OPERATING INSTRUCTIONS FOR APPARATUS TO DETERMINE FERROMAGNETIC CONSTANTS: RETENTIVITY, PERMEABILITY AND SUSCEPTIBILITY BY TRACING B-H CURVE

OBJECT :

To determine the ferromagnetic constants: retentivity, permeability and susceptibility by tracing B-H curve.

APPARATUS : -

The apparatus consists of electronic training board New Tech Type NTI – 226. It consists of a solenoid having primary and secondary coils, specimen in the form of several thin wires of iron grouped to form a rod. The training board consists of one AC milliammeter and one AC voltmeter. In addition of the apparatus one CRO is required to perform the experiment.

THEORY AND FORMULA : -

The specimen is put inside the solenoid and is subjected to a varying magnetic field H. In this experiment magnetic field H is produced by passing a.c current in the solenoid is given by –

$$H = \frac{4\pi n\sqrt{2}\ I_{rms}}{10}\ \text{Coswt} \quad \text{——} \quad (1)$$

Where I_{rms} is the current in ampere measured by the ammeter and n is the number of turns per cm in the primary coil of the solenoid. The potential difference developed across Rh_1 is fed to xx plates of CRO and consequently, x defection will be proportional to H.
Its maximum value is:

$$H_{max} = \frac{4\pi n\sqrt{2}\ I_{rms}}{10}$$

Trace lenth L_x corresponds to 2 H_{max} (Fig. 2)

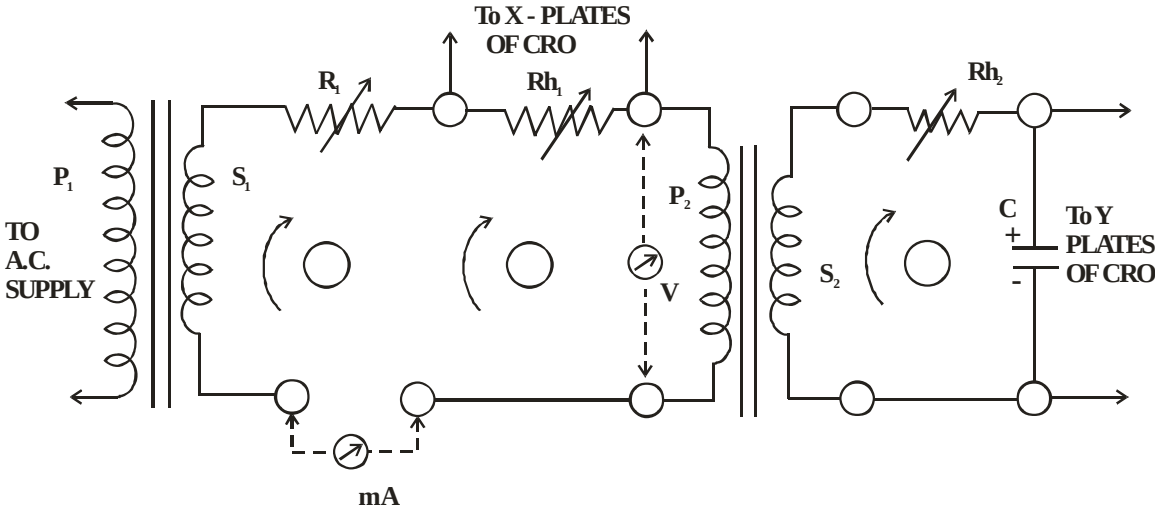

Fig (1) Circuit Diagram for obtaining B-H curve on CRO screen

Hence calibration constant for H axis is:

$$C_x = \frac{2H_{max}}{L_x} \quad \text{..... (1)}$$

$$\text{Where } H_{max} = \frac{4\pi n\sqrt{2}\ I_{rms}}{10} \quad \text{Oersted ..... (2)}$$

Calibration constant for B axis is:

$$C_y = \frac{2H_{max}.F}{L_y} \text{ Gauss / cm. ..... (3)}$$

$\because 2(\Phi_{air})_{max} = 2H_{max}\ S$

Where S is area of Cross section of primary coil and F is amplification factor of y amplifier

$$\text{and} \quad B = \frac{\Phi_{max}}{S}$$

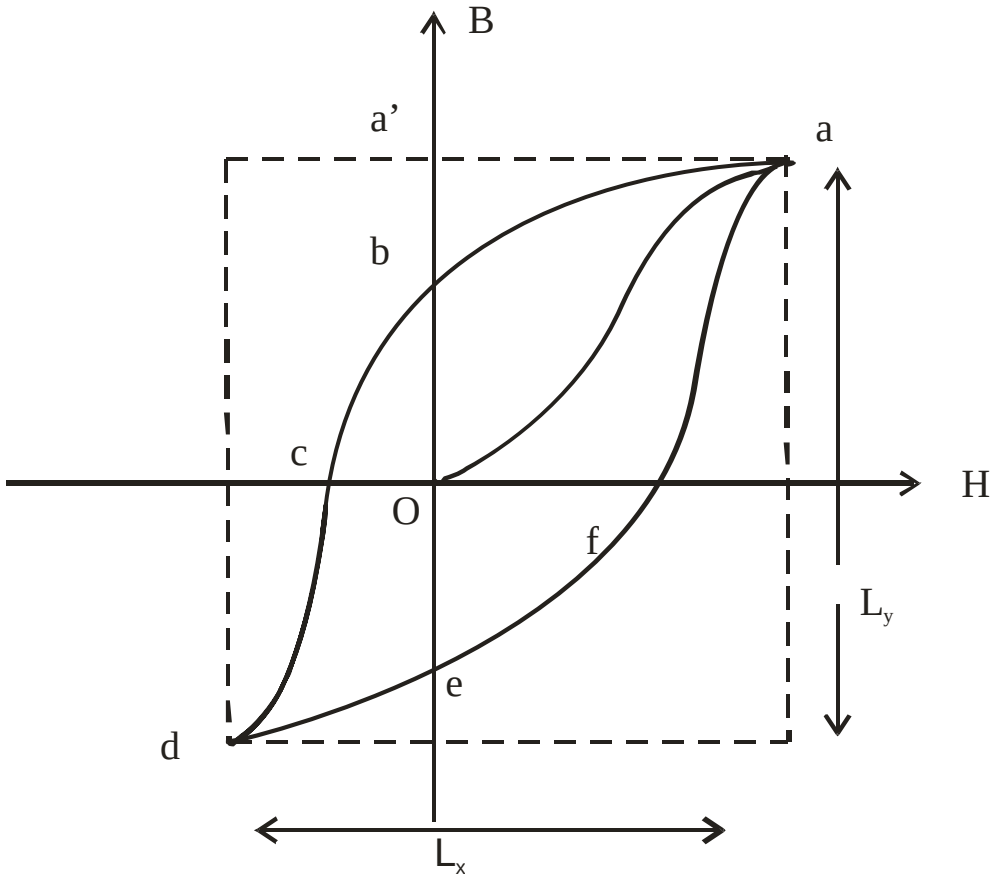

Fig.(2) B-H Curve tracing taken on tracing paper

Retentivity corresponding to Y

If Ob = …….. Cm on the trace

∴ Retentivity = Ob x C_y = ……. Gauss …… (4)

Saturation corresponding to Y

If Oa' = -------- as on the trace

∴ B_{max} = Oa' x C_y ……. (5)

Coercivity if OC = …….. Cm on the trace

∴ Coercivity = OC x C_x …… (6)

Hystersis loss per cycle per unit Volume = $(1/4\pi)$ (Area of B-H curve)

= $(1/4\pi)$ (Area of B-H curve on the trace) $C_x \cdot C_y$

= $(1/4\pi) \cdot A \cdot C_x \cdot C_y$ ……. (7)

= ……. Ergs per cycle per cm^3

Permeability $\mu = B/H$ or B_{max} / H_{max} …… (8)

= ……..

Susceptibility:

$\because \mu = 1 + 4\pi X_m$

$\therefore X_m = (\mu - 1) / 4\pi$ …… (9)

= ……

PROCEDURE:

1. Make connections as shown in Fig. (1).
2. By adjusting Rh_1, Rh_2 and amplifiers of CRO obtain a B-H loop of suitable size on the screen of CRO.
3. By varying Rh_1, values of v and I can be changed.
4. Take a trace of B-H curve on tracing paper.

OBSERVATIONS: **n = 3000 turns / Cm.**

Sr. No.	Current I Amp	Pot. Diff. V Volt	Area of loop Cm^2

1. 2. 3. 4. 5.			

CALCULATIONS:

From the trace of BH loop on tracing paper measure different lengths i.e. Ob, Oa', OC etc. and calculate the values of Retentivity, Saturation, Coerceivity, Permeability, Susceptibility and hystersis loss using the appropriate formula mentioned in theory.

RESULT : - The magnetic constants for iron are :

1. Retentivity = ……. Gauss
2. Coercivity = …… Oersted
3. Hystersis loss per cycle per unit vol = ……. ergs / cycle / Cm^3
4. Permeability = ……
5. Susceptibility = ……

SOURCES OF ERRORS AND PRECAUTIONS:

1. The current in the primary of solenoid should be quite large so as to magnetise the specimen sufficiently.
2. Handle CRO carefully.
3. Trace of BH curve should be taken as tracing paper and it should of suitable size.

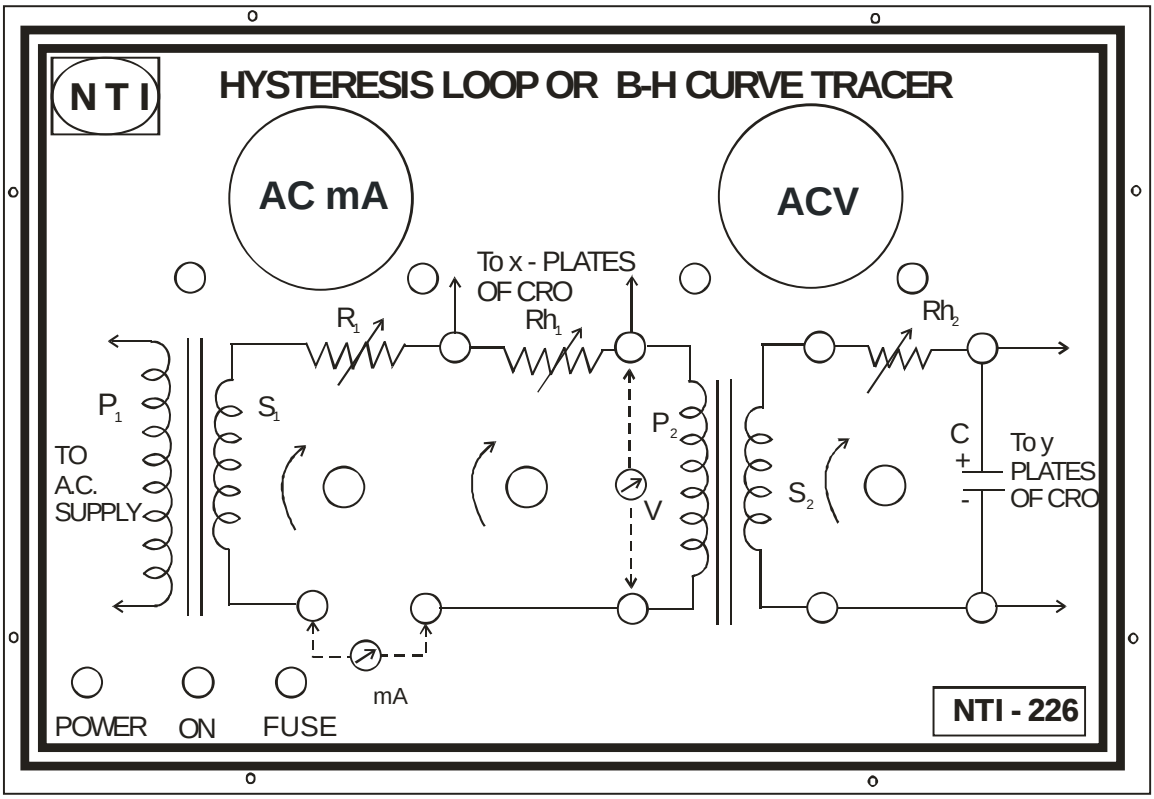

Fig. (3) Panel Diagram

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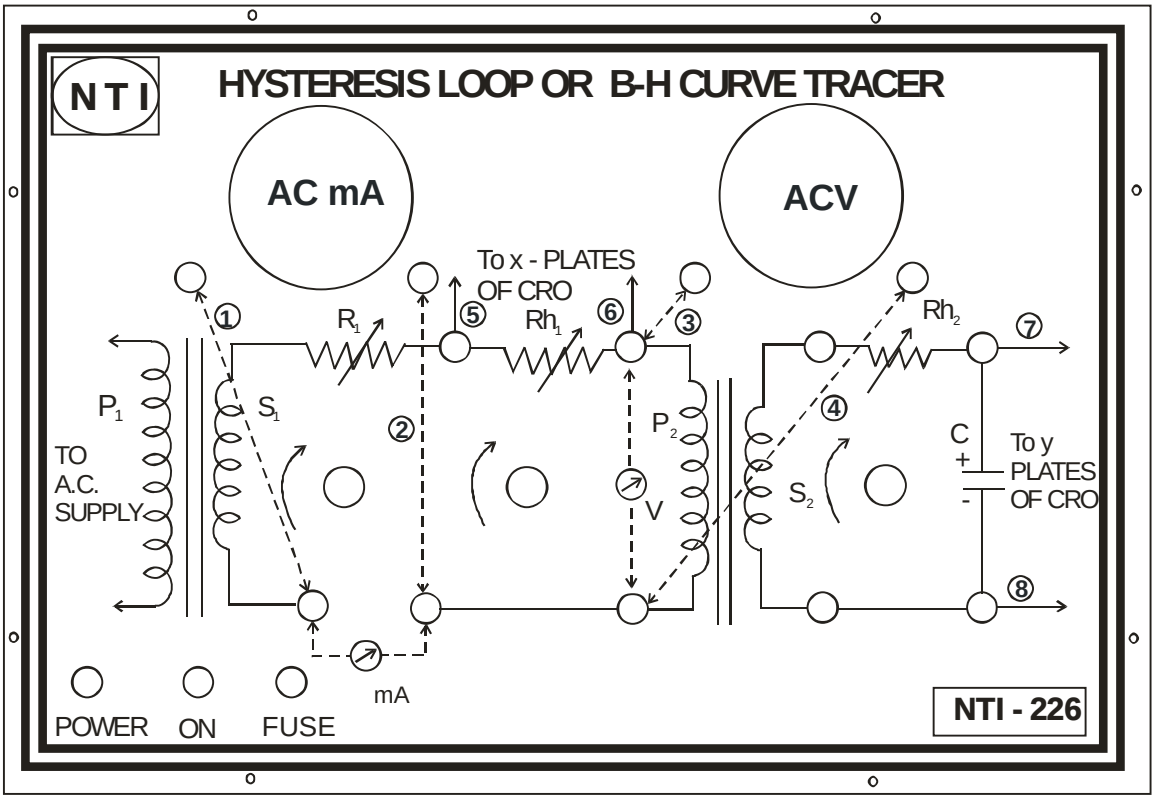

Fig.(4) Connections for Hysteresis Loop or B-H Curve Tracer

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