De Sauty Bridge Construction Circuit and Theory

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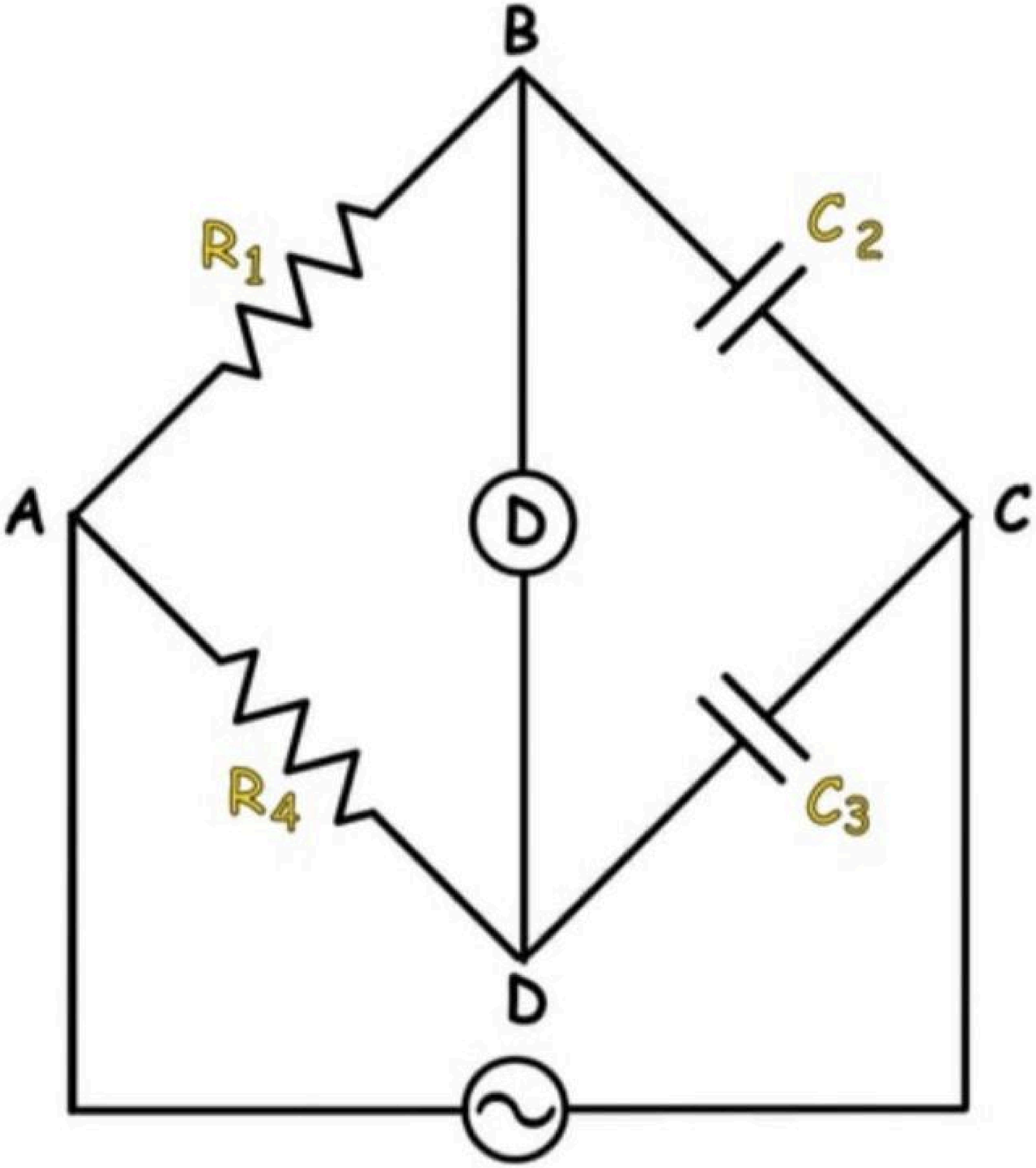
De Sauty Bridge is a very simple type of AC Bridge used to measure capacitance. Here we measure in unknown capacitance in terms of known capacitance and known resistance. Hence, we design a De Sauty Bridge by using two known resistances (R_1 and R_4), one known capacitance (C_2) and one unknown capacitance (C_3). The device gives the expression of C_3 in terms of R_1, R_4, and C_2.

Construction of De Sauty Bridge

For showing the basic construction of a De Sauty Bridge let us draw the circuit diagram of such bridge.

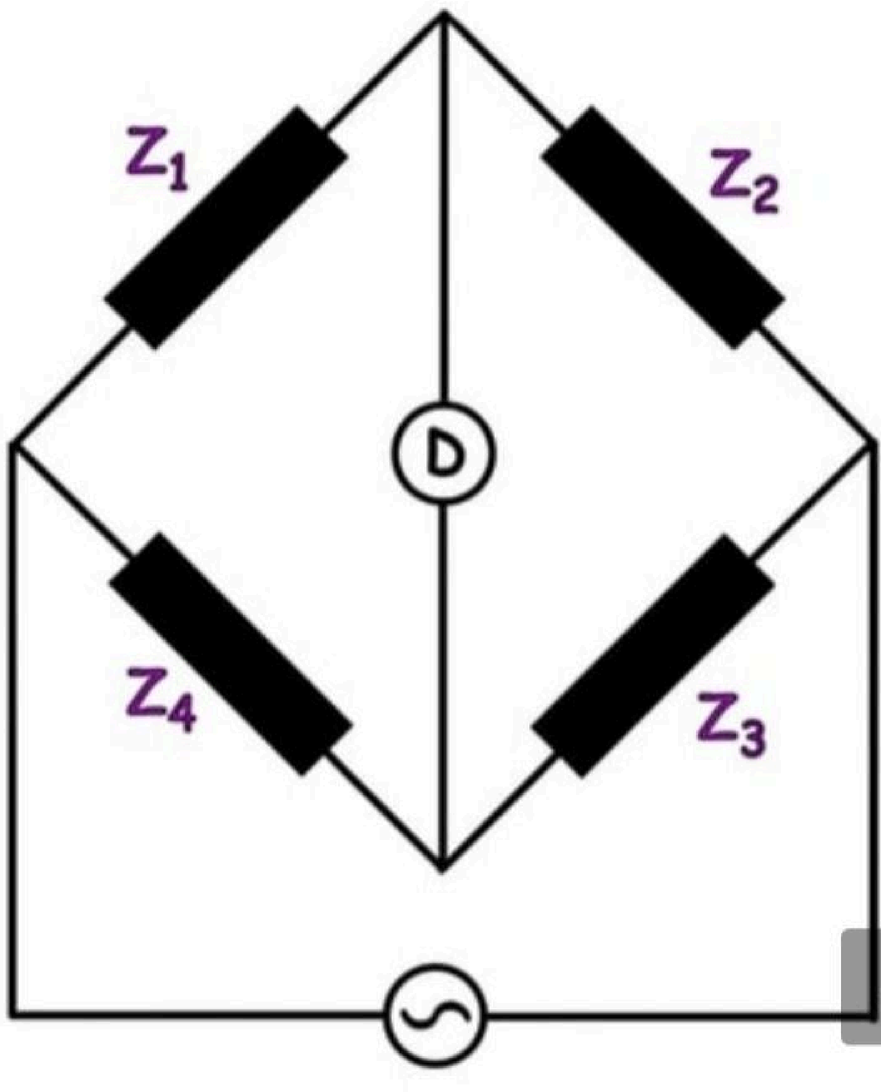


De Sauty Bridge

The first arm that is arm AB consists of a pure resistance R_1. The second arm that is arm BC consists of a capacitor of unknown capacitance C_2. Then the third arm that is arm CD consists of a standard capacitor of known capacitance C_3. Forth arm that is BA consists of a pure resistance R_4.

Theory of De Sauty Bridge

Now let us compare this De Sauty Bridge circuit with a generalized AC Bridge circuit. For that, we will draw a generalized AC Bridge circuit.



By comparing the De Sauty Bridge circuit and the AC Bridge circuit, we can write.

$$Z_1 = R_1$$
$$Z_2 = -\frac{j}{\omega C_2}$$
$$Z_3 = -\frac{j}{\omega C_3}$$
$$Z_4 = R_4$$

Now we know that the balanced condition of the AC Bridge circuit is

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

On comparison of this equation, we write

$$Z_1 Z_3 = Z_2 Z_4$$
$$\Rightarrow R_1 \left(-\frac{j}{\omega C_3}\right) = \left(-\frac{j}{\omega C_2}\right) R_4$$
$$\Rightarrow \frac{R_1}{C_3} = \frac{R_4}{C_2} \Rightarrow C_2 = C_3 \times \frac{R_4}{R_1}$$

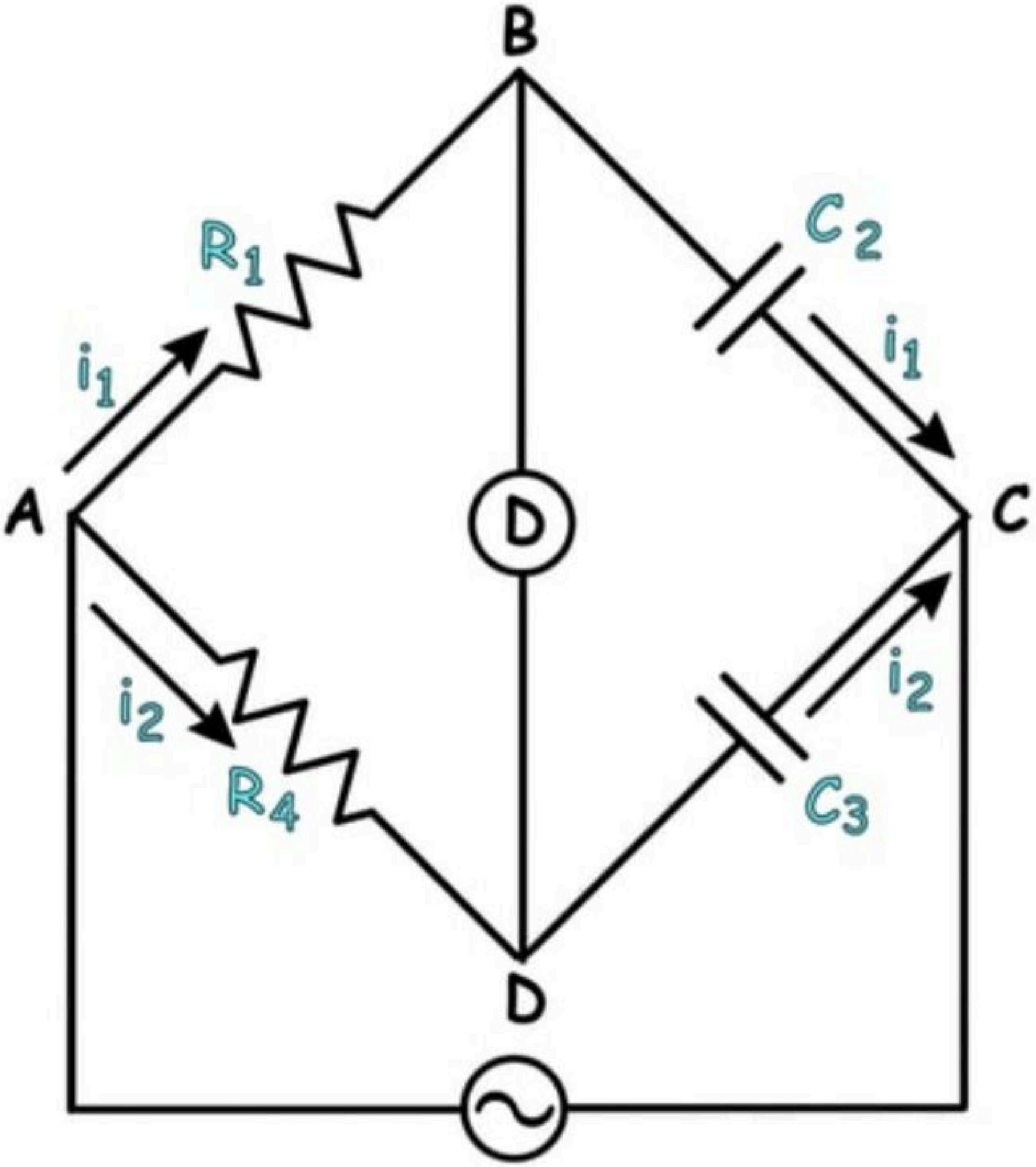
Now, if the value of resistance are equal, then

$$\because R_1 = R_4$$
$$\therefore C_2 = C_3$$

De Sauty Bridge has maximum sensitivity when the value of known capacitance and unknown capacitance are equal.

We cannot obtain perfect balancing in this type of bridge if the capacitors suffer from dielectric losses. So we can only obtain the perfect balancing if we use air condensers as the capacitors for the purpose.

There is another approach to create the equation for balancing the bridge. Let us explain that. Suppose the current flowing through the path ABC if i_1. And the Current flowing through the path ADC is i_2.



De Sauty Bridge Circuit

So, the voltage of node B in respect of node A is

$$i_1 R_1$$

Similarly, the voltage of node D in respect of node A is

$$i_2 R_4$$

At balanced condition there should not be any potential difference between node B and node D. Hence, we can write,

$$i_1 R_1 = i_2 R_4 \cdots\cdot (i)$$

Again, the voltage of node B in respect of node C is

$$\frac{-j}{\omega C_2} \cdot i_1$$

Similarly, the voltage of node D in respect of node C is

$$\frac{-j}{\omega C_3} \cdot i_2$$

As we told in the previous lines that, the voltage of node B is the same as that of node D. Now we can write, As we told in the previous lines that, the voltage of node B is the same as that of node D. Now we can write,

$$\frac{-j}{\omega C_2} \cdot i_1 = \frac{-j}{\omega C_3} \cdot i_2 \cdots\cdots (ii)$$

By dividing equation (i) by (ii), we get

$$\frac{R_1}{C_3} = \frac{R_4}{C_2} \Rightarrow C_2 = C_3 \times \frac{R_4}{R_1}$$

This is the same expression of unknown capacitance which we have already derived in the previous section of this De Sauty Bridge article.