OPERATING INSTRUCTIONS FOR DETERMINATION OF UNKNOWN FREQUENCY USING WIEN'S BRIDGE

OBJECT:

To determine unknown capacitance and frequency using Wien's Bridge.

(Mostly Wien's Bridge is used for determining unknown capacitance)

APPARATUS:

Wien's bridge New Tech Type NTI – 220, Fixed frequency oscillator 1KHz A.C. Source, head phone, one D.C. source and one galvanometer.

THEORY:

Let the values of resistances in four arms one R1, R2, R3, R4 and values of capacitors in BD and CD arms are C2, C. At Balance-

$$\frac{Z_1}{Z_2} = \frac{Z_3}{Z_4} \text{ or } \frac{Z_1}{Z_3} = \frac{Z_2}{Z_4}$$

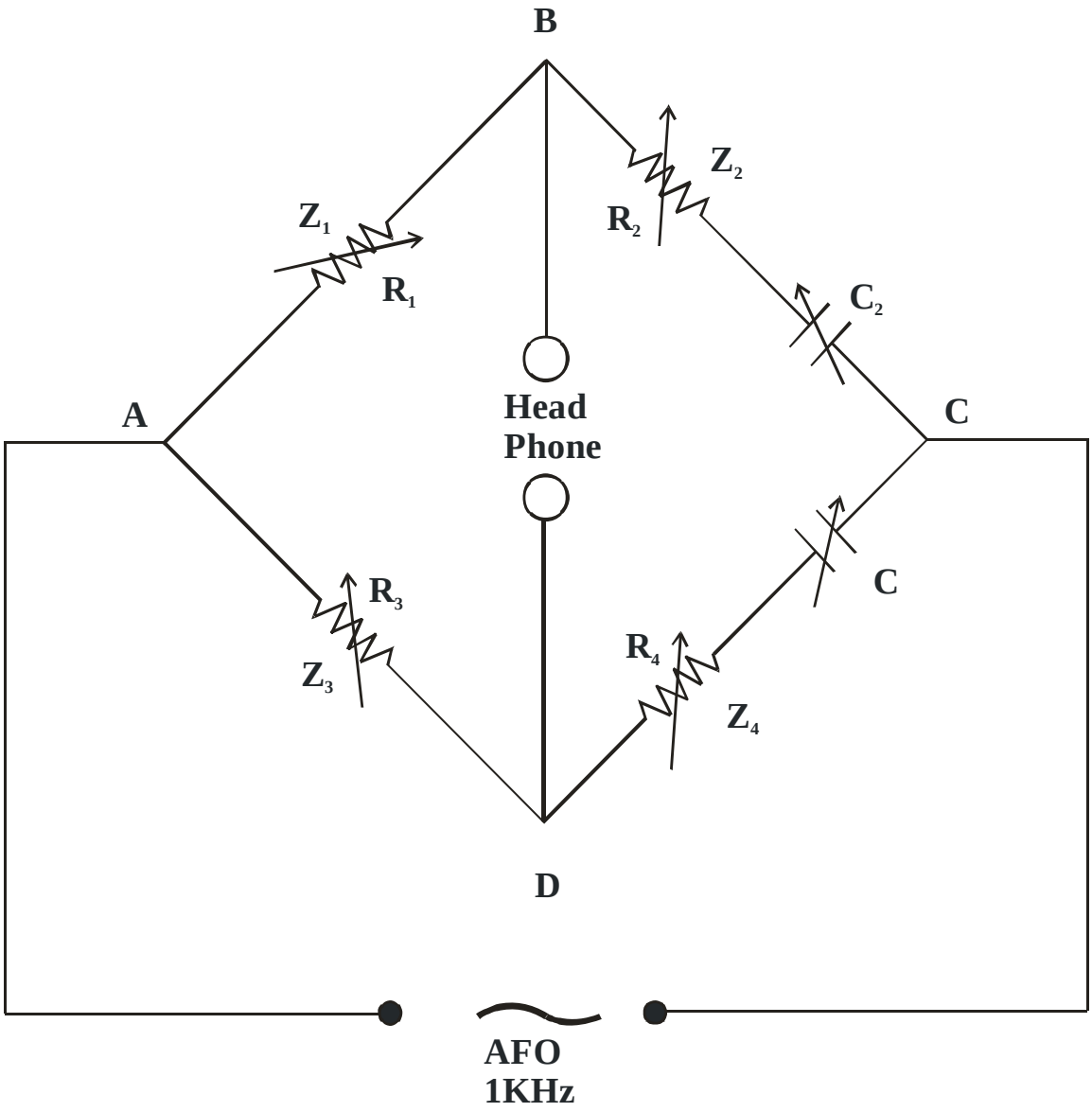

Fig. (1)

$$\text{or} \quad \frac{R_1}{R_3} = \frac{R_2 + \dfrac{1}{j\omega c_2}}{R_4 + \dfrac{1}{j\omega c}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\text{or} \quad \frac{R_1}{R_3} = \frac{\sqrt{R_2^{\,2} + \dfrac{1}{\omega^2 c_2^{\,2}}}}{\sqrt{R_4^{\,2} + \dfrac{1}{\omega^2 c^2}}}$$

$$\text{or} \quad \frac{R_1^2}{R_3^2} = \frac{R_2^2 + \frac{1}{\omega^2 c_2^2}}{R_4^2 + \frac{1}{\omega^2 c^2}}$$

$$\text{or} \quad R_1^2 R_4^2 + \frac{R_1^2}{\omega^2 c^2} = R_2^2 R_3^2 + \frac{R_3^2}{\omega^2 c_2^2}$$

$$\text{or} \quad \frac{1}{\omega^2}\left[\frac{R_1^2}{c^2} - \frac{R_3^2}{c_2^2}\right] = R_2^2 R_3^2 - R_1^2 R_4^2$$

$$\frac{1}{4\pi^2 f^2}\left[\frac{R_1^2 c_2^2 - R_3^2 c^2}{c^2 c_2^2}\right] = R_2^2 R_3^2 - R_1^2 R_4^2$$

$$f^2 = \left(\frac{R_1^2 c_2^2 - R_3^2 c^2}{4\pi^2 c^2 c_2^2 (R_2^2 R_3^2 - R_1^2 - R_4^2)}\right)$$

$$f = \sqrt{\frac{(R_1^2 c_2^2 - R_3^2 c^2)}{4\pi^2 c^2 c_2^2 (R_2^2 R_3^2 - R_1^2 R_4^2)}} \quad \ldots\ldots\ldots\ldots\ldots (2)$$

Using this formula f is calculated.

<u>Determination of unknown value of capacitor:</u>

$$\text{Form (1)} \quad R_1 R_4 + \frac{R_1}{j\omega c} = R_2 R_3 + \frac{R_3}{j\omega c_2}$$

Equating imaginary parts

$$\frac{R_1}{\omega c} = \frac{R_3}{\omega c_2}$$

$$\text{or} \quad c = \frac{R_1}{R_3} c_2 \quad \ldots\ldots\ldots\ldots\ldots (3)$$

Using this formula c is calculated.

PROCEDURE:

1. First the Wheat Stone bridge is balanced with no capacitances in arms using DC Source. Ratio R1/R2 and resistance R3 are kept fixed the resistance R4 is varied. The balance obtained is kept as such.

2. For second balance of wheat stone bridge the capacitances are connected in arms. DC source and galvanometer are replaced by AC source and headphones. For obtaining balance condition R3 is varied until minimum sound is heard in the headphones.

3. Using formula (2) the frequency of AC source is calculated.

   If unknown capacitance is to be determined it is connected in place of C and formula (3) is used.

OBSERVATIONS:

Sr. No.	R_1 Ohm	R_2 Ohm	R_3 Ohm	R_4 Ohm	C μF	C_2 μF
1.						
2.						
3.						
4.						
5.						

CALCULATIONS:

Using formula:-

$$f = \sqrt{\frac{(R_1^2 c_2^2 - R_3^2 c^2)}{4\pi^2 c^2 c_2 (R_2^2 R_3^2 - R_1^2 R_4^2)}}$$

The frequency is calculated for each set & its mean value is calculated.

RESULT:

The frequency of A.C. source determined using Wein's bridge is = —— Hz.

PRECAUTIONS:

1. Connections must be tight.

2. Impedances in four arms of the bridge should be of same order so that the bridge is most sensitive.

3. The surrounding should be peaceful and noise less. Initially the intensity of source should be kept low and at balance point it should be increased.

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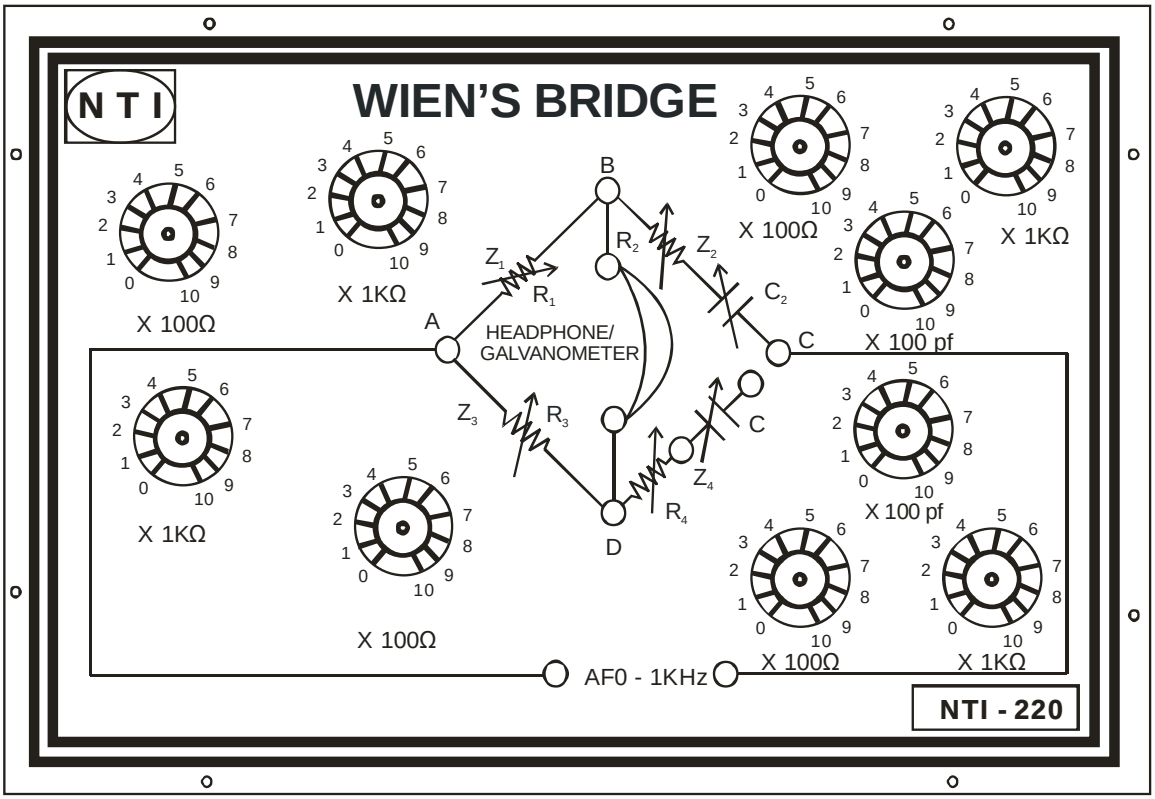

Fig. (2) Panel Diagram

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