COOLING SLEEVE FOR GAS TURBINE
COMBUSTOR TRANSITION MEMBER

Inventor: Carl F. Wilhelm, Jr., 40 Jennifer Road, Scotia, N.Y. 12302

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Field of Search 415/115, 116, 117, 175, 60/39.66

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Primary Examiner—Henry F. Raduazo
Attorney—William C. Crutcher, Frank L. Neuhauser, Oscar B. Waddell and Joseph B. Forman

ABSTRACT

In a heavy duty gas turbine, the transition member leading from the combustion chamber outlet to the first turbine stage is cooled by means of a surrounding sleeve which admits compressor air on one side and which, after cooling the transition member, admits air into the hot combustion gas path to improve the radial temperature gradient at the turbine nozzle.

3 Claims, 3 Drawing Figures
COOLING SLEEVE FOR GAS TURBINE COMBUSTOR TRANSITION MEMBER

BACKGROUND OF THE INVENTION

This invention relates generally to gas turbine power plants and more particularly to an improved construction for cooling of the transition member supplying hot combustion gases from the combustion chamber to the turbine, as well as an improved construction for improving the temperature distribution of the hot gas to the turbine blades.

Industrial gas turbines generally supply compressor air to a jacket surrounding a combustion liner within which combustion takes place for supplying hot gases to the turbine located some distance away from the combustion chamber outlet. To conduct the hot gases from the combustion liner outlet to the nozzle, there is generally provided a "transition" member which is oftentimes partially cooled by the compressor air on its way to the combustion chamber. Some parts of the transition member are relatively difficult to cool in this manner because they are in locations which are relatively inaccessible to the cooling air flow. One such region is the radially outer portion of the transition member closest to the turbine.

Another problem encountered with gas turbines is that of the temperature distribution in the hot gases from the combustion chamber. It is desirable to "profile" the flow so that the cooler gas flow is at the radially inner portion of the gas path where the rotating turbine bucket stresses are highest.

Constructions for admitting compressor air at the inlet to the first turbine stages for the purpose of improving the radial temperature gradient are disclosed in U.S. Pat. No. 2,805,355 to Schörner, U.S. Pat. No. 3,135,496 to Scheper, and U.S. Pat. No. 3,490,747 to DeCorso. In all of the foregoing constructions, profiling air is admitted directly through the wall into the hot gas path. Insignificant cooling of the wall itself by the profiling air occurs with the foregoing constructions.

Accordingly, one object of the present invention is to provide an improved construction for cooling the inaccessible wall portions of the transition member in a gas turbine.

Another object of the invention is to provide an improved construction for introducing compressor air into the hot gas path to "profile" the radial temperature gradient in a gas turbine.

DRAWING

The invention, both as to organization and method of practice, together with further objects and advantages thereof, will best be understood by reference to the following specification, taken in connection with the accompanying drawings, in which:

FIG. 1 is a partial horizontal cross section of a gas turbine power plant illustrating the location of the transition member.
FIG. 2 is an enlarged view of the end of the transition member illustrating the cooling sleeve of the present invention, and
FIG. 3 is a cross section of the transition member and cooling sleeve taken along the lines III—III of FIG. 2.

SUMMARY OF THE INVENTION

Briefly stated, the invention is practiced by providing a cooling sleeve which surrounds and encloses the end of the transition member adjacent the turbine inlet. Inlet holes into the sleeve provide cooling by impingement against the transition member in addition to some connection cooling. Holes through the transition member into the hot gas path are located diametrically opposite the inlet holes so that cooling air flows around the transition member to cool it before entering the hot gas path to cool the blade root region.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1 of the drawing, the illustrated portion of a gas turbine power plant shows a section of the compressor 1, the combustion chamber 2, and the turbine 3. The compressor 1 has an outlet 4 which discharges into a closed chamber 5 containing a curved transition member 6. The transition member 6 connects the open circular end of the combustion liner 7 with an arc of radially extending stationary nozzle partitions 8 and is suitably curved to provide the flow transition from a circular inlet to an arcuate outlet. A number of such transition members 6 and combustion liners 7 are circumferentially spaced around the gas turbine, only one being shown here for simplicity. The turbine portion includes additional rotating turbine buckets 9 and stationary nozzle partitions 8 in the first turbine stage.

The foregoing construction is well known in the art. The present invention comprises an improvement by the addition of a cooling sleeve 11 surrounding the end of the transition member 6.

Reference to FIG. 2 of the drawing and the cross section of FIG. 3 shows that the end of transition member 6 adjacent the inlet to turbine nozzle partitions 8 includes a sheet metal sleeve 11 confirming in shape to the transition member curvature but spaced therefrom by means of a crimped edge 12 which is spot welded or otherwise tightly attached to transition member 6. The sleeve 11 is so proportioned as indicated in the drawings to leave a passage 13 surrounding the transition member 6 for the flow of cooling air between the transition member and the sleeve walls. The transition member 6 has a top wall 14 and a bottom wall 15. Similarly, the sleeve has a top wall 16 and bottom wall 17. Reference in the description and claims to "top walls" means radially outer walls with respect to the gas turbine axis. Similarly "bottom walls" means radially inner walls with respect to the axis.

The top wall 16 of the sleeve is perforated with a large number of small inlet holes 18 distributed for impingement cooling of transition member top wall 14, while the bottom wall 17 of the sleeve 11 is imperforate. On the other hand, the bottom wall 15 of the transition member is perforated with a smaller number of fairly large air outlet holes 19 for temperature profiling, while the top wall 14 of the transition sleeve is imperforate. Air therefore must enter at inlet holes 18 and flow in both directions around the sides of the transition member to exit through holes 19.

Inlet holes 18 are distributed with respect to the surface of the upper transition wall 14 and are selected and sized to provide air impingement cooling by relatively small jets of air striking against the surface of wall 14. For example, in the illustrated construction, around 150 holes of one-eighth inch diameter have been found suitable for gas turbines in the 15 to 75 mw. output range.

The outlet holes 19 are arranged and proportioned for a different purpose, i.e., for injection of air to provide radial temperature profiling of the hot gas flowing through transition member 6. Therefore, they are arranged along one or two rows and are larger in diameter to minimize radial velocity and keep air near the root of nozzle portion 8. In the construction illustrated, two rows of around 10 holes each of three-eighths inch diameter have been found suitable.

OPERATION

The operation of the invention is as follows:

Referring to FIG. 1, air from the compressor outlet 4 partially cools transition member 6 en route to the combustion chamber. A portion of the compressor air flows toward the relatively inaccessible radially outer or "top" portion of the transition member and into the air inlet holes 18 because of the existing pressure difference. The tiny jets of air from the numerous small inlet holes 18 serve to effectively cool the arcuate surface of the top transition wall 14 by impingement thereon. The air then flows around the sides of the transition wall serving to further cool the same by convection. At the bottom of the transition member, the partially heated air now flows through the outlet holes 19 into the radially inner portion of the hot gases flowing through the transition member 6.
Although the air has been somewhat heated by virtue of having cooled the transition member exterior, it is nevertheless quite effective in tempering or profiling the hot combustion gases entering the turbine.

Thus it can be seen that a very effective means for cooling the inaccessible portions of the transition member have been provided, as well as providing an effective way to introduce air into the gas path for profiling the temperature gradient.

While there has been shown what is considered at present to the preferred embodiment of the invention, it is of course understood that various other modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a gas turbine having a transition member arranged to conduct hot combustion gases from a combustion chamber to a turbine inlet passage, said transition member being disposed in a chamber connected to a source of pressurized cooling fluid, the improvement comprising:
   a transition member portion having a substantially imperforate top wall top and an opposed bottom wall,
   a sleeve member surrounding and spaced from said transition member portion and having top and bottom opposed walls spaced from said respective top and bottom transition member opposed walls to form an unobstructed flow space there between,
   said top wall of the sleeve member being perforated and communicating with a supply of compressed air and arranged to admit jets of cooling fluid for impingement cooling of the transition member top wall, and
   said bottom wall of the transition member portion having openings arranged to admit cooling fluid from the sleeve into the transition member interior for profiling the hot combustion gases entering the turbine.

2. The combination according to claim 1, wherein said top and bottom walls are arcuate surfaces, and wherein said top walls have greater surface areas than said bottom walls and wherein the perforations in the top wall are smaller in size and greater in number than the openings in said bottom wall.

3. The combination according to claim 1, wherein said sleeve member comprises a sheet metal jacket surrounding said transition member portion and substantially uniformly spaced therefrom and sealingly attached thereto by crimped edges on said jacket.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION


Inventor(s) Carl F. Wilhelm, Jr.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:


Signed and sealed this 12th day of December 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents