INDEX NO. : M-235

RAJAT

TECHNICAL MANUAL
FOR

SEPARATION OF IRON LOSSES IN THREE PHASE TRANSFORMER

Manufactured by :

PREMIER TRADING CORPORATION
(An ISO 9001:2000 Certified Company)
212/1, Mansarover
Civil Lines, MEERUT.
Phone : 0121-2645457, 2654068

SEPARATION OF IRON LOSSES IN 3-PHASE TRANSFORMER

AIM

To separate the iron losses occurring in a three-phase transformer into its components.

INSTRUMENTS REQUIRED

(i) Three Phase Synchronous Generator, coupled with DC Shunt Motor alongwith panel fitted with required instruments including Digital Frequency meter, to obtain variable voltage and variable frequency.

(ii)	Three Phase Transformer Delta/Star	-	1 No
(iii)	LPF Wattmeters	-	2 Nos
(iv)	Rheostat 1.4 A, 260 Ohms	-	1 No.
(v)	Rheostat 5 A, 45 Ohms	-	1 No.

THEORY

When a transformer is operated at no load, power drawn from the supply is equal to the no load losses, which are equal to the sum of constant losses (iron losses) and copper losses in the primary winding. The no load current of the transformer is quite small (of the order of 5 percent of full load current) and the resistance of the primary winding is also low, as such copper losses in the primary winding under this condition is negligible. Hence, the power drawn from the supply under no load condition can be approximately taken as the total iron losses.

Iron losses = Hysteresis loss + Eddy current loss

Hysteresis loss $\propto B^n f \propto f$, with flux density being kept constant

$= K_1 f$

Eddy current loss $\propto B^2 f^2 \propto f^2$ with flux density being kept constant.

$$= K_2 f^2$$

Where, K1 and K2 are constant for a particular transformer.

Also applied voltage $V \gg E1 = 4.44 f B A_i T_{ph}$

$$\text{or } V/f = 4.44 B A_i T_{ph}$$

Thus to maintain flux density constant during the experiment, it is essential to keep v/f constant fro all variation of frequency.

Hence total iron losses $W = k_1 f + k_2 f^2$

$$\text{Or } W/f = k_1 + k_2 f$$

Thus the plot W/f Vs f will be a straight line as shown in Fig '1' from which the Constant K1 and K2 can be found out. Knowing the constant K1 and K2 hysteresis loss and eddy current loss at rated frequency of 50 Hz can be calculated.

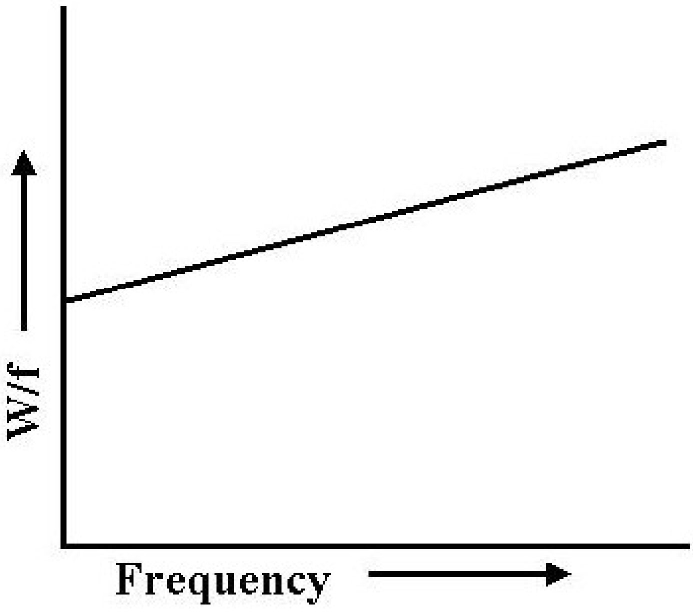


Fig - '1' : Curve of W/f Vs frequency

CIRCUIT DIAGRAM

In this experiment the transformer is to be operated at no load and supplied from a three phase variable voltage variable frequency source with a constraint that V/f is maintained constant during the experiment. Three phase variable voltage, variable frequency supply can be obtained from an alternator coupled with D C shunt motor. Frequency can be varied by varying the speed of the DC motor, with the help of a rheostat included in the field circuit of the DC motor. Phase voltage of the alternator is varied by varying the field current of the alternator with the help of a rheostat included in the field circuit of the alternator. When frequency and voltage are varied, it should be kept in mind that V/f is maintained constant through out the experiment. An ammeter has been included in the circuit of the primary winding to have an idea of the no load current of the transformer. Wattmeters have been included in the circuit to measure the power drawn by the transformer under no load operation. Voltmeter has been connected across the primary winding to indicate the voltage applied, so that v/f constant could be verified during each reading of the experiment. Frequency meter has been connected in the circuit diagram to indicate the frequency of the generated emf. Based on this discussion the circuit diagram has been drawn and is shown as per attached sheet.

PROCEDURE

1. Connect the circuit as per fig in attached sheet.
2. Adjust the position of the rheostat in the field circuit of DC motor, so that the external resistance in this circuit is zero at the instant of starting the DC Motor.
3. Adjust the position of the rheostat in the alternator field circuit, such that the resistance included is maximum, so that the field current will be minimum and as such the generated emf is lesser at the instant of starting.

4. Switch ON the DC motor and the alternator field. Start the DC Motor using the starter properly.

5. Adjust the speed of the motor corresponding to a frequency of 60 Hz, by varying the resistance in the field circuit of DC motor.

6. Adjust the proper value of the generated emf of the alternator i.e. 400V (L-L).

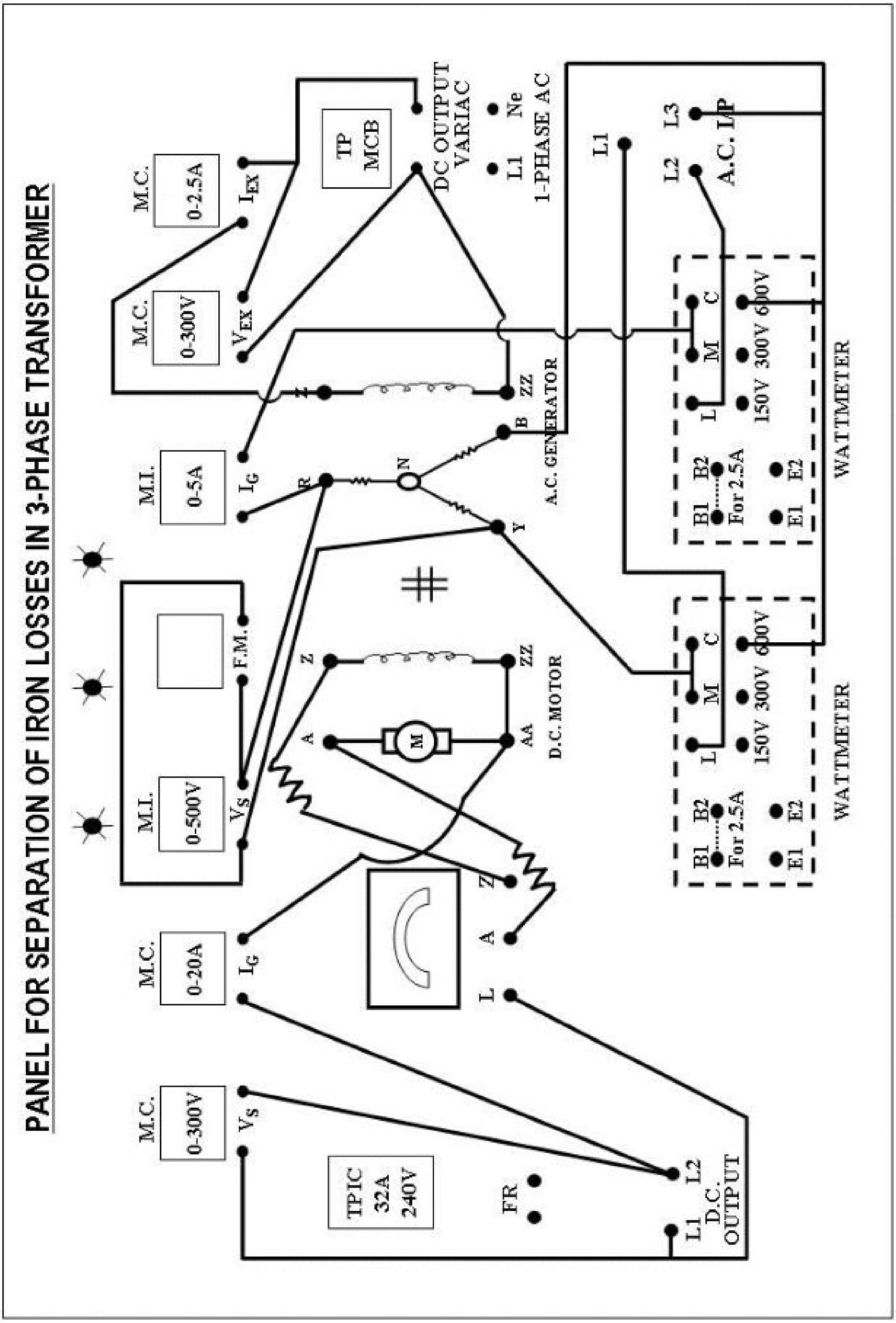
7. Note down the reading of all the meters connected in the circuit.

8. Repeat step No 5, 6 and 7 for variable frequency upto 30 Hz maintaining the voltage/frequency ratio fixed at 8 Volt/Hz.

9. Switch OFF the DC supply connected to DC Motor and the field circuit of alternator.

OBSERVATIONS : May be tabulated as follows.

S. No.	Frequency	Applied Voltage	V/f	No-Load Current	Wattmeter readings		No-Load Power	W/f
					W1	W2	(W1 + W2)	


PANEL FOR SEPARATION OF IRON LOSSES IN 3-PHASE TRANSFORMER
M.C. 0-2.5A
I_{EX}
M.C. 0-300V
V_{EX}
TP MCB
DC OUTPUT VARIAC
L1 Ne
1-PHASE AC
L1
L2 L3
A.C. I/P
M.I. 0-5A
I_G
Z
ZZ
R
N
B
Y
A.C. GENERATOR
L M C
150V 300V 600V
B1 B2
For 2.5A
E1 E2
WATTMETER
F.M.
M.I. 0-500V
V_S
Z
ZZ
A
M
AA
D.C. MOTOR
WATTMETER
M.C. 0-20A
I_G
Z
A
L
M.C. 0-300V
V_S
TPIC 32A 240V
FR
L1 L2
D.C. OUTPUT