AIN-SHAMS UNIVERSITY
FACULTY OF ENGINEERING

STUDY OF THE EFFECT OF VANE CURVATURE ON THE PERFORMANCE OF VACUUM PUMPS

BY

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THESIS

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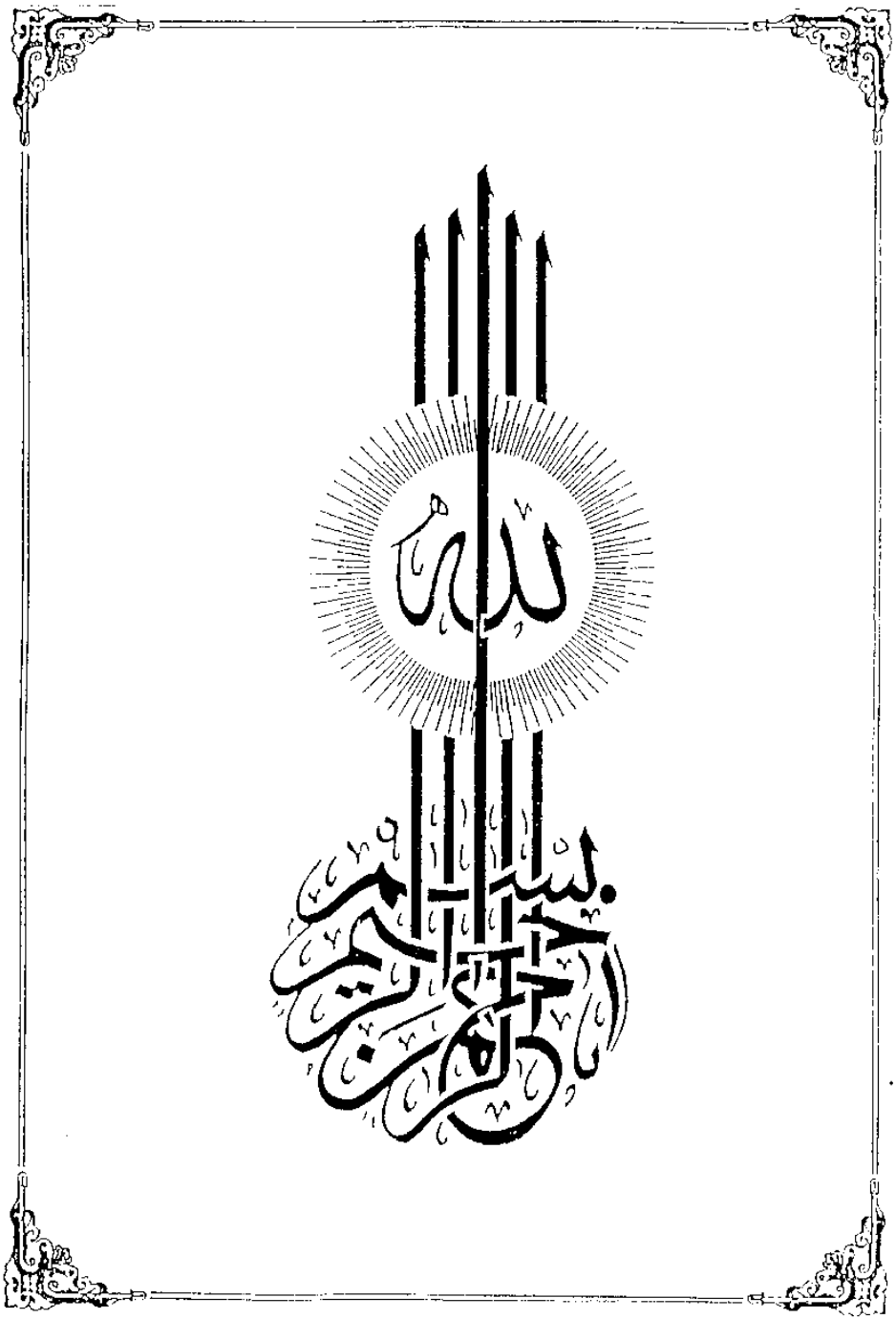

PREFACE

(I) PREFACE

This thesis is submitted to Ain Shams University for the degree of Master of Science in Mechanical Engineering.

The Work included in this thesis was carried out by the author at El Nasr Pharmaceutical company laboratory.

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ABSTRACT

(III) ABSTRACT

The present work is carried out to investigate the effect of variation of impeller vane curvature, speed and water flow rate on the performance of a water ring vacuum pump.

A test rig was designed. It contained calibrated measuring instruments to determine the pump speed, suction and delivery pressures, mass flow rate and brake power input.

The pump was tested at three different operating speeds of 1130, 1580 and 1750 rpm and for three different water flow rates, of 8,12 and 16 lit./min.

Five different impeller vane shapes were tested. The vanes were designed to have the same chord length but different camber.

An analysis was made to the characteristics of each impeller at different speeds and different water flow rates. Also the performance characteristics of different impellers were analysed for the same speed and the same water flow rate.

The followings are the major conclusions of this study :

1- The performance characteristics of the water ring vacuum pump showed a marked dependence on the vacuum percentage developed by the pump.

2- Every rotational speed, water flow rate and blade curvature

resulted in a different characteristic curve.

3- The optimal efficiency and the maximum fluid power were realized inside the stable region of suction capacity for each characteristic curve.

4- A back flow problem was noticed at low speeds of rotation (1130 rpm). Consequently, it is not advised to run vacuum pumps at such low speeds.

5- The vane curvature variation had a great effect on the water ring vacuum pump performance. Within the tested range, increasing the blade camber improved the pump performance and had an increasing effect on the operating parameters. These are suction capacity, vacuum percentage, fluid power and efficiency.

6- The water flow rate variation had also a remarkable effect on the pump performance. The increase of water flow rate improved both the sealing and the cooling of different pump components. Accordingly, this improved the operating parameters. However, the brake power is found to be nearly independent of water flow rate variation.

7- The speed variation had also a noticeable effect on pump performance. As the speed increased, all the values of operating parameters also increased; except the efficiency which decreased after exceeding a certain speed limit. This limit changes with water flow rate and vane curvature.

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