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MEASUREMENT AND MEASURING INSTRUMENTS LAB

PROJECT ON : HAYS BRIDGE

A SESSIONAL REPORT SUBMITTED TO

NATIONAL INSTITUTE OF TECHNOLOGY

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PROJECT ON HAYS BRIDGE

Aim: Measurement of inductance by Hay's bridge

Apparatus Used:

Sl no	Name of the item	Specification	Quantity
1)	Dot board	-	1
2)	Resistors	100 ohm	1
3)	Inductor	-	1
4)	potentiometer	1kohm	2
5)	wires		As required
6)	capacitor	33 microfarad	1

Theory:

The Hay's Bridge differs from Maxwell's bridge by having resistor R1 in series with standard capacitor C1 instead of in parallel. It is immediately apparent that for large phase angles, R1 should have a very low value. The Hay's circuit is therefore more convenient for measuring high Q coils. The balance equations are again derived by substituting the values of the impedance of the bridge arms into the general equation for bridge balance. On separating real and imaginary terms, the balance equations are:

Let,

L1 – unknown inductance having a resistance R1

R2, R3, R4 – known non-inductive resistance.

C4 – standard capacitor

At balance condition,

$$(R_1 + j\omega L_1)(R_4 - j/\omega C_4) = R_2 R_3$$

$$R_1 R_4 + \frac{L_1}{C_4} + j\omega L_1 R_4 - \frac{jR_1}{\omega C_4} = R_2 R_3$$

Separating the real and imaginary term, we obtain

$$R_1 R_4 + \frac{L_1}{C_4} = R_2 R_3 \quad and\ L_1 = \frac{-\ R_1}{\omega^2 R_4 C_4}$$

Solving the above equation, we have

$$L_1 = \frac{R_2 R_3 C_4}{1 + \omega^2 R_4^2 C_4^2}$$

$$R_1 = \frac{\omega^2 C_4^2 R_2 R_3 R_4}{1 + \omega^2 R_4^2 C_4^2}$$

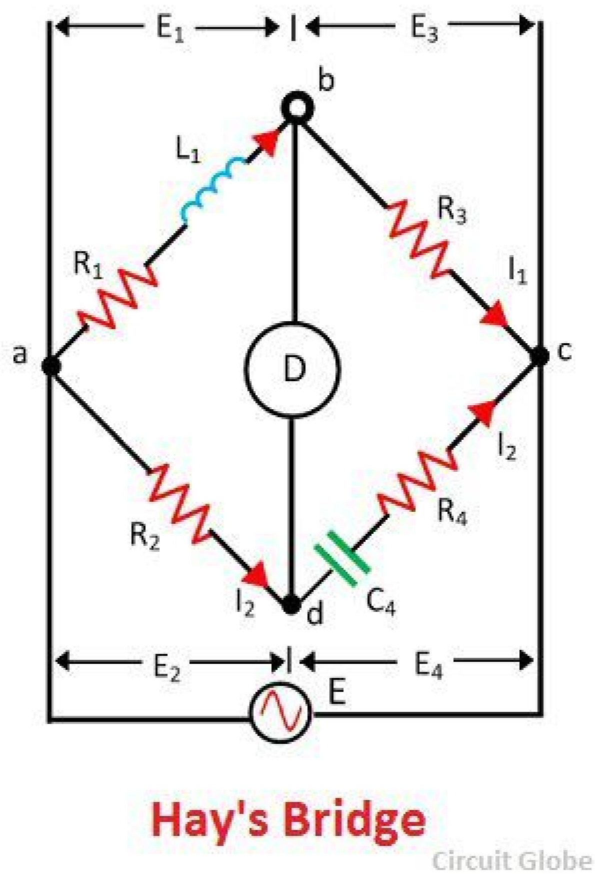
The quality factor of the coil is

$$Q = \frac{\omega L_1}{R_1} = \frac{1}{\omega^2 C_4 R_4}$$

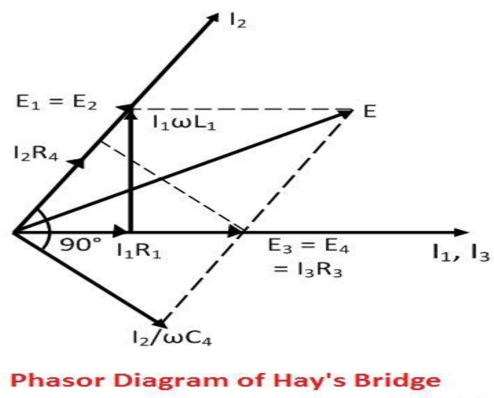
Substituting the value of Q in the equation of unknown inductance, we get

$$L_1 = \frac{R_2 R_3 C_4}{1 + (1/Q)^2}$$

Circuit Diagram:



Phasor diagram:



Procedure:

1. **Switch ON the trainer & check the power supply**
2. **Connect the unknown value of inductance (high Q) in arm marked Lx**
3. **Vary R2 for fine balance adjustment**
4. **. The balance of bridge can be observed by using head phone. Connect the output of the bridge at the input of the detector**
5. **Connect the : headphone at output of the detector, alternately adjust R1 and proper selection of R3 for a minimum sound in the head phone.**
6. **Finally disconnect the circuit and measure the value of R1 at balance point using any multimeter. By substituting R1, R3 and C1 the unknown inductance can be obtained.**

Calculation:

$\omega = 2\pi f$

$\omega = 314.2\, rad/s$

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R2=100 ohm , R3 =3.3 ohm, R4=870.76 ohm,c=33 microfarad

$$R_1 = \frac{\omega^2 C^2 R_4 R_2 R_3}{1 + \omega^2 R_4^2 C^2}$$

R1=_314*314*33*10^-12*100*3.03*870.76 /

1+314*314*870.76^2*33*33*10^-2

R1= 28.3 ohm

L1=R2R3R4

=100*3.03*870.76

=10 mh

Conclusion:

Hence the value of resistance is 28.3 ohm

The value of inductance is 10mh

Hence we determine the values using hays bridge.

–The end–