11.HAY'S BRIDGE

Objective:

To measure the unknown inductance value of high Q inductor.

Apparatus:

Name of the apparatus	Quantity
1. Lab trainer kit	01
2. Multimeter	01
3. Unknown inductor	01

Theory:

The Hay's Bridge differs from Maxwell's bridge by having resistor R_1 in series with standard capacitor C_1 instead of in parallel. It is immediately apparent that for large phase angles, R_1 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:

$$R_1R_x+L_x/C_1 = R_2R_3 \quad \text{------------} \ (1)$$

$$R_x/\omega C_1 = \omega L_x R_1 \quad \text{---------------} \ (2)$$

Both equations 1 & 2 consist of L & R. By solving the above equations

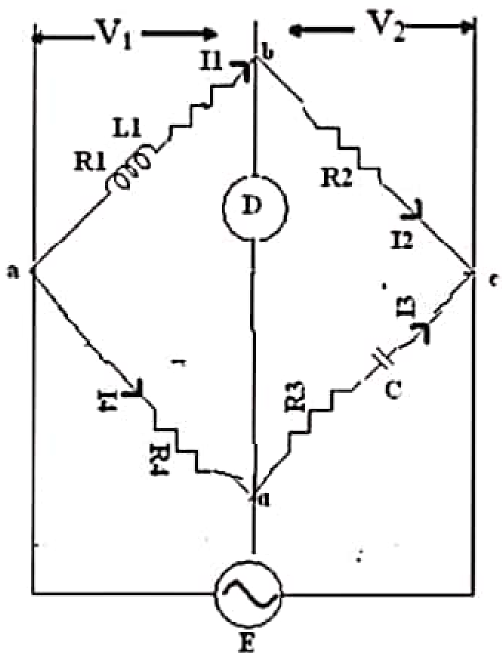
$$R_x = \frac{\omega^2 C_1^2 R_1 R_2 R_3}{1+\omega^2 C_1^2 R_1^2} \quad \text{---------------} \ (3)$$

$$L_x = \frac{R_2 R_3 C_1}{1+\omega^2 C_1^2 R_1^2} \quad \text{---------------} \ (4)$$

The expressions for the unknown inductance & resistance are consists of frequency term under balanced condition when two phase angles are equal, their tangents are also equal. Hence,

$$\tan\theta_L = \tan\theta_C \ (\text{or}) \ Q = \frac{1}{\omega C_1 R_1} \quad \text{-------} \ (5)$$

Substituting (5) in (4)

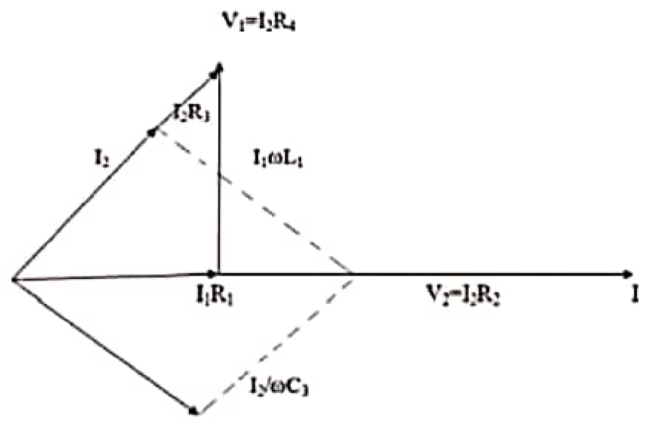


So, $L_x = \frac{R_2 R_3 C_1}{1+(\frac{1}{Q})^2}$, but for high values of Q (i.e.) Q > 10 the term $(\frac{1}{Q})^2$ is negligible.

So, $L_x = R_2R_3C_1$

The Hay's bridge is suited for the measurement of high-Q inductors, especially for those inductors having a Q greater than ten. For Q-values smaller than ten the term $(\frac{1}{Q})^2$ becomes important & cannot be neglected. In this case, Maxwell's bridge is more suitable.

Phasor Diagram :



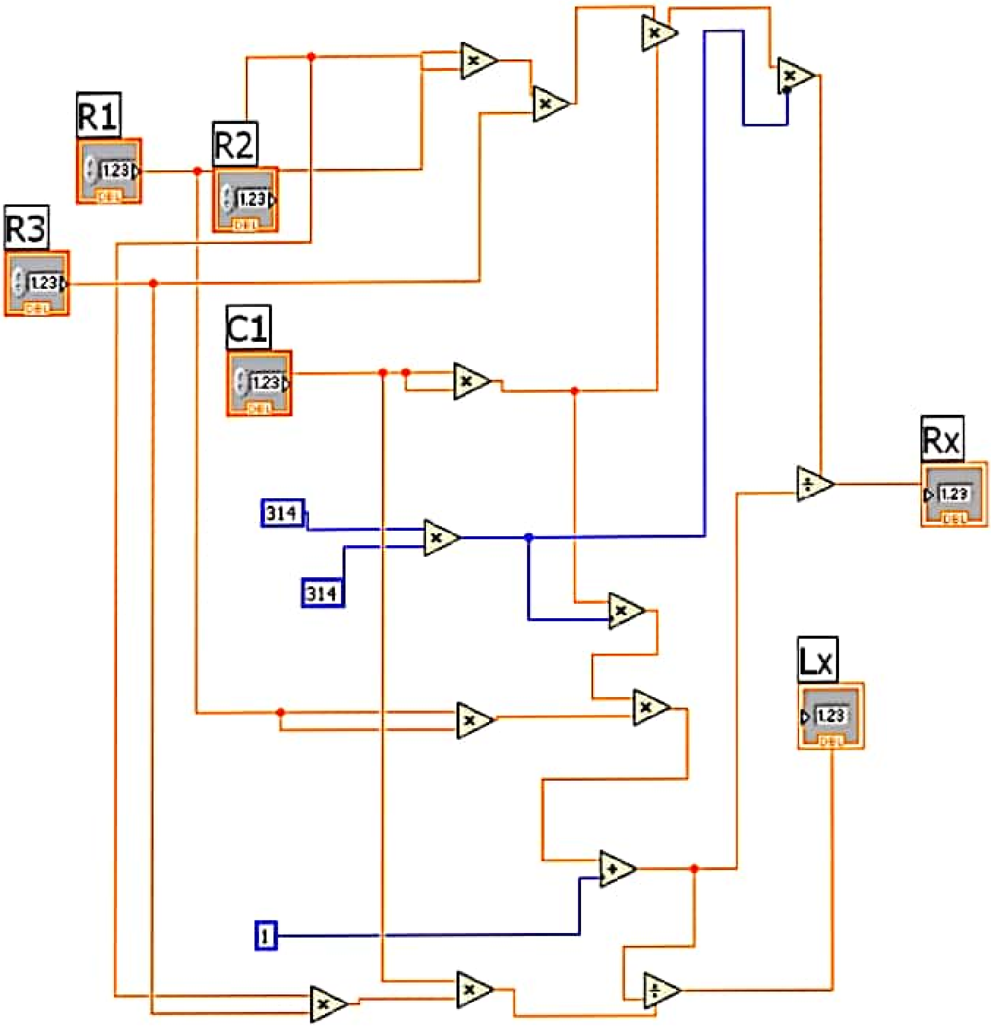
Procedure:

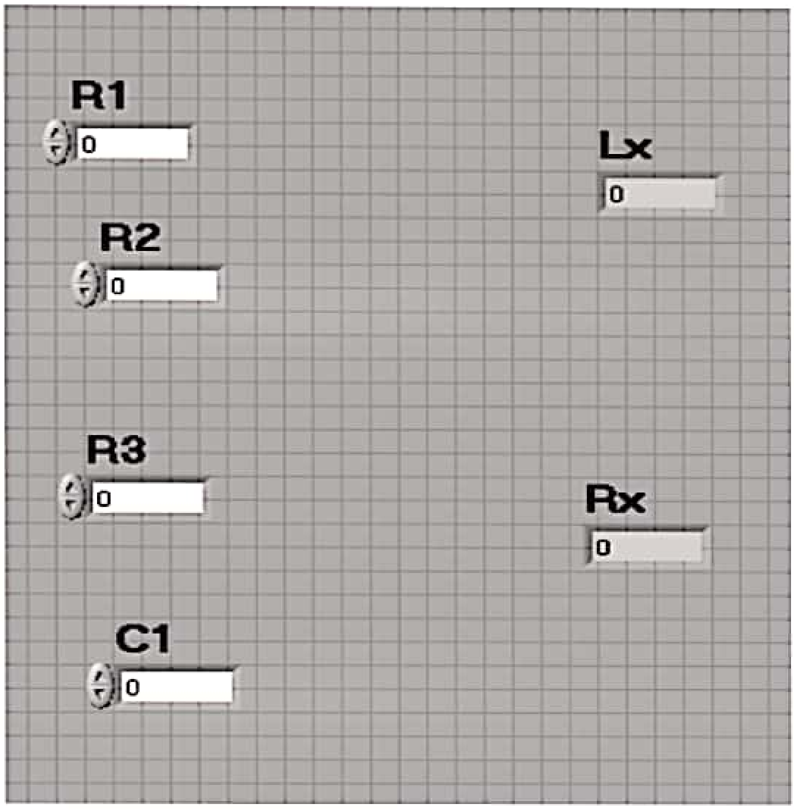
1. Switch ON the trainer & check the power supply.
2. Connect the unknown value of inductance (high Q) in arm marked Lx.
3. Vary R2 for fine balance adjustment.
4. The balance of bridge can be observed by using head phone. Connect the output of the bridge at the input of the detector.
5. Connect the head phone 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 R_1, R_3 and C_1 the unknown inductance can be obtained.

Observations:

S.No.	R_2 (KΩ)	R_3 (Ω)	C_1 (μF)	L_x (mH)	L mH

HAY'S BRIDGE





Result:

After balancing the bridge, the values of R_1 R_3 and C_1 are measured and found that the calculated value of L_x is almost equal to the actual value.