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EXPERIMENT NO. 8

NAME OF EXPERIMENT: TO DETERMINE THE RESISTANCE OF THE GIVEN WIRE AND TO CALCULATE ITS RESISTIVITY BY USING PO BOX

APPARATUS REQUIRED

1. PO Box
2. Galvanometer
3. Resistance wire
4. Connecting wire
5. Leclanche cell

THEORY

Wheatstone bridge principle states that if P, Q, R and X be four resistance (X) being unknown resistance connected as shown in figure. 'G' a moving coil galvanometer and 'E' a leclanche cell, then for null deflection and galvanometer,

$$\frac{X}{R} = \frac{P}{Q}$$

Where, P and Q are resistance in the ratio arms, R that in the resistance arms and X is the unknown resistance to be determined.

$$X = R \times \frac{P}{Q} \quad \text{---} \quad (i)$$

Hence, Resistivity of the wire is

$$\rho = \frac{\pi d^2}{4} \times \frac{X}{L}$$

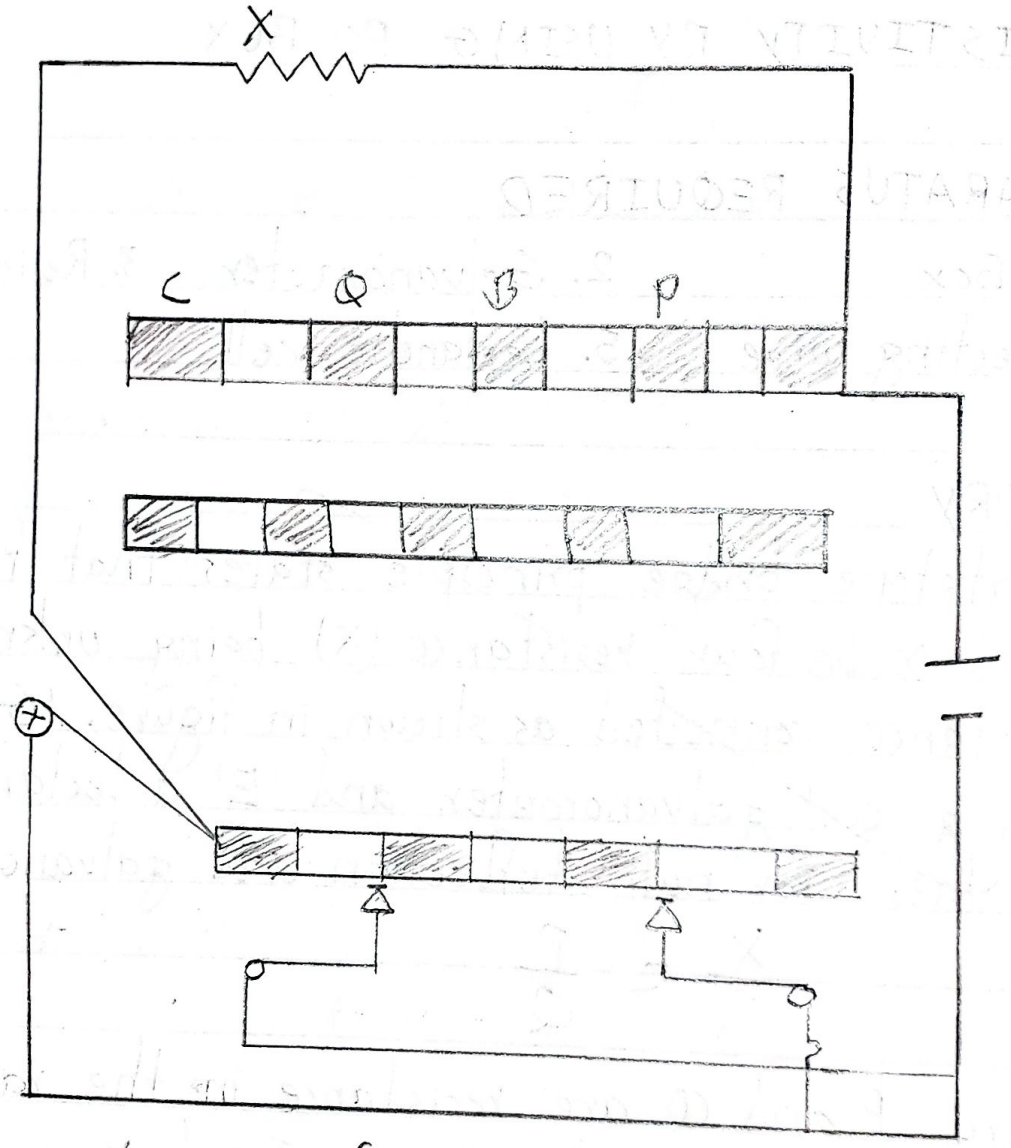

fig. P.O. box

Where, 'd' is the diameter of the resistance wire.
'L' is the length of the resistance wire.

PROCEDURE

1. A circuit diagram was drawn and connections were made.
2. Resistance plugs 10:10 were taken out from the ratio arms AB and BC. After this, in the third arm CD, resistance plugs '0' was taken out and battery key was pressed which shows deflection in the left. Likewise, ∞ resistance plug was taken out and battery key was pressed which shows deflection in the right. So, the circuit was right.
3. This operation was repeated by alternating taking out a low and a higher resistance plug from the resistance arm CD unless the deflection becomes narrower.
4. Next, resistance plugs 10, 100 were taken out from the ratios arm AB and BC and the value of resistance was also increased by 14 times and the process (3) was again repeated.
5. Deflection was observed and direction were noted in the table.

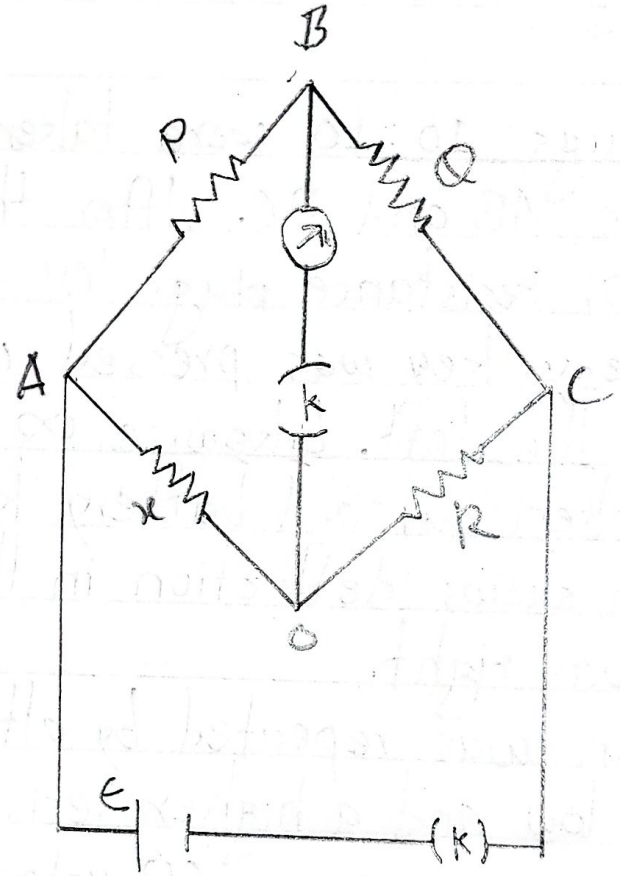

fig. Connecting wire

OBSERVATION TABLE

No. of Obs.	Ratio arms P:Q	Resistance in 3rd arm	Galvanometer deflection	Inference about unknown resistance compared to R
1.	10:10	0	too left	Value of X lies between 0 and 1.
		∞	too right	
		1	too right	
2.	10:100	0	too left	Value of X lies between 4 and 5. It means 0.4 and 0.5
		4	slow left (1 div)	
		5	slow right (14 div)	

CALCULATIONS

∴ Change in deflection of (1+14) division i.e. 15 division is due to a different of 1Ω

$\therefore 1\,\Omega = 15$ divs.

or, $\frac{1}{15}\,\Omega = 1$ div

$\therefore 1$ div $= 0.06\,\Omega$

∴ Required value of $R = 4 + 0.06\,\Omega$

$= 4.06\,\Omega$

Now, we know

$$\frac{X}{R} = \frac{P}{Q}$$

or, $$\frac{X}{4.06} = \frac{10}{100}$$

$\therefore X = 0.406\ \Omega$

Again,

Resistivity $(\rho) = \frac{\pi d^2}{4} \times \frac{X}{L}$

$= \frac{22}{7} \times \frac{(0.49 \times 10^{-3})^2}{4} \times \frac{0.46}{57.5 \times 10^{-2}}$

$= 1.5 \times 10^{-7}\ \Omega m$

RESULT

Hence, the resistance of the given wire is found to be $0.406\ \Omega$ and resistivity is $1.5 \times 10^{-7}\ \Omega m$.

PRECAUTIONS

1. Calculations should be done accurately.
2. PO box should be used properly.
3. Reading of galvanometer should be taken accurately.