AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

EFFECT OF EXCITATION CONTROL ON MINIMIZING INVERTER FED INDUCTION MOTOR LOSSES

BY

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A THESIS

SUBMITTED IN PARTIAL FULFILMENT OF

THE REQUIREMENTS OF THE DEGREE OF MASTER OF

SCIENCE IN ELECTRICAL ENGINEERING

621.396
S.A.

337.1

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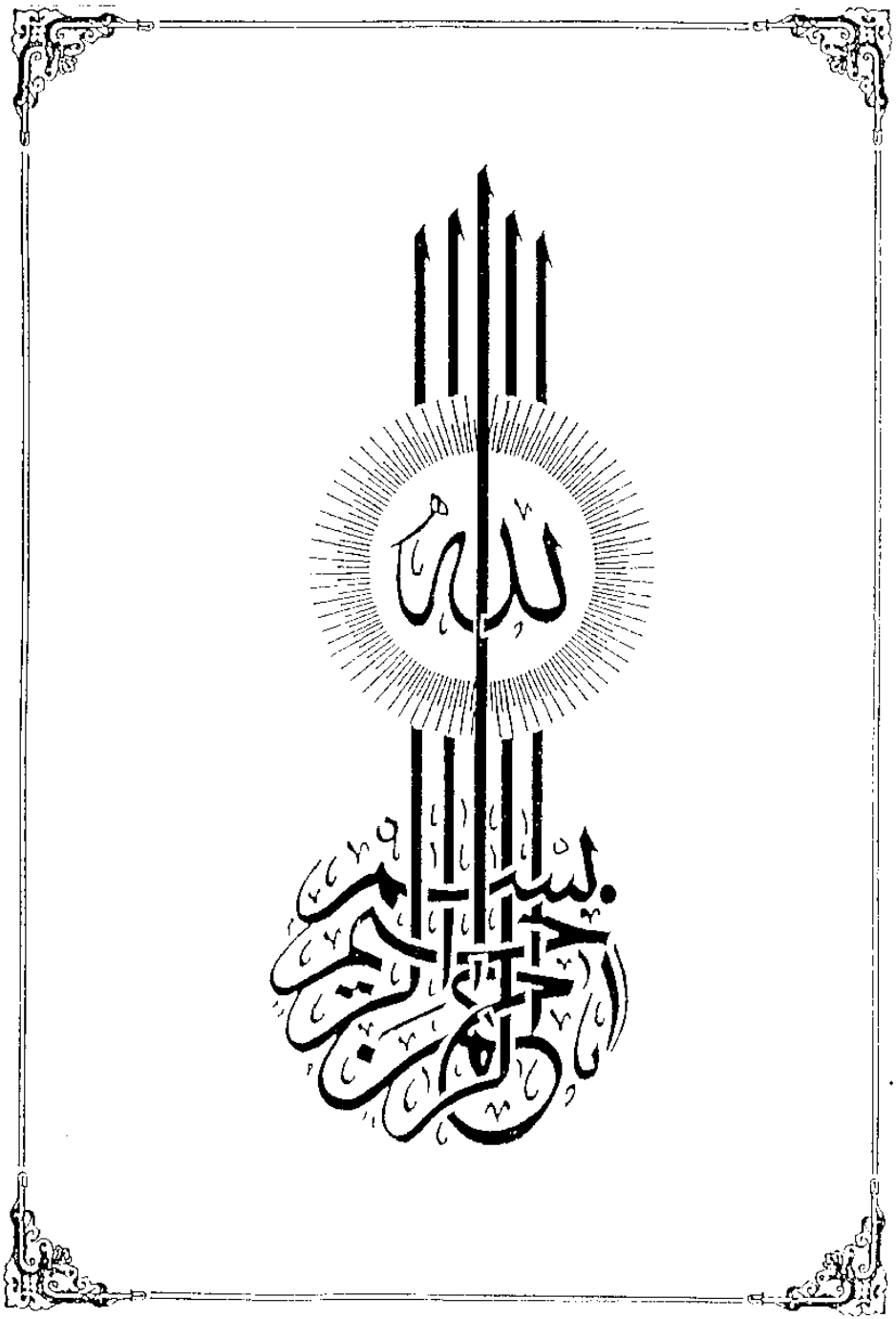

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STATEMENT

This dissertation is submitted to Ain Shams University for the degree of Master in Electrical Engineering .

The work included in this thesis was carried out by the author in the Department of Electrical Power and Machines , Ain Shams University , from October 1985 to October 1990 .

No part of this thesis has been submitted for a degree or a qualification at any other University or institution .

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ABSTRACT

Improving the efficiency of induction motors is a very timely subject. This type of motors represents in effect the work horse of industry and is used in most household and office appliances. Accordingly, even a marginal improvement in its efficiency can result in valuable saving in energy consumption.

This thesis presents a study of the effect of excitation control on the efficiency of inverter fed three phase induction motors under steady state operating contitions. This is achieved through time domain analysis. In this respect, it has been found that better efficiencies realized at high frequencies of operation using square wave input voltage, while improved efficiency at low frequencies calls for the use of sinusoidal pulse width modulation voltage input.

A modified algorithm based on frequency response analysis for performing the above mentioned investigation has been developed. This technique has the advantage of simplicity and computation time saving and yields results in very close agreement with time domain analysis.

The above mentioned investigations are based on nonlinear mathematical models for the induction motor and its control circuit. These take into consideration saturation, proximity and skin effects.

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ACKNOWLEDGEMENT

I would like to express my gratitude to Professor Dr. A. K. EL-KHARASHI , for his support , encouragement and patience during the fruitful discussions throughout the different stages of this work .

I'm also deeply indebted to Professor Dr. M. A. BADR and Dr. A. M. A. MAHMOUD for their real contribution , guidance and the substantial amount of their time and effort in this work .

I'm particularly grateful to my parents and my wife for their unwavering support and encouragement .

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CHAPTER 1

INTRODUCTION

1.1. GENERAL

Statistical studies in the United States of America revealed the fact that, 64 % of the total consumed energy goes to the industrial sector . In addition , 65 % out of such consumed energy is consumed by induction motors in form of pumps, fans and compressors . Therefore ; about 42 percent of the total energy produced goes to induction motors (Fig. 1.1). Consequently ; minimizing induction motor losses over the whole range of operation should help in saving the total energy produced and make the operating costs as economical as possible.

There are many factors influencing the induction motor efficiency such as design considerations and control applications. These will be discussed in the following section:

1.2. Design considerations affecting motor efficiency

The overall performance of an induction motor includes normally the following parameters :

a) Heating .

b) Efficiency .

c) Power factor .

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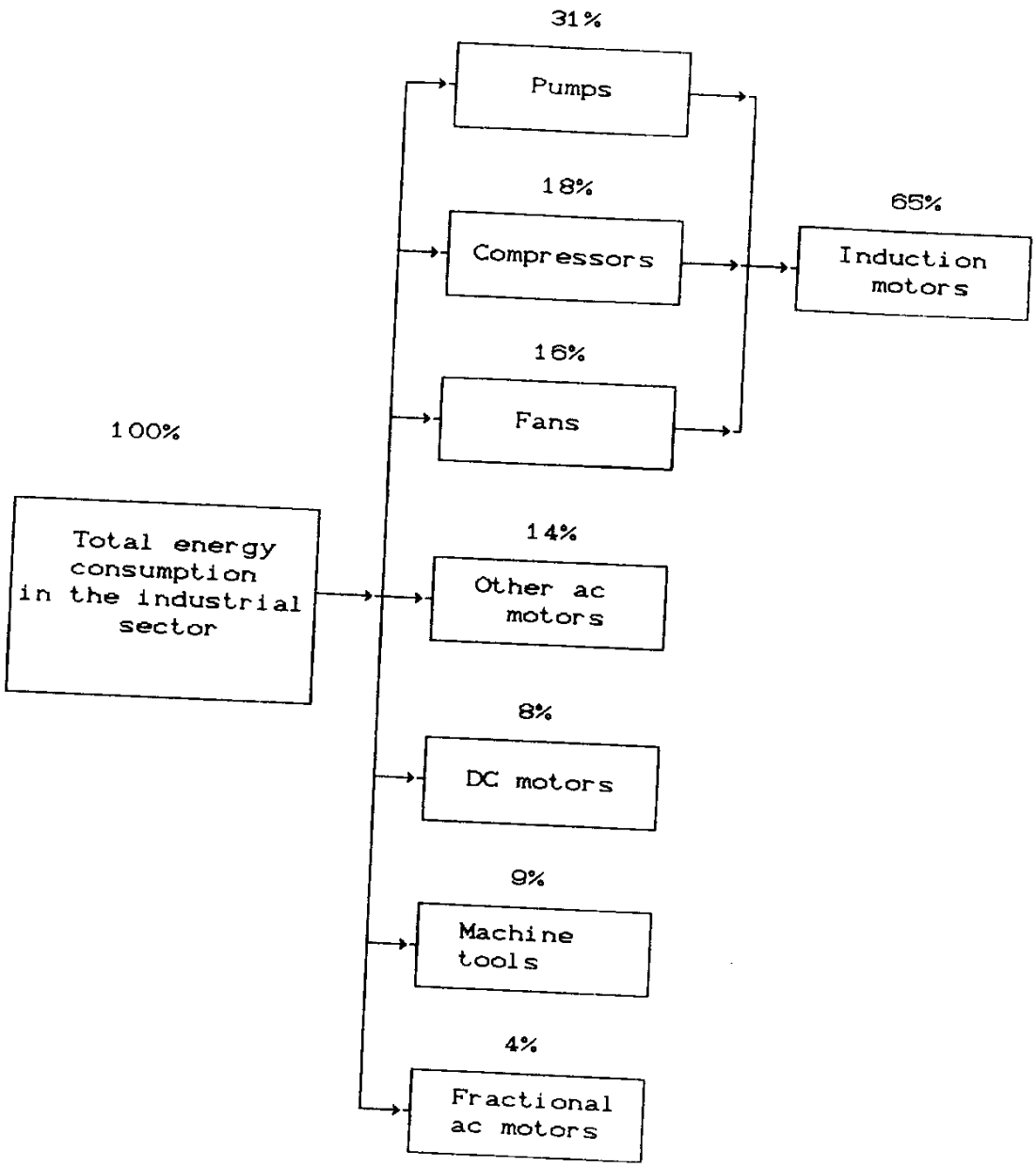

Fig. 1.1 Distribution of energy consumption in the industrial sector

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