EXPERIMENT NO. 13

NAME OF EXPERIMENT: TO DETERMINE THE RESISTANCE OF GIVEN WIRE BY USING METER BRIDGE

APPARATUS REQUIRED

1. Meter bridge
2. Resistance box.
3. Leclanche cell
4. Connecting wire
5. Two way key
6. Galvanometer

THEORY

The principle used in the determination of resistance by meter bridge lies in the application of wheatstone bridge.

According to wheatstone bridge principle, if P, Q, R, X be four resistance (X) being an unknown resistance connected with the galvanometer and E, a leclanche cell then for null deflection,

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

Now, if the wheatstone bridge circuit be applied in the meter bridge, the circuit will be as shown ~~fi~~ in fig.(ii). Let 'B' be the point along the bridge wire when the galvanometer deflection zero. Then, if r = resistance per cm.

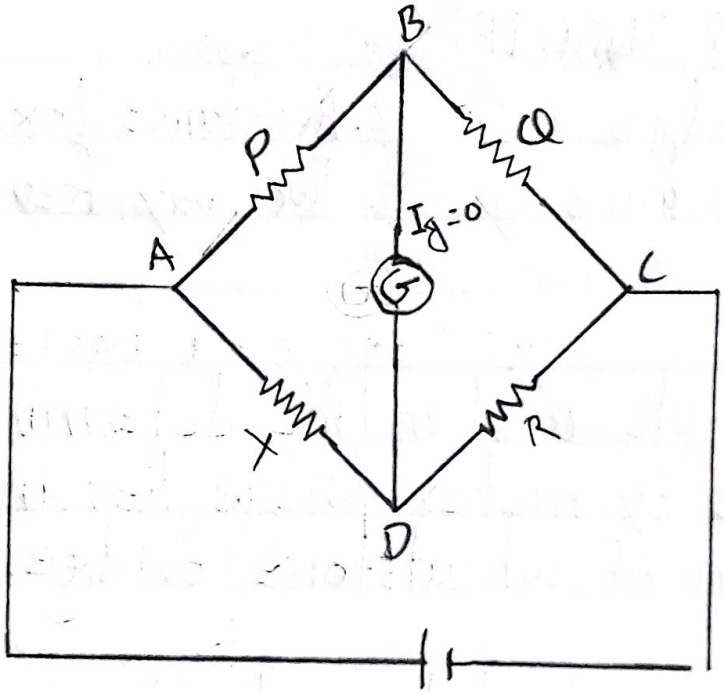

fig. (i) Wheat stone bridge

of the bridge wire, length of AB = l and that of BC = $100 - l$ then from (i)

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

or, $$\frac{X}{R} = \frac{l}{100-l}$$

or, $$\boxed{X = \frac{l}{100-l} \times R}$$ (when, X is in left)

Again, for conditions when X and R are interchanged with each other then,

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

or, $$\frac{R}{X} = \frac{l}{100-l}$$

or, $$\boxed{X = \frac{100-l}{l} \times R}$$ (when X is in right)

PROCEDURE

1. A circuit diagram was drawn and completed.
2. The key was closed. The jockey was pressed at one end of the bridge wire. There was a deflection in the galvanometer say to the left. Next, the jockey was moved to right end and pressed. The galvanometer deflected towards the right.
3. In the diagram, the unknown resistance X was in the left gap and known resistance was plugged

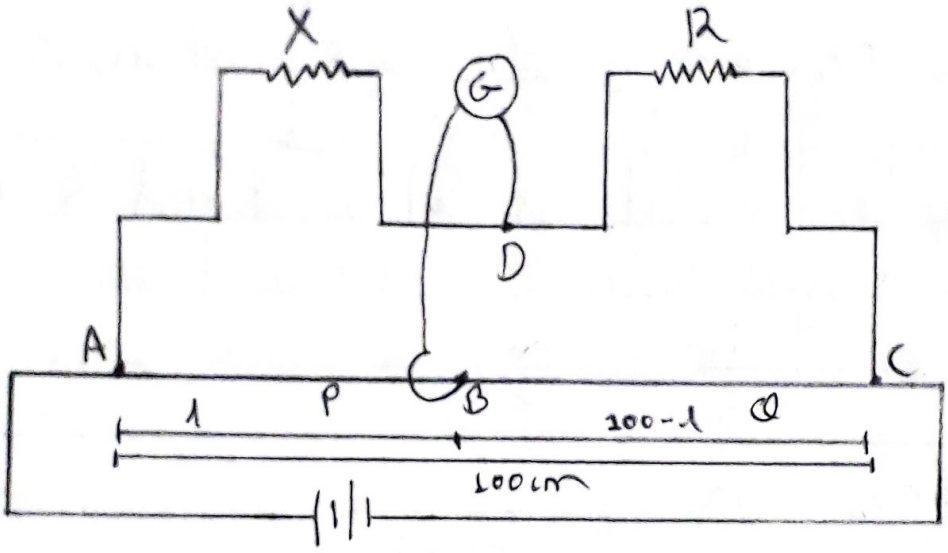

fig. (ii) Meter bridge (When X is in left)

out from the box R. Keeping the key closed the jockey was moved from left side and a null point such as B was obtained from the galvanometer null deflection. The position of B in the wire was noted.

4. The current was reversed by means of two way key in the battery circuit. Operation (3) was repeated.
5. Next the resistance of 3, 4 & 5 ohms are plugged out from the resistance box R. and operation (3) & (4) are repeated in order.
6. After that, the resistance box and the unknown resistance X are interchanged. Operation (3), (4) & (5) are repeated.

OBSERVATION TABLE

No. of Obs.	Resistance in the gap Left	Right	length 'l'	length 100-l	X = left $X = \frac{lR}{100-l}\Omega$	X = right $X = \left(\frac{100-l}{l}\right)R\Omega$	Mean Ω
1.	X = ?	R = 1Ω	29.1 cm	70.9 cm	0.41Ω		
	R = 1Ω	X = ?	71 cm	29 cm		0.40Ω	
2.	X = ?	R = 2Ω	17.2 cm	82.8 cm	0.41Ω		
	R = 2Ω	X = ?	83.9 cm	16.1 cm		0.38Ω	
3.	X = ?	R = 3Ω	11.9 cm	88.1 cm	0.40Ω		0.39Ω
	R = 3Ω	X = ?	89 cm	11 cm		0.37Ω	
4.	X = ?	R = 4Ω	9.1 cm	90.9 cm	0.40Ω		
	R = 4Ω	X = ?	91.6 cm	8.4 cm		0.36Ω	
5.	X = ?	R = 5Ω	7.5 cm	92.5 cm	0.40Ω		
	R = 5Ω	X = ?	93 cm	7 cm		0.37Ω	

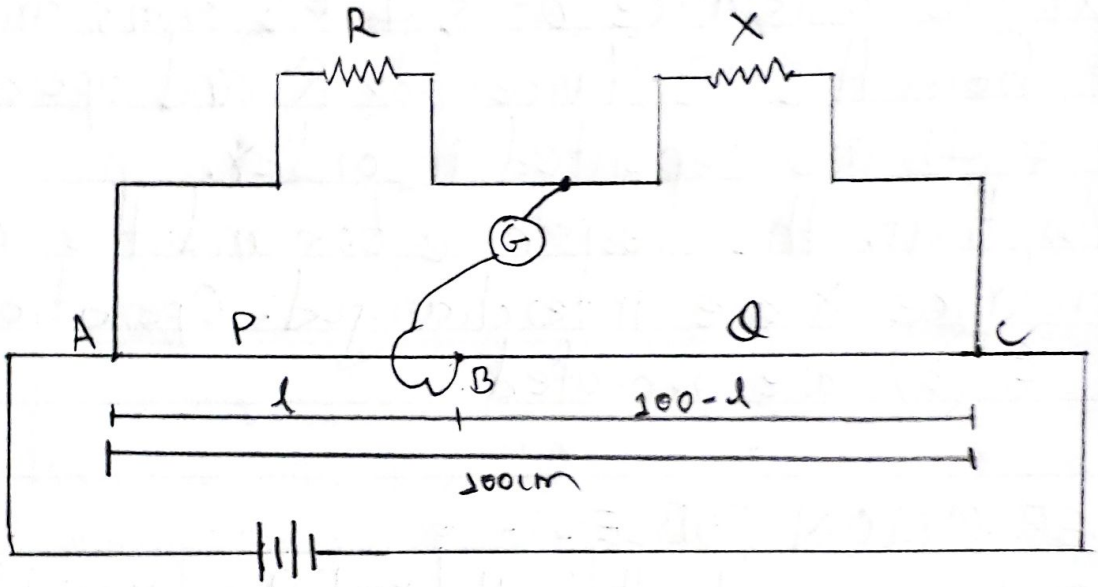

fig. (iii) Meter bridge (When X is in Right)

CALCULATIONS (When X is in left & R is in right)

1. For $R = 1\,\Omega$

$l = 29.1$ cm

$100 - l = 100 - 29.1$

$= 70.9$ cm

$\therefore X_1 = \frac{lR}{100-l}$

$= \frac{29.1 \times 1}{70.9}$

$= 0.41\,\Omega$

2. $R = 2\,\Omega$

$l = 17.2$

$100 - l = 100 - 17.2$

$= 82.8$ cm

$\therefore X_2 = \frac{17.2 \times 2}{82.8}$

$= 0.41\,\Omega$

3. For $R = 3\,\Omega$

$l = 11.9$ cm

$100 - l = 100 - 11.9$

$= 88.1$ cm

$\therefore X_3 = \frac{11.9 \times 3}{88.1}$

$= 0.40\,\Omega$

4. $R = 4\,\Omega$

$l = 9.1$ cm

$100 - l = 100 - 9.1$

$= 90.9$ cm

$\therefore X_4 = \frac{9.1 \times 4}{90.9}$

$= 0.40\,\Omega$

5. For $R = 5\,\Omega$

$l = 7.5$ cm

$100 - l = 100 - 7.5$

$= 92.5$ cm

$\therefore X_3 = \frac{7.5 \times 5}{92.5}$ $= 0.40\,\Omega$

When X is in Right & R is in left

1. For $R = 1\Omega$

$l = 71$ cm

$100 - l = 100 - 71$

$= 29$ cm

$\therefore X_1' = \frac{(100-l) \times R}{l}$

$= \frac{29 \times 1\Omega}{71}$

$= 0.40\Omega$

2. For $R = 2\Omega$

$l = 83.9$ cm

$100 - l = (100 - 83.9)$ cm

$= 10.1$ cm

$\therefore X_2' = \frac{10.1 \times 2}{83.9}$

$= 0.38\Omega$

3. For $R = 3\Omega$

$l = 89$ cm

$100 - l = 100 - 89$

$= 11$ cm

$\therefore X_3' = \frac{11 \times 3}{89}$

$= 0.37\Omega$

4. For $R = 4\Omega$

$l = 91.6$ cm

$100 - l = 100 - 91.6$

$= 8.4$ cm

$\therefore X_4' = \frac{8.4 \times 4\Omega}{91.6}$

$= 0.36\Omega$

5. For $R = 5\Omega$

$l = 93$ cm

$100 - l = 100 - 93$

$= 7$ cm

$\therefore X_5' = \frac{7 \times 5}{93}$

$= 0.37\Omega$

$$\therefore \text{Mean}(X) = \frac{X_1 + X_2 + X_3 + X_4 + X_5 + X_1' + X_2' + X_3' + X_4' + X_5'}{10}$$

$$= \frac{(0.41 + 0.41 + 0.40 + 0.40 + 0.40 + 0.40 + 0.38 + 0.37 + 0.36 + 0.37)\,\Omega}{10}$$

$$= 0.39\,\Omega$$

RESULT

Hence, the resistance of the given wire (X) was calculated as $0.39\,\Omega$

PRECAUTION

1. Calculation should be done properly.
2. Length in the meter bridge should be taken accurately by null deflection of galvanometer.