Design, Implementation and Study of Electrical Machine Laboratory Experiments

Rahul Pukale[1], Rohit Patil[2], Akshay Rote[3], Suhas Patil[4], Snehal Dandage[5], Yogita Koli[6]

Assistant Professor, Electrical Engineering Dept, AMGOI, Maharashtra, India[1]

Student, Electrical Engineering Dept, AMGOI, Maharashtra, India[2, 3, 4, 5 6]

Abstract: This paper describes design and complement of control panels for new tentative in electrical machines laboratory and results of simulation of sumpner's and retardation test experiments. Performing the experiments on motors, transformers, alternator and measuring instruments used which are available in electrical machines laboratory. The intent is to provide students new experiments on electrical machines as well as to civilize understanding of the theory learned from lectures with hands-on-experience.

Keywords: Compliment, Tentative, Intent, Civilize.

I. INTRODUCTION

In the electrical machines laboratory of college, many experiments being conducted on AC machines and DC machines. Going to design and implement panel boards to conduct the experiments of Sumpner's test on two identical transformers to find out efficiency of both the transformers. Also both iron and copper loss can be found. There is no need to perform separate test to find iron loss and copper loss. Second is the retardation test on dc motor to find out rotational losses of the DC motor. In this test moment of inertia of motor can be found. This help to work practically on the machines and help to improve the practical knowledge of the students.

II. BRIEF OVERVIEW

1. Design and implementation of panel board for "SUMPNER'S TEST on Transformer"

Without conducting any actual loading test is the Sumpner's test which can only be conducted simultaneously on two identical transformers. In conducting the Sumpner's test the primaries of the two transformers are connected in parallel across the rated voltage supply(V1), while the two secondary's are connected in phase opposition. As per the superposition theorem, if V2 source is assumed shorted, the two transformers appear in open circuit to source V1 as their secondary's are in phase opposition and therefore no current can flow in them. The current drawn from source V1 is thus $2I_0$ (twice the no-load current of each transformer) and power is 2P0 (= 2Pi , twice the core loss of each transformer). When V1 is regarded as shorted, the transformers are series-connected across V2 and are short-circuited on the side of primaries. Therefore, the impedance seen at V2 is 2Z and whenV2 is adjusted to circulate full-load current (Ifl), the power fed in is 2Pc (twice the full-load copper-loss of each transformer). Thus in the Sumner's test while the transformers are not supplying any load, full iron-loss occurs in their core and full copper-loss occurs in their windings; net power input to the transformers being (2Po+2Pc).The heat run test could , therefore, be conducted on the two transformers, while only losses are supplied
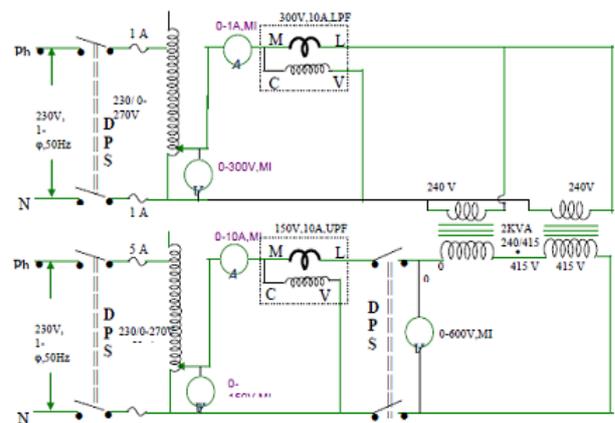
Fig1.1- Laboratory arrangement for sumpners test

1[A] Design and implementation:

Fig1.2 - Implementation Diagram for Sumpner's test

Table no.1.1: system specifications for sumpner's test

Sr. No.	Equipment Name	Specification	Quantities
1	DC compound motor	230 V, 11 A, 1500 rpm	1
2	DC voltmeter	0-250 V	1
3	DC voltmeter	0-100 V	2
4	DC ammeter	0-10 A	1
7	Rheostat	1000 Ω, 5 A	1
6	Rheostat	100 Ω, 5 A	1

1[B] Comparison of experimental and simulation results:

Readings for primary voltage of 240 V-

Table no.1.2: Experimental Results

Sr. No	Experimental result
1	W1 = 55 watt
2	W2 = 170 watt

Where,   w1 = Iron Losses

W2 = Copper Losses

% Efficiency = (output/ output+W1+W2) $\times$ 100

$$= \frac{2 \times 10^2 \times 0.8}{2 \times 10^2 \times 0.8 + 55 + 170}$$

$$= 87.67\%$$

Table no.1.3: Simulation Results

Sr.No	Simulation result
1	W1= 60 watt
2	W2= 150 watt

% Efficiency = 88%

2. Design and implementation of panel board for "RETARDATION TEST on DC Shunt Motor"

This test used to find out stray losses of shunt wound dc machines.Another name for this test is 'running down' test.In this method of testing, firstly motor is speeded up slightly above its rated speed and supply is cut off.Then starting the stop watch till the speed come to below the rated speed. Speed time curve is drawn for various values of speed to obtain rate of change of speed.Secondly, by attatching flywheel of known moment of inertia to motor taking the reading for various values of speed to draw the speed time curve to obtain rate of change of speed.Then by calculating moment of inertia of motor rotational losses can be found.
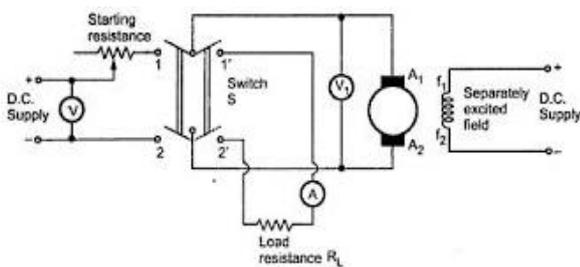
Fig2.1- Laboratory arrangement for retardation test

Table no.2.1: System specification of retardation test

Sr. No.	Equipment Name	Specification	Quantities
1	DC compound motor	230 V, 11 A, 1500 rpm	1
2	DC voltmeter	0-250 V	1
3	DC voltmeter	0-100 V	2
4	DC ammeter	0-10 A	1
7	Rheostat	1000 Ω, 5 A	1
6	Rheostat	100 Ω, 5 A	1

2[A] Design and implementation:
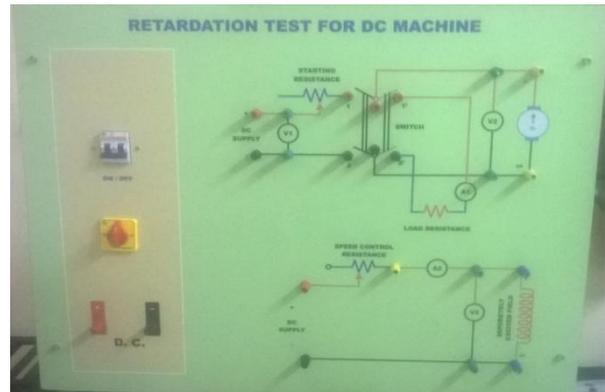
Fig2.2- Implementation of retardation test

Table no.2.2: Experimental Result

Sr. no	Without flywheel		With flywheel	
	Speed (RPM)	Time (Sec)	Speed (RPM)	Time (Sec)
1	1300	5	1300	6
2	1000	7	1000	8
3	700	12	700	13
4	500	17	500	19

Rotational loss (PS) = $(\frac{2\pi}{60})^2 \times J \times N \times \frac{dN}{dt}$

= 4062 watt

Table no.2.3: Simulation Result

Sr. no	Without flywheel		With flywheel	
	Speed (rpm)	time (Sec)	Speed (rpm)	time (Sec)
1	1300	7	1300	9
2	1000	10	1000	12
3	700	13	700	15
4	500	20	500	22

Rotational loss (PS) = 4605 watt

III. CONCLUSION

Practical system for calculating efficiency of two identical transformers and rotational losses of DC compound motor is presented. The goal is to design and implementation of control panels of sumpner's test and retardation test is to work practically on the machines and to improve the practical knowledge of the students.

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