Experiment: Wheatstone Bridge Experiment

Purpose

To learn how to measure the value of resistance of different metal wires using a Wheatstone bridge.

Theory

A Wheatstone bridge is an electrical circuit used to measure an unknown electrical resistance as shown in Fig. 1.There are four resistances named R1 ,R2

,R3 and R4 and G is the galvanometer. When the switch is turned on, it means that the current which flows through R1 and R2

should be the same, and represented by 1I , the current which flows through R3 and R4 is the same, and represented by I2 . The potential difference between two points A and B is zero. The potential of the two points is the same, so

$$I_1 R_1 = I_2 R_3 \quad (1)$$

$$I_1 R_2 = I_2 R_4 \quad (2)$$

Divide the above equations, we obtain

$$\frac{R_1}{R_2} = \frac{R_3}{R_4} \quad (3)$$

or

$$R_2 = R_1 (\frac{R_4}{R_3}) \quad (4)$$

From the above equations, if R_2 is the unknown resistance, the other three resistances are known, we can obtain the value of the resistance using the above method.

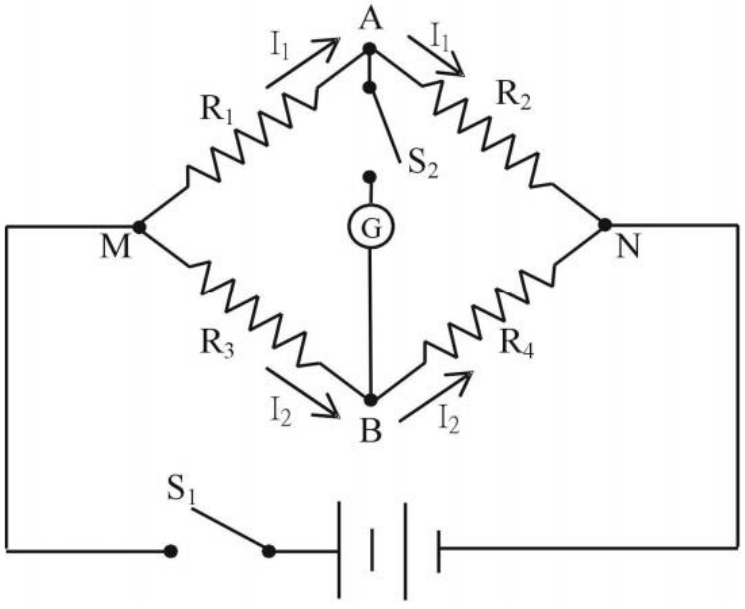


Fig.1

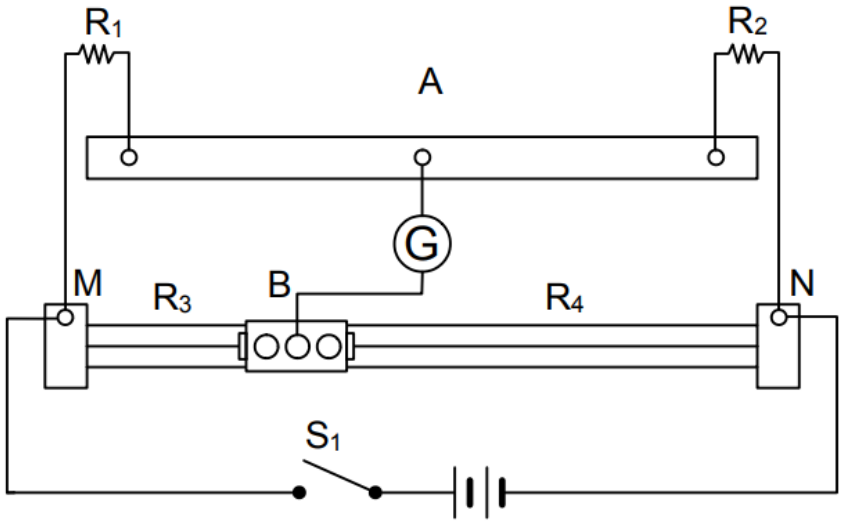


Fig.2

The Wheatstone bridge circuit is as shown in Fig. 2. MN is the metal wire, the point B divides MN into MB and BN , and the resistances are R3 and R4 Each resistance is proportional to its length, so

$$R = \rho \frac{L}{A} \qquad (5)$$

ρ is the resistivity, L is the wire length, and A is the wire cross-sectional area. So

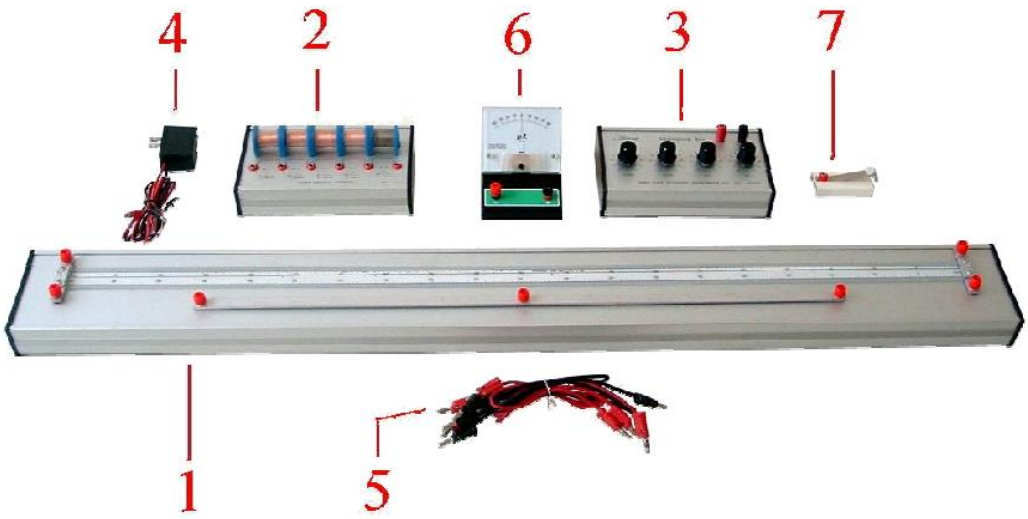
the ratio of R3 and R4 is equal to the ratio of MB and BN . If we can find a spot

to make the reading become zero, and equation (5) can be written as:

$$R_2 = R_1 \left(\frac{\overline{BN}}{\overline{MB}}\right) \qquad (6)$$

We can set the variable resistance as R1 , different resistance values can

Instrument



NO	Accessory	Quantity
1	Slide Wire Bridge	1
2	Unknown Resistance Box	1
3	Variable Resistance Box	1
4	DC Power Supply	1
5	Wire	6
6	Galvanometer	1
7	Probe	1

Procedure

1. Set up the wires as shown in Fig. 2. R_1 is the resistance of the variable resistance box, R_2 is the resistance of the unknown resistance box, G is the galvanometer, and B is the probe.

2. Turn on the power supply power supply and adjust the resistance. Then, push the probe to make it connect to the metal line. The galvanometer deflects at this time, but if deflection is too large, you need to adjust the resistance to an appropriate value. When the deflection is small, move the probe to make the galvanometer reading back to zero, then we can obtain the length of MB and BN.

3. According to equation 1 to 6 to obtain the value of R_2, and substitute R_2 into equation 1 to 5 to obtain the coefficient of resistance of the unknown resistance.