Exp. 48A. Resistance of a coil by Carey Foster's bridge

Object

To determine the resistance of a coil by Carey Foster's bridge wire and to determine the resistance per unit length of the same.

Apparatus

Carey Foster's bridge, Leclanche cell, resistance box, two approximately equal resistances, the unknown resistance and a galvanometer.

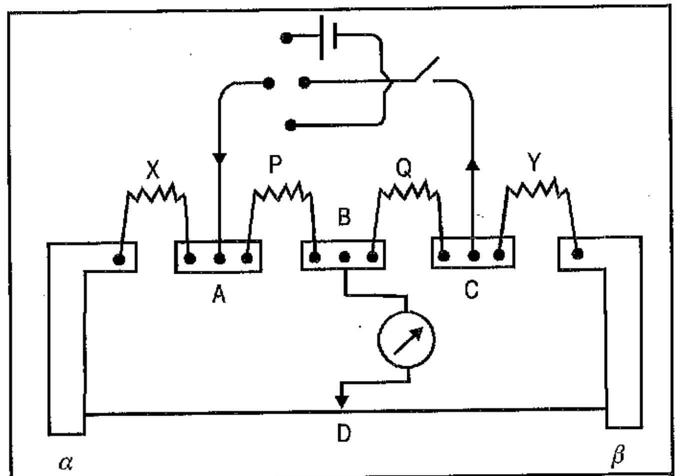

Fig. 48.1

Theory

Carey Foster's 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 to be in series with the bridge wire. This virtually lengthens the bridge wire and makes the arrangement more accurate. Resistances P and Q. (approximately equal) are connected in the inner gaps (fig. 48.1).

Let α and β be the end resistances and let the null point be obtained at a distance l_1, form one end, then

$$\frac{P}{Q} = \frac{X+\alpha+\rho l_1}{Y+\beta+\rho(100-l_1)} \qquad ...(1)$$

where ρ is the resistance per unit length of the bridge wire. Suppose, the null point is obtained at a distance l_2 from the same end when X and Y are interchanged. Then

$$\frac{P}{Q} = \frac{Y+\alpha+\rho l_2}{X+\beta+\rho(100-l_2)} \qquad ...(2)$$

Equating (1) and (2) and simplifying, we get

$$X - Y = \rho\ (l_2 - l_1) \qquad ...\ (3)$$

which is independent of the end resistances.

Let Y be replaced by a thick copper strip and X by a fractional resistance box R. If the balance points are now situated at distances l_1 and l_2' from the left end,

$$\rho = \frac{R}{l'_2 - l'_1} \quad [\because\ Y = 0] \qquad ...(4)$$

Thus, knowing ρ from (4), X can be found out from (3) for known values of Y.

:re

:he connections are made as shown in fig 48.1. For the ratio arms, two :qual (if not, approximately equal) resistances P and Q are chosen.

:he copper strip is connected in the right gap of the bridge and a decimal esistance box in its left gap. The null-point is determined and its distance l_1' from the left end of the bridge is measured. The position of the fractional esistance box and the copper strip are interchanged and the distance l_2' f the new balance point from the left end is measured. Thus, several eadings are noted for different values of fractional resistance both for irect and reverse currents ρ is calculated.

:e unknown resistance is placed in the left gap in place of X, and a esistance box in the right gap in place of Y. Similarly, as above, terchanging X and Y, the two balancing lengths l_1 and l_2 both with rect and reverse currents are found out. Knowing Y and ρ, X can be lculated.

ons

termination of ρ

)	Distance of the balance point from the left end when R is in the						$l'_2-l'_1$ (in cm)	$\rho = \frac{R}{l_2'-l_1'}$
	Left gap (l_1' in cm)			Right gap (l_2' in cm)				
	direct current	reverse current	mean	direct current	reverse current	mean		
							Mean	

rmination of unknown resistance X

	Distance of the balance point from the left end when X is in the						$l_2 - l_1$ (in cm)	$X = Y + \rho\ (l_2 - l_1)$ (ohm)
	Left gap (l_1 cm)			Right gap (l_2 cm)				
	direct current	reverse current	mean	direct current	reverse current	mean		

Calculations

$$\rho = \frac{R}{l_2' - l_1'} = \ldots \text{ ohm/cm.}$$

$$X = Y + \rho\ (l_2 - l_1) = \ldots \text{ ohm.}$$

Result

Resistance per unit length = ... ohm/cm.

Resistance of the coil (correct to significant figures) = ... ohm.

Advantages of Carey Foster's bridge :

1. By introducing extra resistance in the two out gaps, the effective length of the bridge wire has been apparently increased, thereby increasing the accuracy and sensitivity of the bridge.
2. The end corrections are eliminated.

Precautions

(*i*) The connections should be tightly made. Fractional resistance box and the other resistance coils (which are generally small) should be connected in the respective gaps with thick copper wires, so that the connecting wires may not have their own extra resistances.

(*ii*) In order that the bridge may have high sensitiveness, the resistances of the four arms should be of the same order.

(*iii*) The cell circuit should be closed before making the galvanometer circuit. Reverse procedure should be followed while switching off the current.

(*iv*) While determining ρ, the value of R should be adjusted to obtain the two null points as near the ends as possible. This makes $(l_2' - l_1')$ very nearly equal to the entire length of the bridge wire and the error due to non-uniformity of the wire will be reduced to a minimum.

(*v*) In order to eliminate the effect of any thermo-currenr flowing in the circuit, the null points are noted both for direct and reverse currents.

Exp. 48B. Temperature coefficient of resistance by Carey Foster's bridge

Object

To determine the temperature coefficient of resistance for platinum by Carey Foster's bridge.

Apparatus