AC Bridges

- Supply – Alternating Current Source

  Detector –

  Normal Commercial Frequency - Vibration Galvanometer

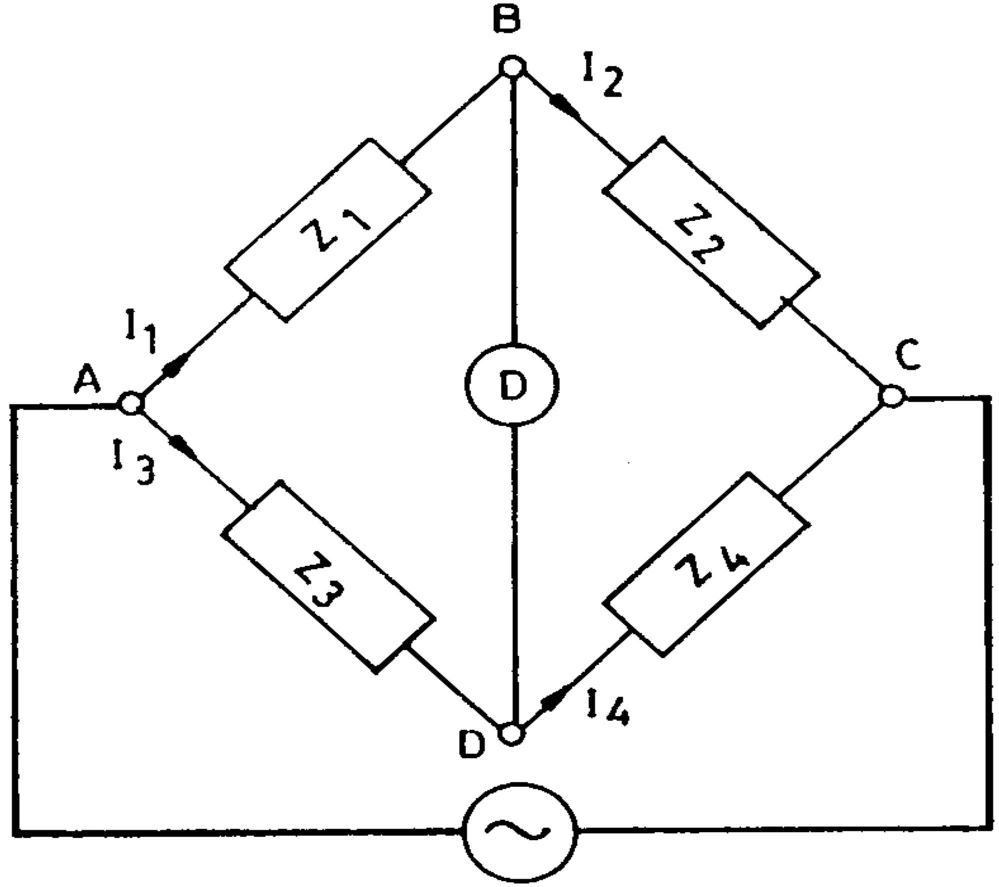
  High Frequency - Headphone

Two Types of AC Bridge –

Ratio Bridge

Product Bridge

Wheatstone bridge



General Four Arm AC Bridge

Ratio Bridge:-

- $Z_1 Z_4 = Z_2 Z_3$

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

- Consider the ratio arms Z_2, Z_4 or Z_3, Z_4
- i.e. $$\frac{Z_2}{Z_4} = (A \pm jB)$$

- Again $Z_1 = Z_3(A \pm jB)$
- $(R_1 \pm jX_1) = (R_3 \pm jX_3)(A \pm jB)$

- **When the ratio arms are real**
- $R_1 = AR_3$ or $R_1 = AR_2$
- $X_1 = AX_3$ or $X_1 = AX_2$

- **When the ratio arms are imaginary**
- $R_1 = -BX_3$ or $R_1 = -BX_2$
- $X_1 = BR_3$ or $X_1 = BR_2$

Product Bridge:-

- $Z_1Z_4 = Z_2Z_3$

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

- Consider the product arm Z_2, Z_3 in form of $(A \pm jB)$

$$(R_1 \pm jX_1) = \frac{A \pm jB}{Z_4} = (A \pm jB)Y_4 = (A \pm jB)(G_4 \pm jB_4)$$

- Admittance $$Y_4 = \left(\frac{1}{R_4} \pm \frac{1}{jX_4}\right) = (G_4 \pm jB_4)$$
- = (Conductance ± j Susceptance)
- **For product arms real**
- $R_1 = AG_4$
- $X_1 = AB_4$

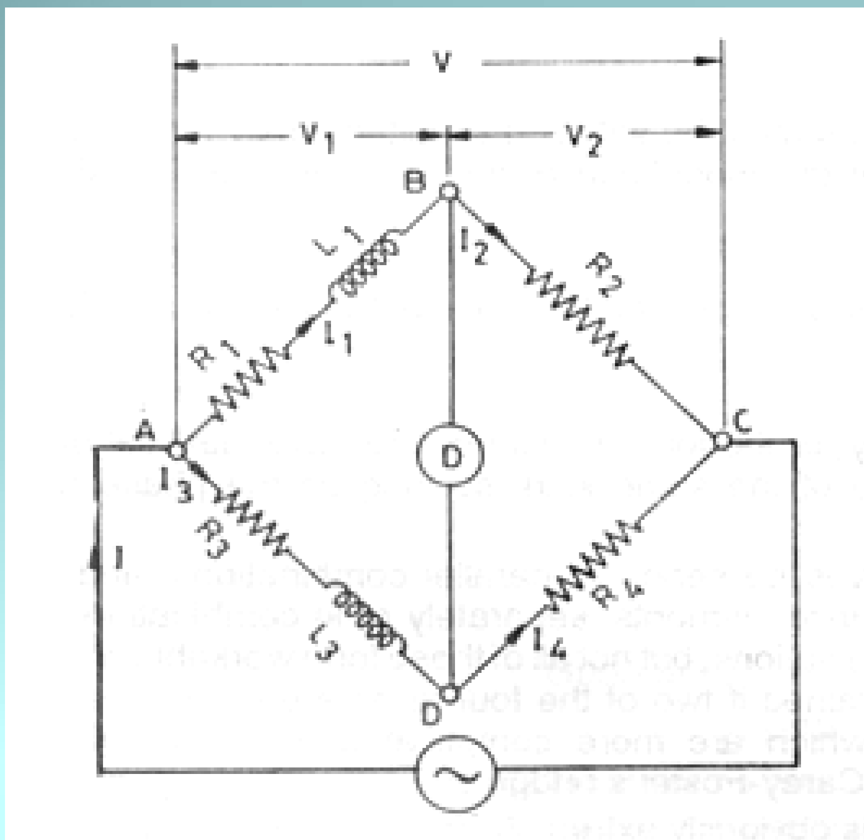
- **For product arms imaginary**
- $R_1 = -BB_4$
- $X_1 = BG_4$

- For Product Bridge Standard arm must be connected in parallel.

- **Measurement of Inductance**
  - Maxwell’s Bridge
  - Maxwell-Wein Bridge
  - Anderson Bridge
  - Hey Bridge
  - Owen Bridge
- **Measurement of Capacitance**
  - De Sauty’s Bridge
  - Schering Bridge
  - High Voltage Schering Bridge
- **Measurement of Frequency**
  - Wein’s Bridge

Maxwell's Bridge:

Accurate measurement of medium inductance

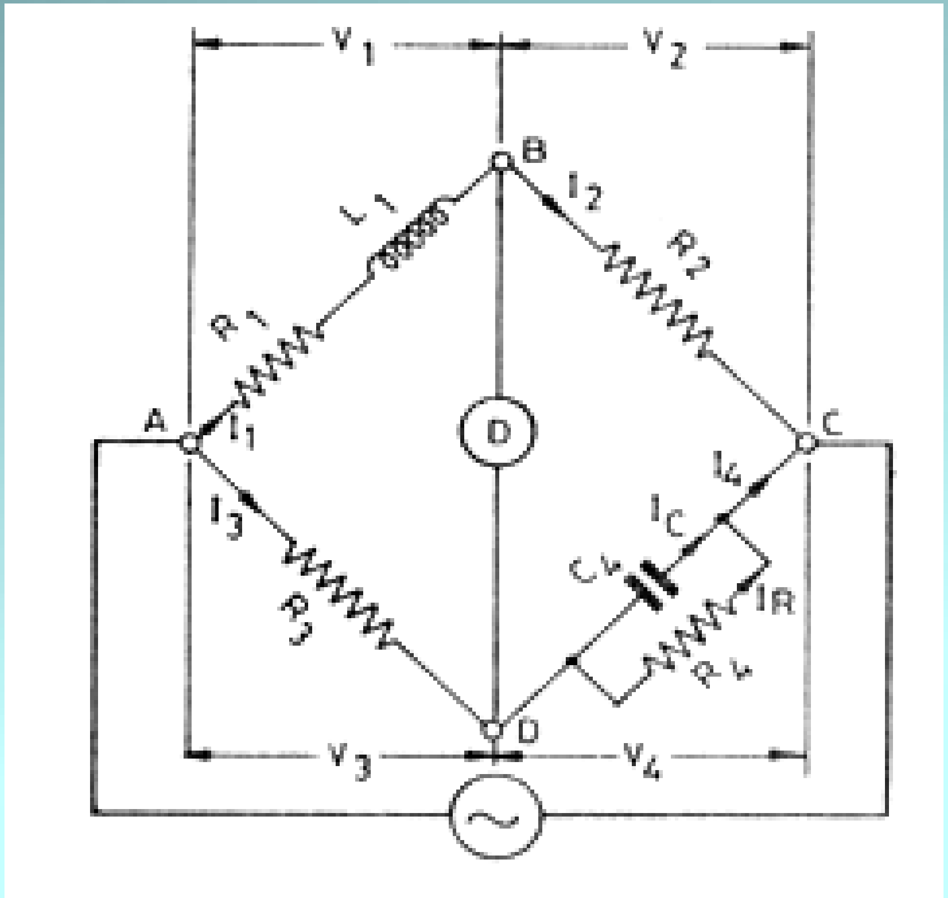


$$R_1 = \frac{R_2}{R_4} R_3$$

$$L_1 = \frac{R_2}{R_4} L_3$$

Maxwell-Wein Bridge:

Measurement of self inductance with a standard variable capacitance



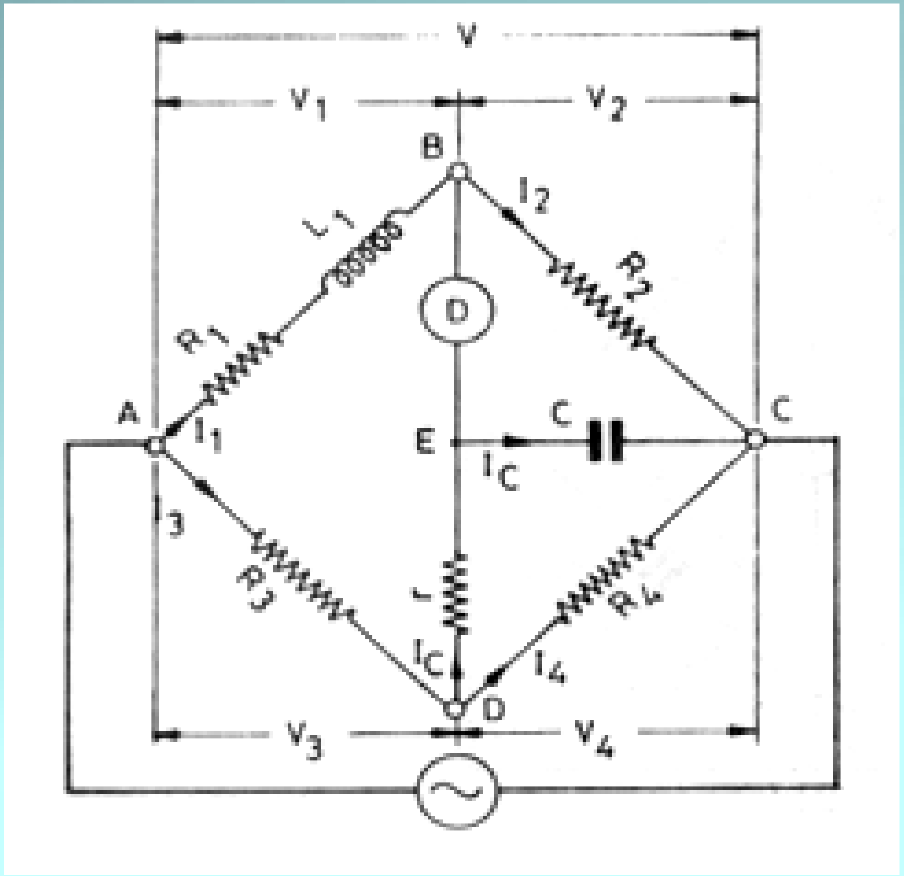
$$R_1 = \frac{R_2}{R_4} R_3$$

$$L_1 = R_2 R_3 C_4$$

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

Anderson Bridge:

Measurement of Self inductance in terms of known capacitance and resistance over a wide range



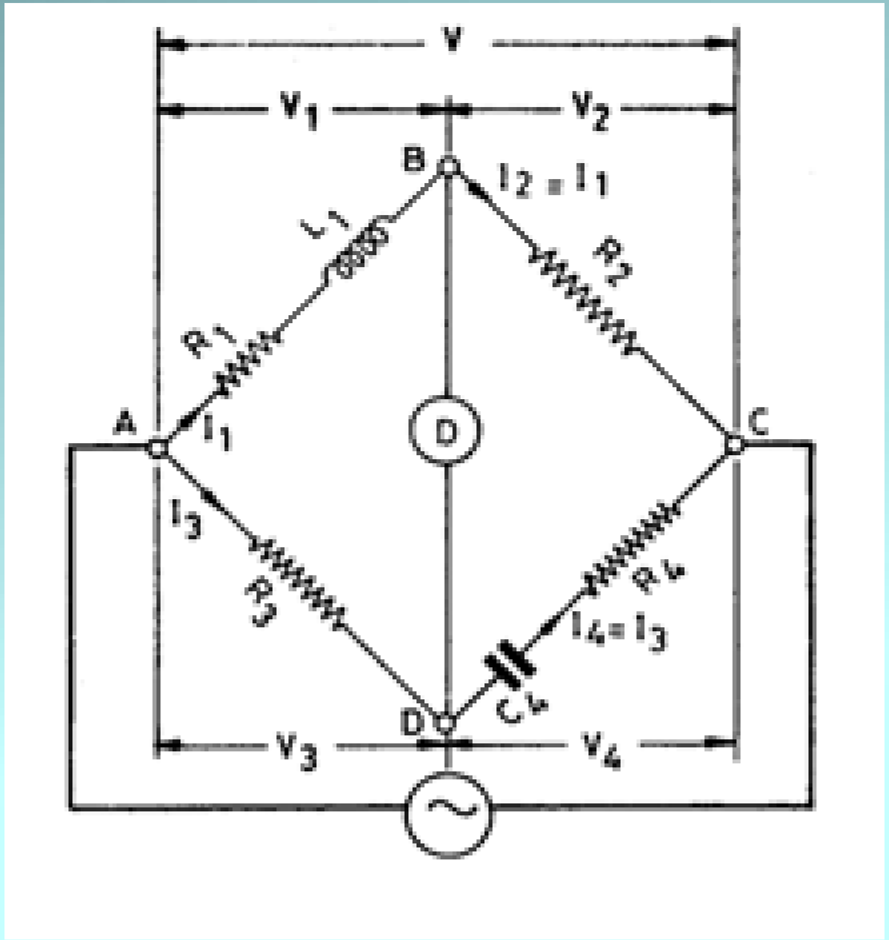
$$R_1 = \frac{R_2}{R_4} R_3$$

$$L_1 = \frac{CR_2}{R_4}[r(R_3 + R_4) + R_3 R_4]$$

Hey Bridge

Modified Maxwell-Wein Bridge

Measured inductor's phase angle large



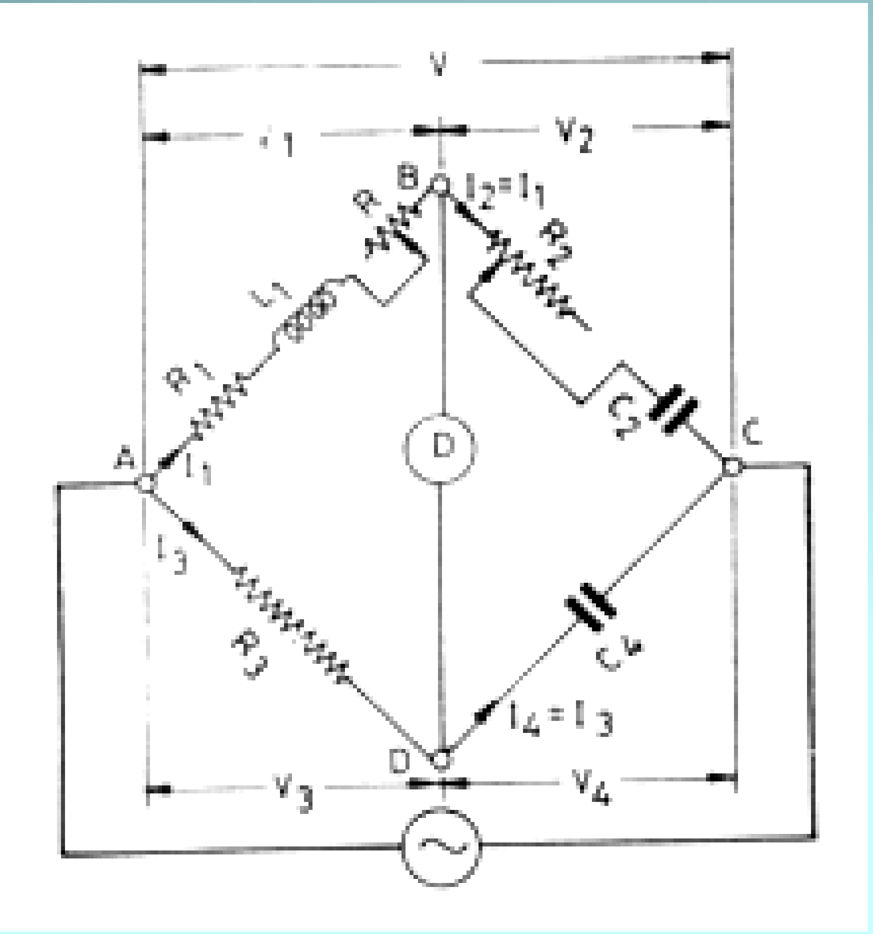
$$R_1 = \frac{R_2 R_3 R_4 C_4{}^2 \omega^2}{1 + \omega^2 C_4{}^2 R_4{}^2}$$

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

$$Q = \frac{1}{\omega R_4 C_4}$$

Owen Bridge:

Measurement of inductance in a wide range

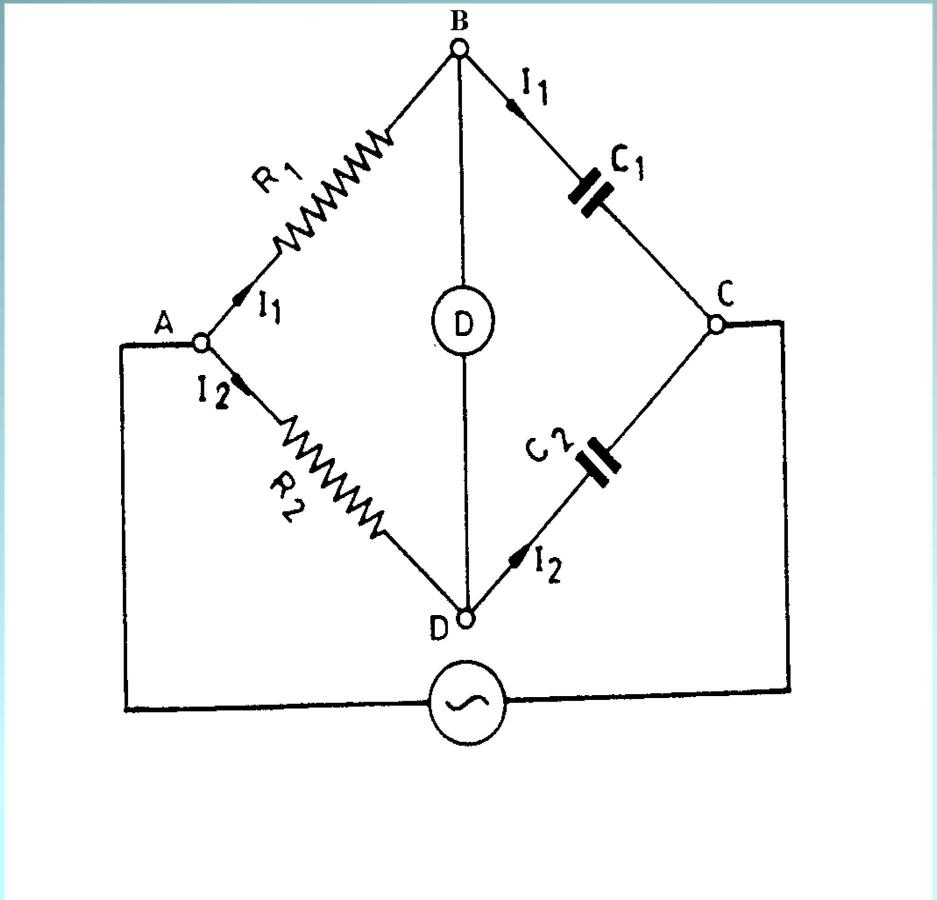


$$R_1 = \frac{R_3 C_4}{C_2} - R$$

$$L_1 = R_2 R_3 C_4$$

De Sauty's Bridge:

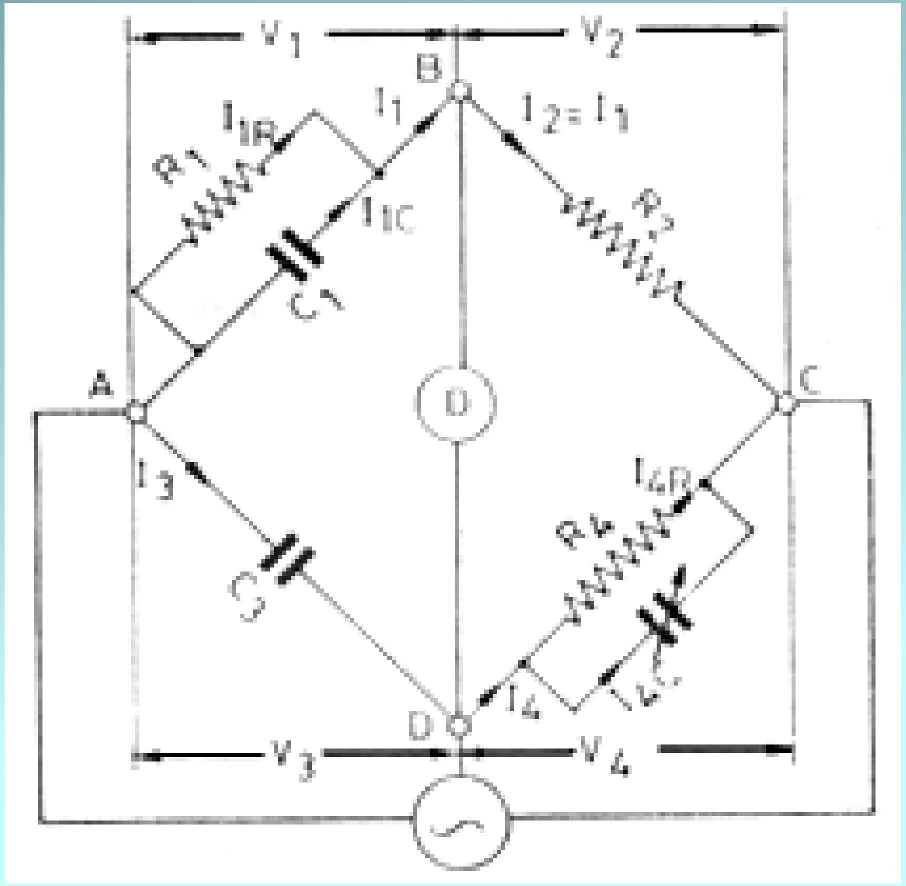
Measurement of Capacitance with respect of known standard capacitance



$$C_1 = C_2 \frac{R_2}{R_1}$$

Schering Bridge:

Measurement of capacitance with respect of a variable capacitance



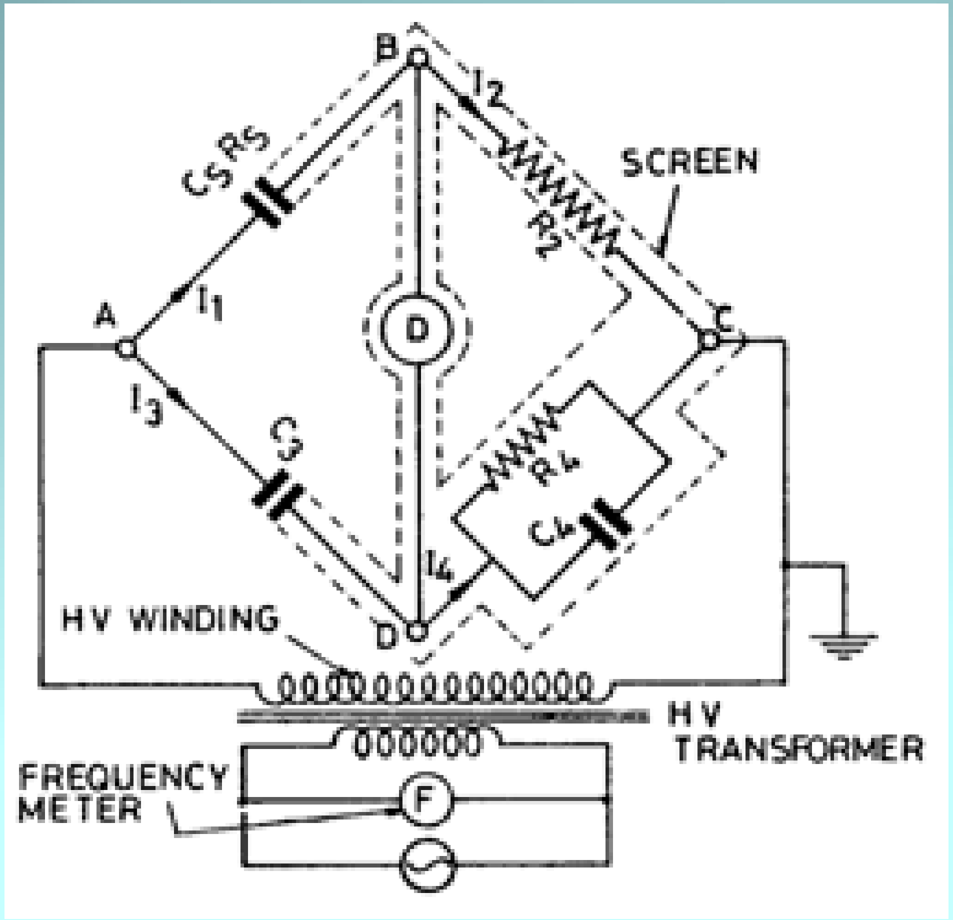
$$R_1 = \frac{1}{\omega^2 C_1 C_4 R_4}$$

$$C_1 = \frac{C_3 R_4 \cos^2 \delta}{R_2}$$

$$\delta = \tan^{-1}\left(\frac{1}{\omega C_1 R_1}\right)$$

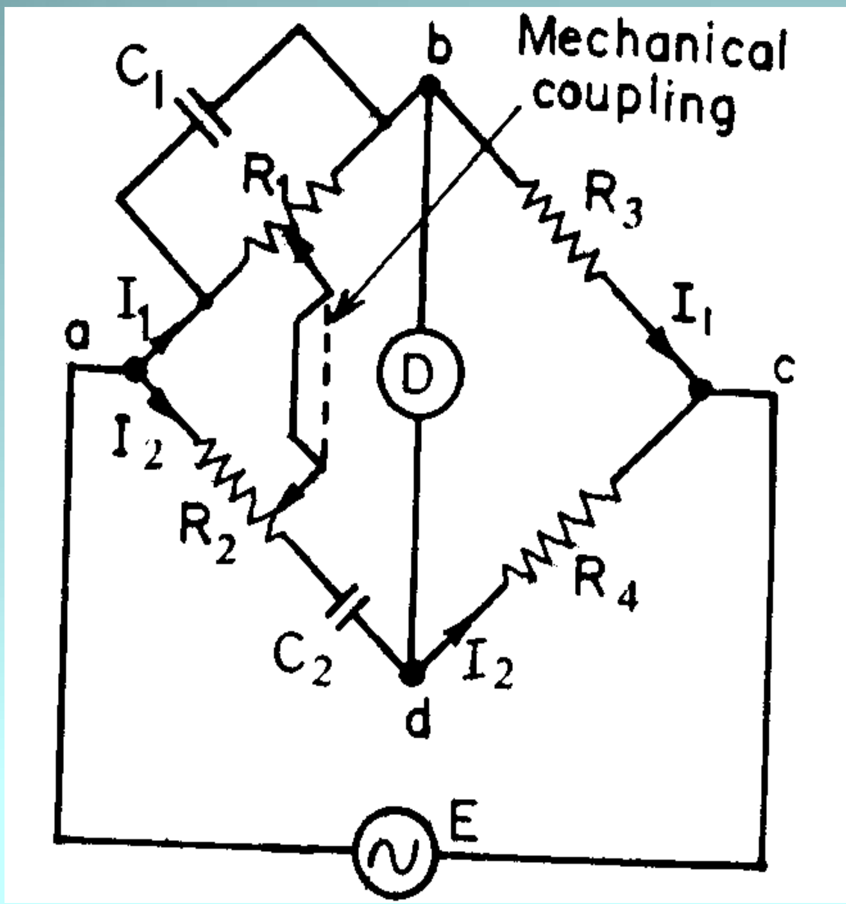
High Voltage Schering Bridge:

Measurement of capacitance, dielectric loss of a capacitance and power factor of cables



Wien's Bridge:

Used for audio and HF oscillators as a frequency determining device



$$f = \frac{1}{2\pi\sqrt{R_1 R_2 C_1 C_2}}$$