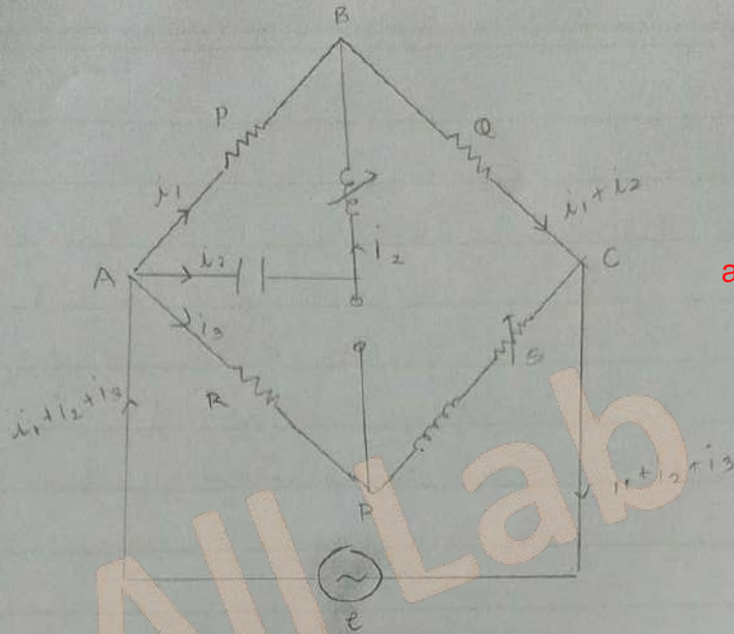

Observations:

DC balance:

S.NO.		S(Ω)	P(Ω)	Q(Ω)	R(Ω)	
					L_1	L_2
1.	$C_1 = 0.1 \mu F$	0.1	1000	1000	40	69
2.	$C_2 = 0.2 \mu F$	0.1	1000	1000	44	70

AC Balance:

	$C = 0.1 \mu F$		$C = 0.2 \mu F$	
	R	M	R	M
For L_1	40	5600	44	2300
For L_2	69	6500	70	3100
For L_3	105	6540	105	3000

Aim: To determine the self inductance L of the given coil by Anderson's bridge.

Apparatus:

Anderson's bridge, headphones & connecting wires.

Theory:

In the diagram, C is a fixed standard capacitor. P, Q, R, S and r are resistances. e is an audio oscillator and H is a headphone.

The condition for balance is that the potential at D & E are the same. Under this condition, no current flows through the path DE.

The potential drop along ABC = potential drop along ADC. Hence, from the figure, $i_1 P + (i_1 + i_2) Q = i_3 (R + j\omega L + S')$ — (1)

Here, $S' = S + R_L$ where R_L is the resistance of the coil.

For the mesh ABEA:

$$i_1 P - i_2 \left(r + \frac{1}{j\omega C}\right) = 0 \quad \text{— (2)}$$

The potential difference from A to E is equal to that from A to P as no current flows through the headphone for the balance

Thus, $\frac{i_2}{j\omega C} = i_3 R$ — (3)

Substituting i_3 from (3) into (1),

$$i_1 (P + Q) = \frac{1}{j\omega CR} i_2 [R + S' + j\omega L] - i_2 Q$$

$$i_1 (P + Q) = i_2 \left[\frac{R + S' + j\omega L}{j\omega CR} - Q\right] \quad \text{— (4)}$$

calculations:

for L_1:

1) $L_0 = CR(Q + 2r)$

$= 0.1 \times 10^{-6} \times 40 \, [1000 + 2 \times 5600]$

$= 48.8 \, mH$

2) $L = 0.2 \times 10^{-2} \times 44 \, [1000 + 2 \times 2300]$

$= 49.28 \, mH$

mean $L_1 = \frac{L_0 + L}{2} = \frac{48.8 + 49.28}{2} = 49.04 \, mH$

for L_2:

1) $L_0 = 0.1 \times 10^{-6} \times 69 \, [1000 + 2 \times 6500]$

$= 96.6 \, mH$

2) $L = 0.2 \times 10^{-6} \times 70 \, [1000 + 2 \times 3100]$

$= 100.8 \, mH$

mean $L_2 = \frac{96.6 + 100.8}{2} = 98.7 \, mH$

for L_3:

1) $L_0 = 0.1 \times 10^{-6} \times 105 \, (1000 + 2 \times 6540)$

$= 147 \, mH$

2) $L = 0.2 \times 10^{-6} \times 105 \, (1000 + 2 \times 3{,}000)$

$= 147 \, mH$

mean $L_3 = 147 \, mH$

Eliminating i_1 & i_2 with the help of (2) & (4), by equating the imaginary parts:

$$S' = \frac{RQ}{P}$$

This is the condition of DC balance of the bridge.

Equating the real parts, we get

$$L = CR\left(\frac{Pr + Qr + PQ}{P}\right)$$

$$= C\left(Rr + \frac{RQ}{P}r + RQ\right)$$

Substituting,

$$L = C[Rr + S'r + RQ]$$

$$\text{or } L = C[RQ + r(R+S')]$$

The values of C, R, Q, S' and r at the balance condition give us self inductance L of the coil. If the resistances are in Ω & capacitance is in Farads, then L is in Henry.

Precautions & Sources of Error:

1. A fractional resistance box can be used in series with P to get the exact balance point.
2. The capacitance should not have an appreciable leakage & should be of low value of capacity.

Result:

The value of inductance L_1, L_2 & L_3 are 49.04 mH, 98.7 mH & 147 mH