**EXPERIMENT NO.4**

# CAREY FOSTER BRIDGE

**OBJCET:**
To determine the specific resistance of the material of given wire using Carey Foster bridge.

**APPARATUS USED:**
Carey Foster bridge, Leclanche cell, Galvanometer; One fractional resistance box, Two resistance boxes (1-10 $\Omega$), Screw gauge and connecting wire.

**FORMULA USED:**
The specific resistance of the material of given wire is given by

$$\rho_s = \frac{XA}{(l_2 - l_1)} \quad (\Omega - cm.)$$

Where $X$ = Fractional resistance
$A$ = Cross sectional area of the wire
$l_2$, $l_1$ = Positions of the null points

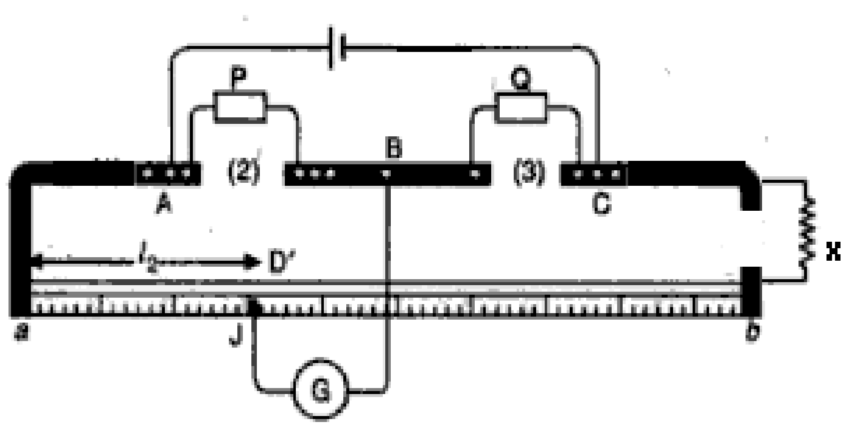


**Figure 1. Carey Foster Bridge circuit diagram**

**THEORY:**
Carey Foster bridge is a modified form of Meter Bridge in which two additional gaps are provided. Two resistances $X$ and $Y$ are connected in the end gaps in series with the bridge wire which virtually increases the length of the bridge wire and makes the arrangement more accurate. This is the first advantage in Carey Foster Bridge over the ordinary meter bridge. The resistances

$P$ and $Q$ are connected in the inner gaps of the bridge. As shown in figure (1), the two arms of bridges are $P$ and $Q$, and the other two are
$R \equiv X + \alpha + \rho_l\, l_1$ and $S \equiv Y + \beta + \rho_l (L - l_1)$, where $\alpha$ and $\beta$ are the end resistances and $\rho_l$ is the resistance per unit length. According to Wheatston's bridge theory, the point $N$ will be null, if at $N$

$$\frac{P}{Q} = \frac{R}{S} = \frac{X + \alpha + \rho_l l_1}{Y + \beta + \rho_l (L - l_1)} \qquad (1)$$

If the positions of $X$ and $Y$ are interchanged and a null point is sought out for the second point at $l_2$, the condition becomes

$$\frac{P}{Q} = \frac{Y + \alpha + \rho_l\, l_2}{X + \beta + \rho_l (L - l_2)} \qquad (2)$$

Now from equation (1)

$$\frac{P}{Q} + 1 = \frac{X + Y + \alpha + \beta + \rho_l L}{Y + \beta + \rho_l (L - l_1)} \qquad (3)$$

Now from equation (2)

$$\frac{P}{Q} + 1 = \frac{X + Y + \alpha + \beta + \rho_l\, L}{X + \beta + \rho_l (L - l_2)} \qquad (4)$$

Equating the right hand sides of equations (3) and (4) as both are equal to $\frac{P+Q}{Q}$ and noting that their numerators are also equal, we get

$$X + \beta + \rho_l L + \rho_l l_2 = Y + \beta + \rho_l L + \rho_l l_1$$

or $\quad X - Y = (l_2 - l_1)\, \rho_l$

$$\rho_l = \frac{X - Y}{(l_2 - l_1)} \qquad (5)$$

Note that as a result of the above procedure the unknown end resistances $\alpha$ and $\beta$ are eliminated. This is the second advantage in Carey-Foster's bridge over the ordinary meter bridge. In this experiment a metal strip is used in place of resistance $Y$ so that $Y = 0$ and therefore,

$$\rho_l = \frac{X}{(l_2 - l_1)} \qquad (6)$$

The specific resistance $(\rho_S)$ of the material of the wire of unit length and unit cross-sectional area is given by

$$\rho_S \;=\; \rho_l\; A = \rho_l\left(\pi\, r^2\right) \quad \Omega - cm$$

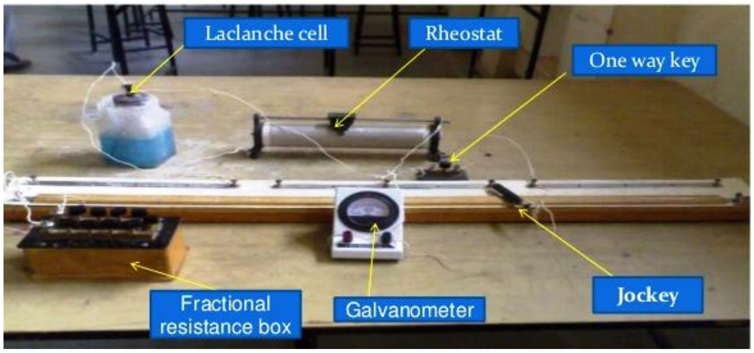


**Figure2. Carey Foster Bridge in the Lab.**

**PROCEDURE:**

(1) Make the connection as shown in figure(1)
(2) Place two equal small resistances $P$ and $Q$ (between $1\,\Omega$ *to* $10\,\Omega$) in gaps 2 and 3.
(3) Connect fractional resistance $X$ in the fractional resistance box in gap 1 and the metal strip in gap 4.
(4) Introduce some resistance (Say $X = 0.1\Omega$ ) in the fractional resistance box by opening the plug.
(5) Find the null position N in the galvanometer G by sliding the jockey J.
(6) Measure the distance of the null point $l_1$ from the left end.
(7) Now interchange the position of metal strip and fractional resistance box (i.e. metal strip in gap 1 and resistance box in gap 4.
(8) Find the new null point N' and measure the distance $l_2$ from the left end.
(9) Repeat the process for different values of the fractional resistance $X$ .
(10)Repeat the completer procedure for reverse current by interchanging the connection of the battery.

**OBSERVATIONS:**

(1) Radius of the constantan wire $(r)$ = ………cm.
(2) $P = Q = \ldots\ldots\ldots\ldots\ldots\ldots\ldots\Omega$

| S.No. | Resistance $(X)$ introduced in fractional resistance box. (In $\Omega$) | Position of null point | | $(l_2 - l_1)$ (In cm) | $\rho_l = \frac{X}{(l_1 - l_1)}$ (in $\Omega / cm$) |
|---|---|---|---|---|---|
| | | Left gap $l_1$ (in cm) | Right gap $l_2$ (in cm) | | |
| 1. | 0.1 | | | | |
| 2. | 0.2 | | | | |
| 3. | 0.3 | | | | |
| 4. | 0.4 | | | | |
| 5. | 0.5 | | | | |

**CALCULATIONS:**

(1) Resistance per unit length, $\rho$

$$\rho_l = \frac{x}{l_2 - l_1} = \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \Omega - Cm$$

Mean $\rho = \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \Omega - Cm$

(2) Specific resistance $\rho_s = \rho_l \ A = \ldots\ldots\ldots\ldots \Omega - Cm$

**RESULT:**

(1)Specific resistance $(\rho_s)$ of the material of the wire is ………… $\Omega - Cm$.

(2) Standard result = 49.1 x $10^{-6} \Omega - Cm$ .

**Error:**

% error =…………………

**PRECAUTIONS:**

1. Connections should be tight.
2. Thick copper wire should be used for connections.
3. In order to eliminate the effect of any thermo-current, null point should be noted both for direct and reverse current.
4. While sliding over wire, jockey should not be pressed.
5. To avoid self discharge, battery connections should be removed when the reading is not being taken.

## VIVA-VOCE

(1) What is electrical resistance?
(2) What is specific resistance?
(3) What is Meter Bridge?
(4) What is Carey Foster Bridge?
(5) What are end resistances?
(6) Why Carey Foster bridge is more accurate than Meter Bridge?
(7) What is galvanometer and its function in an electrical circuit?
(8) What is Leclanche cell?
(9) Does specific resistance depends on the dimension of wire?
(10) Why copper strip is introduced in an additional gap?