Name:	Program:	Lab ID :
Exp No:	Section	Date:

Carey Foster's Bridge (CFB)

Determine the specific resistance of the given wire material.

MARKS DISTRIBUTION

	Max. Marks	Marks Obtained
Pre - lab preparation	10	
Observation	15	
Calculation	15	
Result	05	
Viva	05	
Total	50	

Staff signature with date

CAREY FOSTER'S BRIDGE

Aim: To determine (i) The specific resistance of the material of a wire and (ii) the unknown resistance of the given wire.

Apparatus Required: Meter bridge, Leclanché cell, two equal resistances, variable resistance box, unknown resistance, wire, high resistance, switches, galvanometer, jockey.

Formula:

(i) Resistance of the given coil of wire $X = R + (l_1 - l_2)\,\rho\ \ \Omega$ (1)

(ii) Specific resistance of the given coil of wire $S = \frac{X\pi r^2}{L}\ \Omega\text{m}$ (2)

Symbol	Description	Unit
X	Unknown resistance	Ω
R	Known value of resistance in the resistance box	Ω
l_1, l_2, l_3 and l_4	Balancing lengths	m
ρ	Resistivity of the bridge wire	Ω/m
r	Radius of the given coil of wire	m
L	Length of the given wire	m

PART I - Determination of ρ (Resistance per unit length)

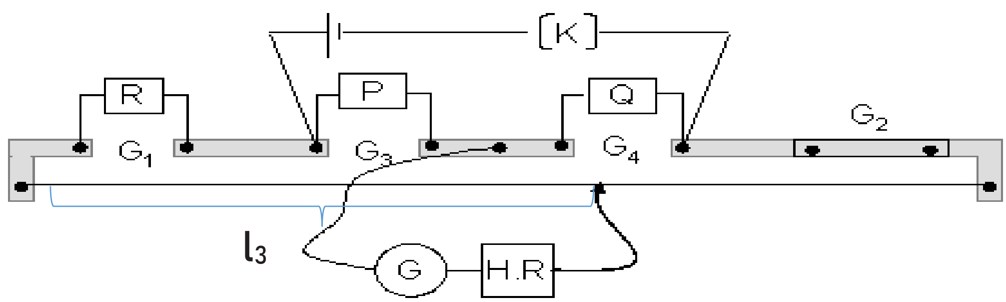

Fig 1- R in the left gap and the right gap shorted

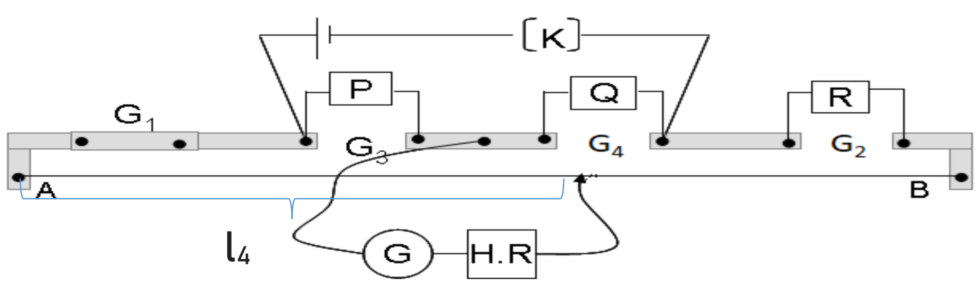

Fig 2 – R in the right gap and the left gap shorted

PART II -Determination of unknown resistance

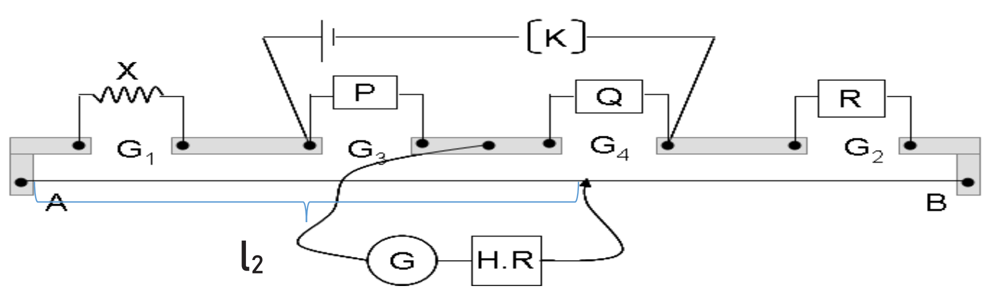

Fig 3 – Unknown resistance X in the left gap

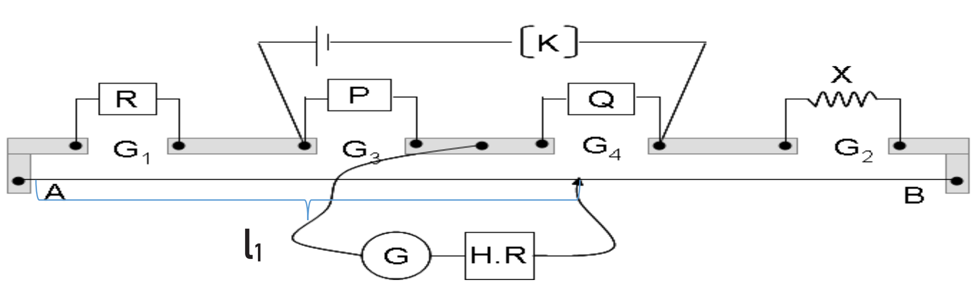

Fig 4 - Unknown resistance X in the right gap

Principle:

Let two equal resistances P and Q be connected in gaps G_3 and G_4. Let a known resistance R be connected in gap G_1 and unknown resistance X in gap G_2. Let l_1 be the balance length measured from the end A (with known resistance R in the left gap). Therefore balancing length corresponding to X is $(100-l_1)$

$$\text{Therefore } \frac{P}{Q}=\frac{R+l_1\rho+\alpha}{X+(100-l_1)\rho+\beta} \qquad (3)$$

Where ρ = resistance per unit length of the bridge wire and α and β are the end corrections at the ends A and B. If the experiment is repeated with R and X interchanged in the gaps, and if l_2 is the balancing length measured from the same end A,

$$\frac{P}{Q}=\frac{X+l_2\rho+\alpha}{R+(100-l_2)\rho+\beta} \qquad (4)$$

From the two equations, we get,

$$X=R+\left(l_1-l_2\right)r_b \ \ \Omega$$

Instead of resistance X, let a thick copper strip be connected in the gap G_2. i.e, X = 0.
Let l_3 be the balancing length measured from the end A (with known resistance R in gap G_1)
With R in gap G_2 and the copper strip connected in G_1, let l_4 be the balancing length measured from the same end A.
Using the above equation,

$$0 = R+\left(l_3 \sim l_4\right)\rho$$

$$\text{Or, } \rho = \frac{R}{l_3 \sim l_4}$$

Specific resistance, $S = \dfrac{\pi r^2 X}{L}$, where r is the radius and L, the length of the wire.

Procedure:

Part I To determine the resistance/unit length (ρ) of the bridge wire.

a) Connections are made as shown in the Figure 1. P and Q are two equal resistances.

b) A low range resistance box R is connected in gap G_1 and short circuit to gap G2 using a thick copper strip of Zero resistance.

c) A small resistance (order of 0.1Ω) is introduced in R. The balancing length l_3 from the end A is noted.

d) The resistance R and the copper strip are interchanged in the gaps. (Refer Fig 2).

The balancing length l_4 from the end A is again determined.

e) Hence $\rho = \frac{R}{l_3 \sim l_4}$ is calculated. The experiment is repeated for different values of R.

f) The mean value of ρ is calculated.

Part II To determine the unknown resistance (X):

a) Instead of copper strip, the coil of unknown resistance of length l is connected in gap G_1 (refer Fig 3)

b) The balancing lengths l_1 and l_2 are determined with R in the right and left extreme gaps respectively.

c) Knowing ρ, the value X is calculated using $X = R + (l_1 - l_2)\rho$.

d) The experiment is repeated for different values of R and the mean value of X is taken.

e) Measuring the radius r using screw gauge and using the given the length l of the coil, the specific resistance is calculated.

Observations:

(i) Determination of ρ

Resistance, R (Ω)	Balancing Length with R in Left gap (l_3) (m)	Balancing Length with R in Right gap (l_4) (m)	$(l_3 \sim l_4)$ (m)	$\rho = \frac{R}{(l_3 \sim l_4)}\ \Omega/m$

Mean ρ = __________ Ω / m

(ii) Determination of X

Resistance, R (Ω)	Balancing Length with R in		$(l_1 - l_2)$(m)	$X = R + (l_1 - l_2)\rho$ (Ω)
	Left gap (l_1) (m)	Right gap (l_2) (m)		

Mean X = ___________ Ω

(iii) Radius of the wire (r) = ________ x10^{-3} m

(iv) Length of the wire (L) = _________m

Specific resistance S = $\dfrac{\pi r^2 X}{L}$ = = Ω m

Result:

(i) The unknown resistance of the given coil of wire (X) = Ω

(ii) Specific resistance of the material (S) = Ω m

Signature of Faculty In-charge

<u>Sample viva questions:</u>

1. What is the principle of Carey-Foster's bridge?

2. What is specific resistance?

3. When is Carey-Foster's Bridge more sensitive?

WORKSHEET