at least a portion of said downstream facing end surface, whereby said high pressure gas and the gas pressure prevailing immediately downstream of said turbine unit counteracts at least a part of the bending forces on the guide vane means resulting from movement of said piston means due to pressure forces on said upstream facing end surface during operation of said turbo-assembly.

2. An arrangement according to claim 1, wherein said first connecting means rigidly connects said inner guide vane ring to said housing means, and wherein said second connecting means is interposed between said outer guide vane ring and said collar means.

3. An arrangement according to claim 1, wherein said high pressure communicating means includes means for conducting said high pressure gas from a high pressure compressor of said turbo-assembly which is arranged downstream of said turbine unit.

4. An arrangement according to claim 2, wherein said high pressure communicating means includes means for conducting said high pressure gas from a high pressure compressor of said turbo-assembly which is arranged downstream of said turbine unit.

5. An arrangement according to claim 1, further comprising seal means for sealing the high gas pressure with respect to the gas pressure prevailing immediately downstream of said turbine unit.

6. An arrangement according to claim 2, further comprising seal means for sealing the high gas pressure with respect to the gas pressure prevailing immediately downstream of said turbine unit.

7. An arrangement according to claim 2, wherein said outer guide vane ring includes a radially outwardly extending protrusion which engages with radial play in said piston means.

8. An arrangement according to claim 1, wherein a portion of said turbo-assembly including said gas duct and guide vane means is axially yieldingly connected with an adjacent portion of said turbo-assembly by way of a plug-type connecting means.

9. An arrangement according to claim 8, wherein said plug-type connecting means includes an extension on said piston means which axially and yieldingly engages in a corresponding opening of said next adjacent portion.

10. An arrangement according to claim 2, wherein a portion of said turbo-assembly including said gas duct and guide vane means is axially yieldingly connected with an adjacent portion of said turbo-assembly by way of a plug-type connecting means.

11. An arrangement according to claim 10, wherein said plug-type connecting means includes an extension on said piston means which axially and yieldingly engages in a corresponding opening of said next adjacent portion.

12. An arrangement according to claim 11, wherein said collar means and said next adjacent portion axially abut one another.

13. An arrangement according to claim 9, further comprising seal means interposed between said extension and said next adjacent portion for sealing said high gas pressure with respect to the gas pressure immediately downstream of said turbine unit.

14. An arrangement according to claim 12, further comprising seal means interposed between said extension and said next adjacent portion for sealing said high gas pressure with respect to the gas pressure immediately downstream of said turbine unit.

15. An arrangement according to claim 1, wherein said facing end surfaces and said high pressure communicating means are so configured that during normal operation of said turbo assembly, the axial pressure forces on said upstream facing end surface approximately equal the axial pressure forces on said downstream facing end surface such that said guide vane means is axially supported at both said inner and outer guide vane rings without bending forces on said guide vane means due to gas flow during said normal operation.

16. An arrangement according to claim 2, wherein said facing end surfaces and said pressure communicating means are so configured that during normal operation of said turbo assembly, the axial pressure forces on said upstream facing end surface approximately equal the axial pressure forces on said down-

stream facing end surface such that said guide vane means is axially supported at both said inner and outer guide vane rings without bending forces on said guide vane means due to gas flow during said normal operation.

17. An arrangement according to claim 16, wherein said high pressure communicating means includes means for conducting said high pressure gas from a high pressure compressor of said turbo-assembly which is arranged downstream of said turbine unit.

18. An arrangement according to claim 15, further comprising seal means for sealing the high gas pressure with respect to the gas pressure prevailing immediately downstream of said turbine unit.

19. An arrangement according to claim 16, wherein said outer guide vane ring includes a radially outwardly extending protrusion which engages with radial play in

said piston means.

20. An arrangement according to claim 15, wherein a portion of said turbo-assembly including said gas duct and guide vane means is axially yieldingly connected with an adjacent portion of said turbo-assembly by way of a plug-type connecting means.

21. An arrangement according to claim 20, wherein said plug-type connecting means includes an extension on said piston means which axially and yieldingly engages in a corresponding opening of said next adjacent portion.

22. An arrangement according to claim 21, further comprising seal means interposed between said extension and said next adjacent portion for sealing said high gas pressure with respect to the gas pressure immediately downstream of said turbine unit.

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