سامية محمد مصطفى

شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

سامية محمد مصطفى

شبكة المعلومات الجامعية

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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سامية محمد مصطفى

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

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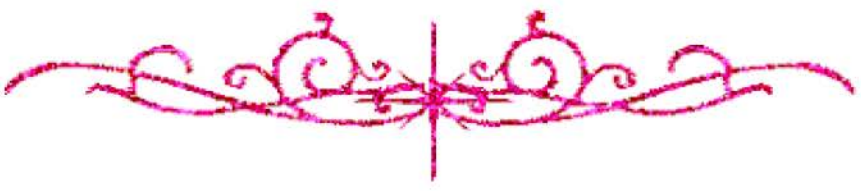

سامية محمد مصطفى

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بالرسالة صفحات لم ترد بالأصل

Tanta University
Faculty of Engineering
Mechanical Power Engineering Department

THE FLOW PATTERN AND SEPARATION IN ANNULAR DIFFUSERS

A Thesis Submitted in Partial Fulfillment for the Degree of
Master of Science

BY

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ABSTRACT

Annular diffusers are often used in turbomachines as exducers in turbines, diffusing elements in compressors and interstage ducts in multi-stage turbines. The design and performance of these diffusers are dependent on large number of geometrical and fluid dynamical parameters, if they are not carefully designed the flow pattern within them frequently shows large energy losses and stall. The flow pattern is further complicated if the flow entering such diffusers is swirled, which is commonly the case for flow leaving turbomachines rotors. In view of adverse pressure gradient and the complexity of the flow pattern in annular diffusers with swirled flow, a complete theoretical flow analysis through annular diffusers is rarely possible. Therefore, experimental methods have been of great importance in achieving some understanding of the flow behaviour.

In this thesis, an experimental study of the influence of non-swirling and swirling flows on the performance of annular diffusers is presented. Five diffusers were tested over a range of casing wall angles from 8 to 30 degrees, and a cylinderical hub. In addition, 180 degrees annular sudden expansion, as a short annular diffuser is tested. The experimental study conducted for a range of entry Reynolds number from 9.1×10^4 to 2.15×10^5. Two different methods of swirl generation are separately used for adding the swirl velocity component to the incoming axial flow in the tested annular diffusers. The first swirl generator (free-swirl) imparts a swirl component via passages through swirl vanes installed upstream of the diffuser. Variuos swirl vanes with different angles of vane settings were fabricated. Swirl angles are varied from 0 to 45 degrees were separately tested for each diffuser configuration. In the second method of swirl generation (forced-swirl), the swirl component is presented in the axial-air

stream by the rotation of the cylinderical hub. The swirl intensity is varied by changing the speed rotation. The measurements are conducted at speed of 0, 825, 1170 and 1655 rpm. The performance of the tested annular diffusers are measured for both swirl types.

Comparison of experimental results indicated that, the pressure recovery of the tested diffusers and the total pressure loss are dependent on the geometrical parameters of the diffuser, inlet Reynolds number, swirl type and swirl intensity. In both cases of swirl generation the pressure recovery coefficient of annular diffusers increases with increasing the swirl intensity. Also, the results of the annular sudden expansion indicate that the reattachment length is strongly depends on the swirl type and swirl intensity.