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NASA TECH BRIEF

Computer Program for Analysis of Flow Across a Gas Turbine Seal

The problem:

To develop a means of designing noncontact face-sealing dams of the type used in gas turbines. Some powerplants, such as advanced jet engines, exceed the operating limits for which face-contact seals were designed. As a result, noncontact seals have become necessary.

The solution:

A computer program has been developed to carry out an analysis of the flow (leakage) across a sealing dam for the case of steady, laminar, subsonic, isothermal, compressible flow. The analysis considers both parallel sealing-dam surfaces and surfaces with small tilt angles.

How it's done:

The program is based on a sealing-dam model, which consists of two parallel, concentric, circular rings separated by a very narrow gap and rotating at a constant speed. The model is limited by the following physical constraints: the fluid is homogeneous, compressible, viscous, and Newtonian; the flow is steady and laminar; the bulk modulus is ignored; the fluid behaves as a perfect gas; the entrance region effects are negligible; and the fluid film is isothermal.

The governing equations for compressible-fluid flow with constant viscosity are incorporated into the analysis. The physical constraints applied to the model are used to simplify these equations before the boundary conditions of the specific problem are inserted.

The program input variables include the dimensions of the seal, pressure boundary conditions, and the physical properties of the gas. The output includes: mass flowrate; pressure and velocity distributions, Mach number, force, axial film stiffness, center of pressure, rotational and pressure-flow Reynolds numbers, Knudsen number, torque, power loss and approximate temperature rise resulting from viscous shearing in a specified film thickness. The output data are stated in both English and International units.

Notes:

1. The program is written in FORTRAN IV for the IBM-7094/7044 DCS.
2. Inquiries should be made to:

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   Reference: B70-10317

Patent status:

No patent action is contemplated by NASA.

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