AEC-NASA TECH BRIEF

Computer Program Performs Frequency Analysis of Nonuniform Turbine Disk Subjected to Temperature Gradients

The problem:

To develop a computer program for the determination of the natural frequencies of a turbine disk of variable thickness subjected to uniform rotation and radial temperature gradients.

The solution:

A program that involves the potential and kinetic energy expressions for a circular flat plate of variable thickness. Final natural frequencies of the disk are obtained by the use of "Raleigh-Ritz's" procedure.

How it's done:

The basic approach used in this method assumes a normal deflection function expressed in a finite power series, matching the particular boundary conditions of the turbine disk. The coefficients of the deflection function in the potential and kinetic energy expressions for the entire disk are then minimized by Ritz's procedure, yielding a set of integrated algebraic equations. Equating to zero the determinant of this set of equations will yield the natural frequencies of the turbine disk. The analytical result obtained may be considered as an adequate approximation of the free vibration solution of a rotating disk of distributed mass.

Notes:

1. This program is written in Fortran IV and MAP for use on the IBM 7094 computer.
2. A series of vibration shake tests of the nuclear rocket (NERVA) turbine disk have been conducted and the results obtained agree with the disk frequency predicted theoretically.
3. This program may be useful to those who design steam or gas turbines.
4. Inquiries concerning this program may be made to:
   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B68-10006

Patent status:

No patent action is contemplated by AEC or NASA.

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