

DESIGN AND CONSTRUCTION OF SMALL  
EPSTEIN APPARATUS  
FOR ELECTRICAL ENGINEERING LABORATORY

by



Hirun Buranahirun

B. Eng., Chulalongkorn University, 1958

๓๐๘๘๕๐

Thesis

Submitted in partial fulfillment of the requirements of the

Degree of Master of Engineering

in

The Chulalongkorn University Graduate School

Department of Electrical Engineering

May, 1965

(B.E. 2508)

Accepted by the Graduate School, Chulalongkorn  
University in partial fulfillment of the requirements  
for the Degree of Master of Engineering.

.....

Dean of the Graduate School

Thesis Committee.....*Aporn Kengphol*.....Chairman

.....*Chanay Boonpradit*.....

.....*Niram Kancharakanti*.....

.....

.....

Thesis Supervisor.....*Niram Kancharakanti*.....

Date.....*May 28, 1965*.....

Thesis Title. Design and Construction of Small Epstein  
Apparatus for Electrical Engineering Laboratory.

Name. Hiron Buranahirun. Department. Electrical Engineering.  
Department. Date. May, 1965.

ABSTRACT

This thesis deals with the magnetic materials for the general properties, characteristics, the iron loss, the design and construction of the apparatus, rules of testing, and the experiments. Each experiment includes the purpose, procedure, details, circuit diagrams, typical data and the calculations.



## ACKNOWLEDGEMENT



Many persons have contributed either directly and indirectly to this thesis. The author is deeply indebted to Dr. Ittipon Padunkchevit Graduate Supervisor, Mr. Annaj Sakarin Mr. Paibul Chainil for their useful suggestions, guidance. The author ~~can~~ not run most of experiments <sup>could</sup> with-out the help and suggestion of Mr. Annaj, Mr. Paibul and Mr. Pairat, the last but not least the author was helped by Mr. Somchet Wattanasinthu the manager of Sirivivat Co., in preparing the four solinoids in his work-shop.

from Japan and the others two are locally made, one of which varnish coated and the other is tin coated. This apparatus can be used in testing the magnetic materials, and, performing the experiments on the iron loss which are very important for Electrical Engineer.

## INTRODUCTION



All of the engineers have been working against the economic for a long time. They tried their best to create the new inventions in the minimum investment of best efficiency or minimum losses and low maintenance. For electrical designation that used the magnetic core, the losses in the core is the most important thing. The Epstein apparatus is the apparatus used in measuring the losses. In Electrical machine laboratory of Chulalongkorn University, there are insufficient of apparatus for undergraduate students to study the losses of magnetic core. The author's intention is to prepare the Epstein Apparatus for that purpose which this idea has been approved by graduate supervisor and the staff. This apparatus is constructed as a present to Electrical laboratory in order to help the undergraduate students in determining the iron loss at various flux densities and frequencies. For this purpose this Thesis has been successfully done and aimed only to construct the Epstein apparatus with basic principle.

In fact, the experiments on iron loss are already performed in several universities in Europe and America. The test specimens composed of 4 per cent silicon steel

## CONTENTS

	Page
ABSTRACT	iii
ACKNOWLEDGEMENT	iv
INTRODUCTION	v
Chapter 1	
INTRODUCTION TO FERROMAGNETIC MATERIAL	1
2	
CHARACTERISTIC OF MAGNETIC MATERIAL	8
The magneto motive force	8
The reluctance	8
The magnetic flux	9
The magnetic flux density	9
The magnetic intensity	9
The B - H curve	10
Table of magnetic materials properties	13
3	
LOSSES IN MAGNETIC CORE	14
Hysteresis loss	14
Eddy current loss	19
The total core loss	20
4	
The apparatus and its principle	22
The measuring principle	25
Connection of the circuit	26



	Page
Rules of iron testing	28
Design and construction	28
5	
DATA AND RESULTS	31
PROCEDURE	32
Sample of calculation	34
Data of the experiments	36
The hysteresis loop of the tested sample	66
Discussion and conclusions	67
BIBLIOGRAPHY	68
Graphs Fig. 1 to 7	69-75