OPERATING INSTRUCTIONS FOR DETERMINATION OF LOW RESISTANCE BY KELVIN'S DOUBLE BRIDGE

OBJECT:

To determine very low resistance by Kelvin's double bridge.

APPARATUS:

Kelvin's double bridge super sensitive galvanometer, Battery eliminator and copper wire whose resistance is to be found.

THEORY:

Let Y be the unknown and X standard known resistance of same order. R_1, R_2, R_3, R_4 are non inductive resistances of higher values as compared to X, Y.

The Balance is obtained when the points B and D are at the same potential. The current at A divides into I_1 and Ix in arms R_1 and X respectively and I_3 passes through R_3, Potential drop on AD arm = I_1R_1. The sum of potential drops across X and R_3 = Ix X + I_3R_3

But potential at B and D are the same for no deflection in galvanometer, which implies that –

$$I_1R_1 = Ix\ X + I_3R_3 \text{ …….. (1)}$$

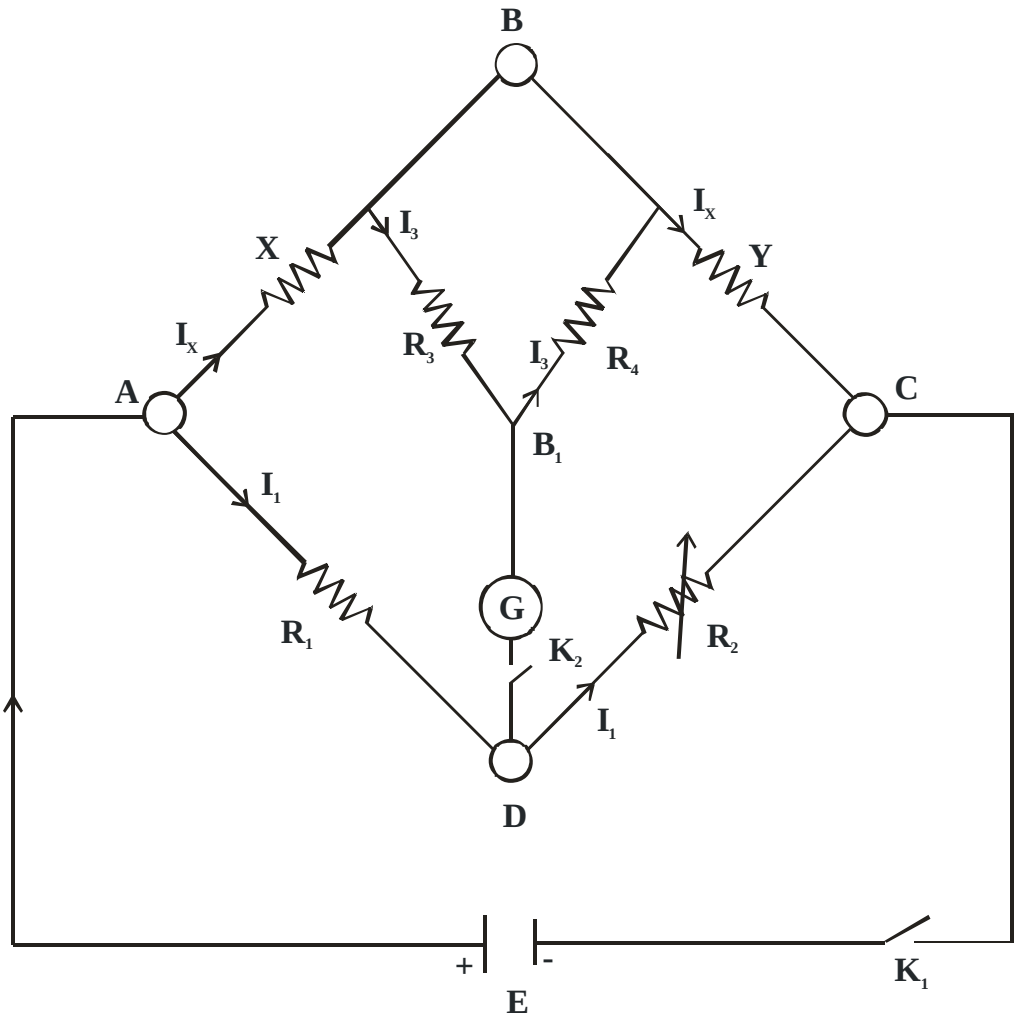

Fig. (1)

Similarly,

P.D. across R_2 = P.D. across R_4 + P.D. across Y

or $I_1R_2 = I_3R_4 + I_x Y$ …… (2)

From (1) and (2) we get

$I_X X = I_1R_1 – I_3R_3$

$I_X Y = I_1R_2 – I_3R_4$

Dividing

$$\frac{Y}{X} = \frac{I_1R_2 - I_3R_4}{I_1R_1 - I_3R_3}$$

or $$\frac{X}{Y} = \frac{R_2\left[I_1 - I_3\frac{R_4}{R_2}\right]}{R_1\left[I_1 - I_3\frac{R_3}{R_1}\right]}$$

But $$\frac{R_1}{R_2} = \frac{R_3}{R_4} \text{ or } \frac{R_4}{R_2} = \frac{R_3}{R_1} = K$$

$$\therefore \frac{Y}{X} = \frac{R_2\left[I_1 - I_3K\right]}{R_1\left[I_1 - I_3K\right]}$$

or $$\frac{Y}{X} = \frac{R_2}{R_1}$$

or $$\boxed{Y = X\frac{R_2}{R_1}} \quad \text{..... (3)}$$

This equation gives the value of Y in terms of known X_1R_1, R_2 resistances.

PROCEDURE:

Refer to Fig. (1) and make connections accordingly.

1. Connect the unknown low resistance in place of Y.
2. Fix ratio $R_2 : R_1 = 1 : 1$.
3. Now vary standard resistance X so that on closing battery key K_1 and then galvanometer key K_2 null position in galvanometer is obtained. Calculate unknown resistance using formula (3).
4. Repeat the experiment with $\frac{R_2}{R_1} = \frac{1}{10}$ and $\frac{R_2}{R_1} = \frac{1}{100}$

and find the final mean value of Y.

OBSERVATIONS:

Ratio $\frac{R_2}{R_1}$	Value of Standard Resistance X Ohms	$Y = X \frac{R_2}{R_1}$	Final Value Y Ohm
1 : 1 1 : 10 1 : 100			

RESULT:

The value of unknown low resistance as determined by double Kelvin's bridge is ————— Ohm.

PRECAUTIONS:

1. Galvanometer should be of high sensitivity.
2. Short and thick copper wires should be used for connections if necessary.
3. Battery should supply sufficient current.

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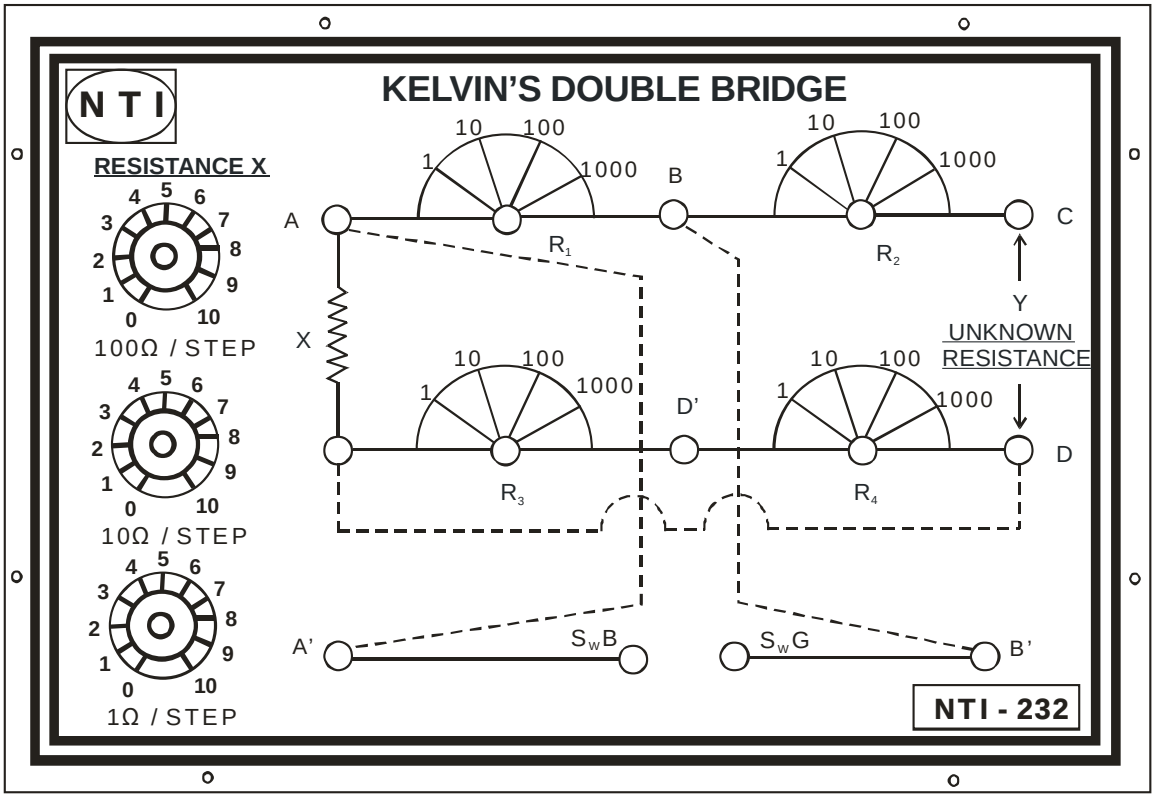

Fig. (2) Panel Diagram

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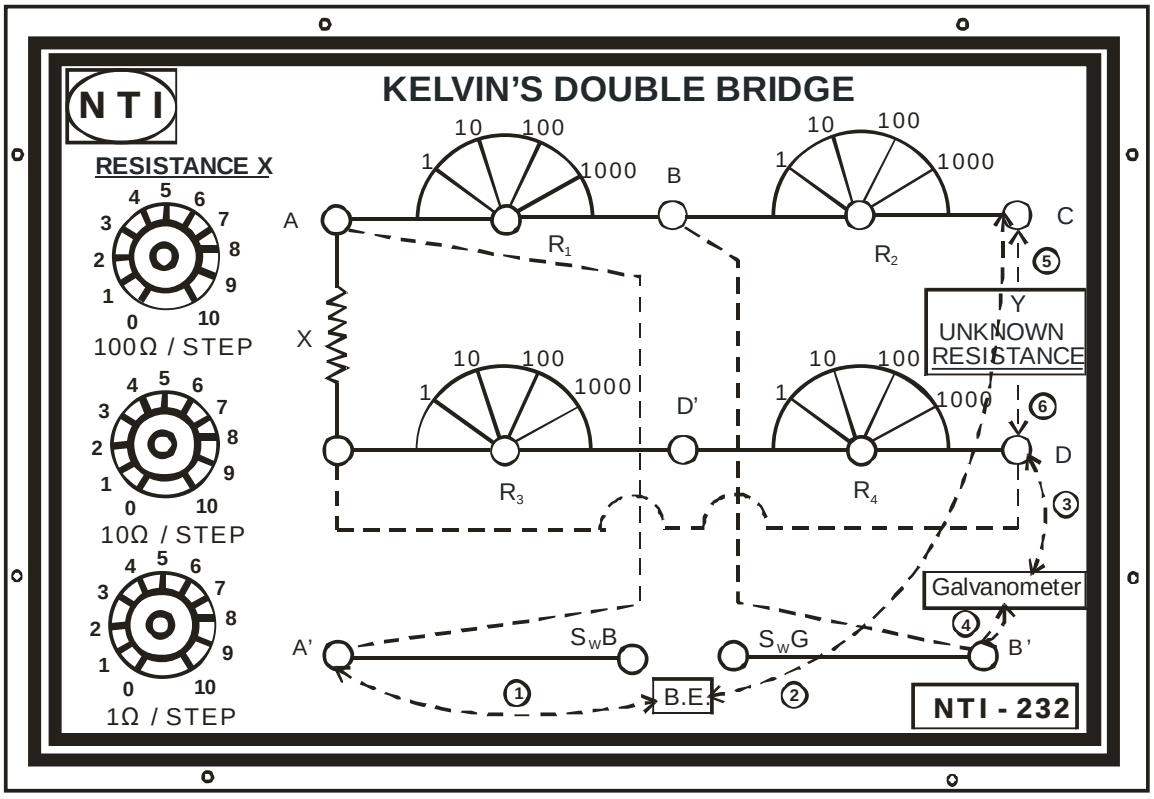

Fig. (3) Connections for Kelvin's Double Bridge

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