Doctoral Thesis

Graphische Behandlung der kompressiblen und inkompressiblen Strömung durch Turbomaschinenstufen

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Graphische Behandlung
der kompressiblen und inkompressiblen Strömung
durch Turbomaschinenstufen

VON DER
EIDGENÖSSISCHEN TECHNISCHEN HOCHSCHULE IN ZÜRICH
ZUR ERLANGUNG DER
WÜRDE EINES DOKTORS DER TECHNISCHEN WISSENSCHAFTEN
GENEHMIGTE
PROMOTIONSARBEIT

VORGELEGT VON

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aus Ägypten

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Summary

The present work deals with the three dimensional compressible and incompressible flow between the long blades of turbomachines such as those often encountered in the last stages of steam and gas turbines. The flow through these stages is assumed to be isentropic, and the blade spacing is taken to be infinitely small. With the help of the isentropic curves, relating the temperature, density and mass rate of flow in terms of the Mach-number, a graphical method is developed which determines the radial variation of the velocity and the density in the axial gap between the fixed and moving blades. These in turn determine the characteristics of the stage and the location of the meridional stream lines. These lines turn out to have a periodical wave shape except in the case of a stage with a constant axial mass rate of flow, where they are straight.

The graphical determination of the flow in the gap is based on the condition of radial equilibrium between the centrifugal forces and the pressure gradient. The influence of the curvature of the meridional stream lines on this radial equilibrium is nevertheless not taken into account. This assumption, which is permissible in the majority of practical cases, simplifies the solution to a large extent. Although greater accuracy may be secured by labourious analytical calculations, the graphical method has the practical advantage of presenting clearly the various factors involved, in a relatively short time. Furthermore it is felt, as explained in the last chapter, that since the real flow deviates from the ideal, the approximate method presented is adequate for practical requirements.