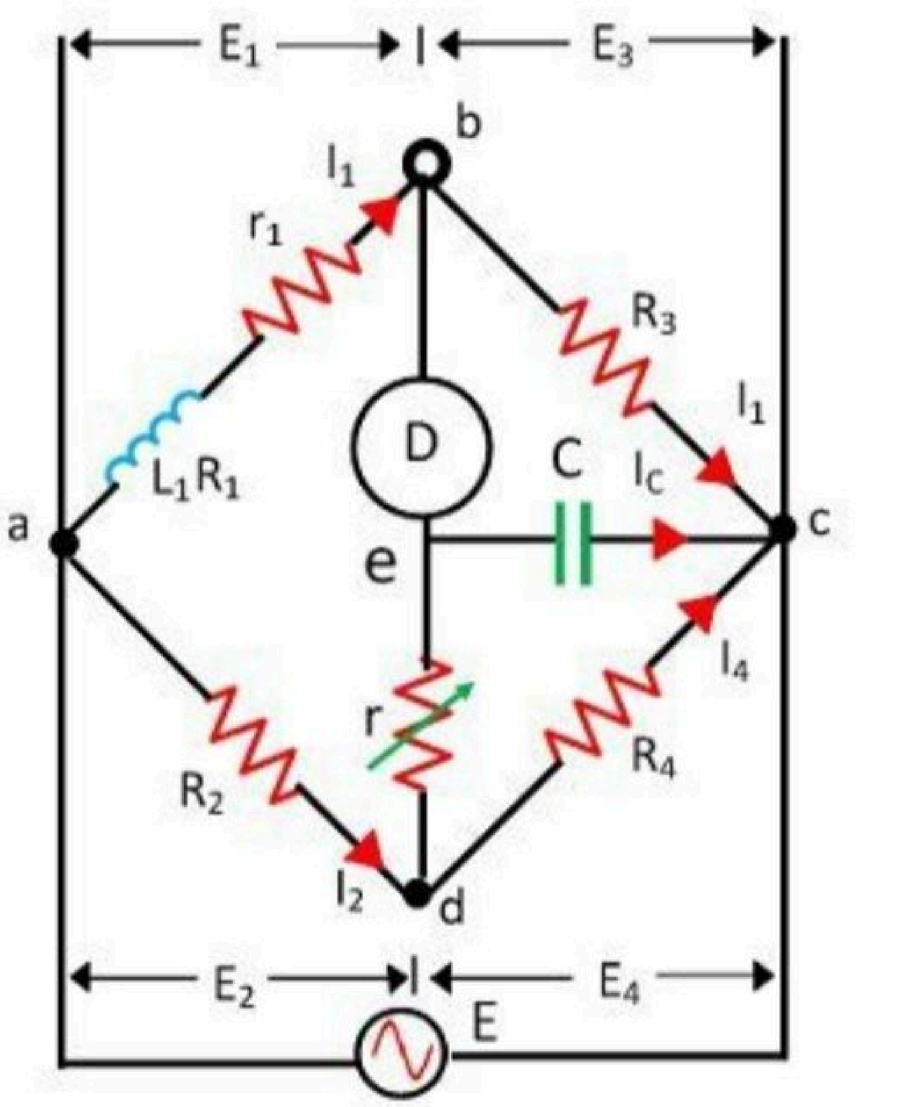
Anderson’s Bridge

Definition: The **Anderson’s bridge** gives the **accurate measurement** of **self-inductance** of the circuit. The bridge is the **advanced form** of **Maxwell’s inductance capacitance bridge.** In Anderson bridge, the **unknown inductance** is compared with the **standard fixed capacitance** which is connected between the two arms of the bridge.

Constructions of Anderson's Bridge

The bridge has fours arms **ab, bc, cd,** and **ad.** The arm **ab** consists unknown inductance along with the resistance. And the other three arms consist the purely resistive arms connected in series with the circuit.

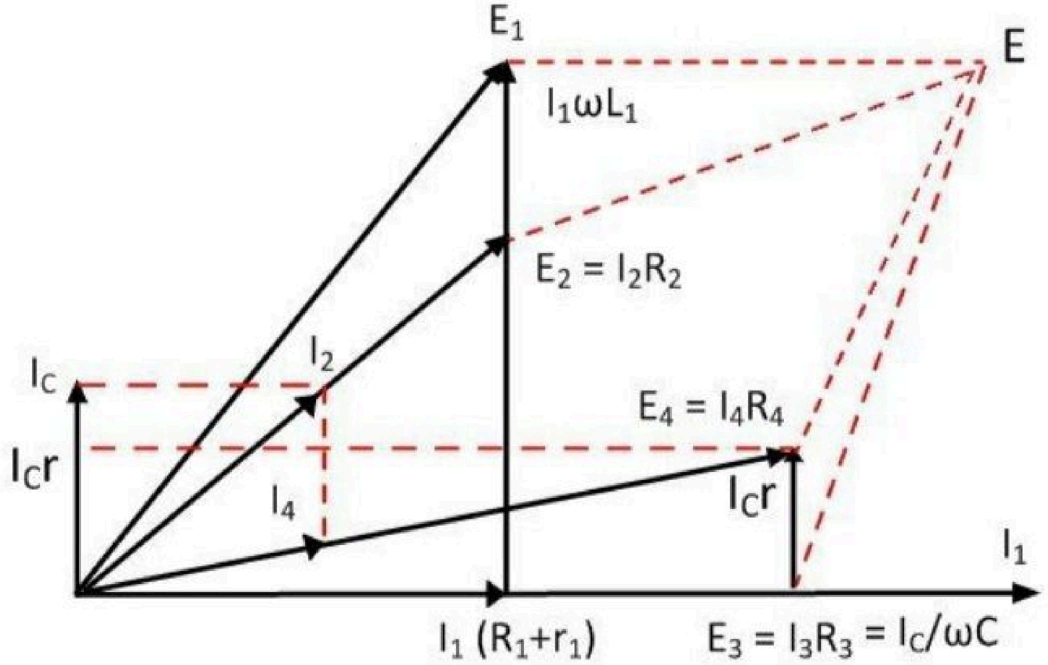


Anderson's Bridge

The static capacitor and the variable resistor are connected in series and placed in parallel with the **cd** arm. The voltage source is applied to the terminal a and c.

Phasor Diagram of Anderson's Bridge

The phasor diagram of the Anderson bridge is shown in the figure below. The current I_1 and the E_3 are in phase and represented on the horizontal axis. When the bridge is in balance condition the voltage across the arm **bc** and **ec** are equal.



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The current enters into the bridge is divided into the two parts I_1 and I_2. The I_1 is entered into the arm **ab** and causes the voltage drop $I_1(R_1+R)$ which is in phase with the I_1. As the bridge is in the balanced condition, the same current is passed through the arms bc and **ec.**

The voltage drop E_4 is equal to the sum of the $I_C/\omega C$ and the $I_C r$. The current I_4 and the voltage E_4 are in the same phase and representing on the same line of the phasor diagram. The sum of the current I_C and I_4 will give rise to the current I_2 in the arm **ad.**

When the bridge is at balance condition the emf across the arm **ab** and the point **a, d** and **e** are equal. The phasor sum of the voltage across the arms **ac** and **de** will give rise the voltage drops across the arm **ab.**

The $\mathbf{V_1}$ is also obtained by adding the $\mathbf{I_1(R_1+r_1)}$ with the voltage drop $\mathbf{\omega I_1 L_1}$ in the arm **AB**. The phasor sum of the $\mathbf{E_1}$ and $\mathbf{E_3}$ or $\mathbf{E_2}$ and $\mathbf{E_4}$ will give the supply voltage.

Theory of Anderson Bridge

Let, L_1 – unknown inductance having a resistance R_1.
R_2, R_3, R_4 – known non-inductive resistance
C_4 – standard capacitor

At balance Condition,

$$I_1 = I_3 \; and \; I_2 = I_C + I_4$$

Now,

$$I_1 R_3 = I_C \times \frac{1}{j\omega C}$$

$$I_C = I_1 \omega C R_3$$

The other balance condition equation is expressed as

$$I_1(r_1 + R_1 + j\omega L_1) = I_2 R_2 + I_C r$$

$$I_c\left(r + \frac{1}{j\omega C}\right) = (I_2 - I_C)R_4$$

By substituting the value of I_c in the above equation we get,

$$I_1(r_1 + R_1 + j\omega L_1) = I_2 R_2 + I_1 j\omega C R_3 r$$

$$I_1(r_1 + R_1 + j\omega L_1 - j\omega C R_3 r) = I_2 R_2$$

and

$$I_1(R_3 + j\omega R_3 R_4 + j\omega C R_3 r) = I_2 R_4$$

on equating the equation, we get

$$I_1(r_1 + R_1 + j\omega L_1 - j\omega C R_3 r) = I_1\left(\frac{R_1 R_2}{R_3} + \frac{j\omega C R_3 r R_2}{R_4} + j\omega C R_3 R_2\right)$$

Equating the real and the imaginary part, we get

$$R_1 = \frac{R_1 R_3}{R_4} - r_1$$

$$L_1 = C\frac{R_3}{R_4}[4(R_4 + R_2) + R_2 R_4]$$

Advantages of Anderson Bridge

The following are the advantages of the Anderson's Bridge.

1. The balance point is easily obtained on the Anderson bridge as compared to Maxwell's inductance capacitance bridge.
2. The bridge uses fixed capacitor because of which accurate reading is obtained.
3. The bridge measures the accurate capacitances in terms of inductances.

Disadvantages of Anderson Bridge

The main disadvantages of Anderson's bridge are as follow.

1. The circuit has more arms which make it more complex as compared to Maxwell's bridge. The equation of the bridge is also more complex.
2. The bridge has an additional junction which arises the difficulty in shielding the bridge.

Because of the above-mentioned disadvantages, Maxwell's inductance capacitance bridge is used in the circuit.