To Convert the Given Galvanometer (Of Known Resistance & Figure Of Merit) Into An Ammeter Of Desired Range & to Verify the Same

Aim

To convert the given galvanometer (of known resistance and figure of merit) into an ammeter of desired range and to verify the same.

Apparatus

A Weston type galvanometer, an ammeter of 0-3 A. range a battery of two cells or battery eliminator, two (10,000 Ω and 200 Ω) resistance boxes, two one way keys, a rheostat, connecting wires and a piece of sand paper.

Theory

The shunt resistance required for conversion,

$$S = \frac{I_g \cdot G}{I - I_g}$$

where I is the range of conversion.

Circuit diagram

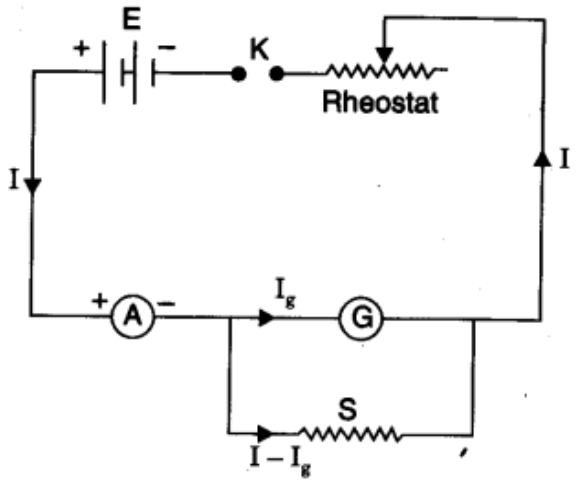

Fig. Circuit diagram for verification for ammeter.

Procedure

1. Count the total number of divisions on either side of zero of the galvanometer scale. Let it be n.
2. Calculate the current (I_g) for full scale deflection i.e., $I_g = nk$.
3. Calculate the value of shunt resistance, for conversion into ammeter, using the formula,

   $$S = \frac{I_g \, . G}{I - I_g}$$

   where I is the range of conversion.
   (The value of shunt resistance S is usually very small and a resistance box of that range is not available. Such small resistances are obtained by taking wires of copper, constantan, manganin, eureka, etc., of a suitable diameter and length).
4. Cut a length of the wire 2 cm more than the calculated value l. Mark two points on the wire, one cm away from each end. Connect this wire to the two terminals of the galvanometer such that the marked points are just outside the terminal screws. This galvanometer with shunt wire, will now work as an ammeter of range I.
5. Make the electric connections as shown in circuit diagram.
6. Insert the key and adjust the rheostat so that the galvanometer shows nearly maxi-mum deflection.
7. Note the reading on the galvanometer scale and also corresponding reading on the ammeter.
8. Record your observations.

Calculations

Resistance of the galvanometer, $G = \ldots\ldots$

$\therefore$ Figure of merit, $k = \ldots\ldots$

Number of divisions in the galvanometer scale, $n = \ldots\ldots$

Current for full scale deflection, $I_g = nk$

$= \ldots\ldots$

Range of conversion, $I = \ldots\ldots$

$\therefore$ Shunt resistance $S = \frac{I_g \, . G}{I - I_g} = \ldots\ldots$

Verification

Least count of the galvanometer converted into ammeter

$$= \frac{I}{n}$$

$$= .....$$

Table for verification for converted ammeter

Serial No. of Obs (1)	*Galvanometer Reading*		*Ammeter Reading* I_2 (A) (3)	*Difference (Error)* $I_2 - I_1$ (A) (4)
	Deflection θ (2a)	*Current in Amp.* $I_1 = \theta \times L.C.$ (A) (2b)		
1.				
2.				
3.				
4.				

Result

As the difference in actual and measured value of currents (as recored, in column 4) is very small, the conversion is perfect.

Precautions

Same as given in Experiment 8.

Viva Voce

Galvanometer

Question. 1. What is a galvanometer?
Answer. It is a device (instrument) used for detecting feeble electric currents in circuits.

Question. 2. What type of galvanometer is available in laboratories?
Answer. The laboratory galvanometer is a Weston Galvanometer. It has a pivoted coil.

Question.3. Why the scale of galvanometer has zero in the middle?
Answer. A needle at zero in the middle can deflect on both sides.

Question.4. Do we have positive and negative terminal in a galvanometer?
Answer. No, a galvanometer has no positive and negative terminals. The pointer can deflect on either side from zero in the middle.

Question. 5. Why the divisions of a galvanometer scale are equally spaced?
Answer. Deflection in pointer is proportional to the current passed. The number of divisions in deflection will be proportional to the current passed. I $\propto = \emptyset$.

Question. 6. Define figure of merit of a galvanometer.
Answer. The quantity of current required to produce a deflection of one division in the galvanometer, is called figure of merit of the galvanometer. It is represented by the symbol k. Its unit is ampere per division.

Question. 7. Define current sensitivity of a galvanometer.
Answer. The deflection produced in the galvanometer when a unit current is passed through it, is called current sensitivity of the galvanometer.

Question.8.How are 'figure of merit' and 'current sensitivity' related to each other?
Answer. They sire reciprocal, $S_1 \propto 1/k$

Question. 9. Why is the galvanometer called a moving coil galvanometer?
Answer. Because in this galvanometer, the coil moves (deflects), while the magnet remains fixed.

Question. 10. Is there any moving magnet galvanometer?
Answer. Yes, the tangent galvanometer is called a moving magnet galvanometer.

Question. 11. Why is tangent galvanometer, called a moving magnet galvanometer?
Answer. Because in tangent galvanometer, the magnet (a small pivoted magnetic needle) moves (deflects), while the coil remains fixed.

Resistance of a galvanometer

Question. 12. What do you mean by resistance of a galvanometer?
Answer. The resistance of the coil of a galvanometer, is called the resistance of the galvanometer. It is represented by the symbol G.

Question. 13. How do you determine the resistance of a galvanometer?
Answer. The resistance of a galvanometer is determined by half-deflection method.

Question.14. Why is this method called half deflection method?
Answer. It is so because the deflection is made half by using a shunt resistance S.

Question. 15. Under what conditions, G = S?
Answer. G = S, only when series resistance R is very high.

Ammeter

Question. 16. What is an ammeter?
Answer. An ammeter is a device (instrument) for measuring large electric currents in circuits.

Question.17. How is an ammeter used in a circuit?
Answer. An ammeter is used in series in a circuit.

Question.18. Why is an ammeter used in series in a circuit?
Answer. The whole current to be measured is passed through it.

Question.19. What are the required properties of an ammeter?
Answer. An ammeter must have a very small resistance (zero, if possible) and a large current carrying capacity.

Question.20. Why should an ammeter have a very small resistance?
Answer. So that when put in series in circuit, it should not reduce much the original current to be measured.

Question. 21. Why should an ammeter have a large current carrying capacity?
Answer. So that it may measure large currents.

Voltmeter

Question.22.What is a voltmeter?
Answer. A voltmeter is a device (instrument) for measuring electric potential difference between two points in a circuit.

Question.23.How is a voltmeter used in a circuit?
Answer. A voltmeter is used in parallel with that branch of circuit at the ends of which the potential difference is to be measured.

Question.24.Why is a voltmeter used in parallel in a circuit?
Answer. The potential difference to be measured is maintained at the terminals of the voltmeter.

Question.25.What are the required properties of a voltmeter?
Answer. A voltmeter must have a very large resistance (infinite, if possible) and a very small current carrying capacity.

Question.26.Why should a voltmeter have a very large resistance?
Answer. So that when put in parallel in circuit, it should not divert much current from parallel branch.

Question.27.Why should a voltmeter have a very small current carrying capacity?
Answer. So that it may not withdraw much current from parallel branch of the circuit.

Conversion of a galvanometer into an ammeter

Question.28.Why is a galvanometer not suitable to work as ammeter?
Answer. A galvanometer has more resistance and less current current-carrying capacity from those required by an ammeter. It will damage when large current flow through it.

Question.29.How is a galvanometer converted into an ammeter?
Answer. A galvanometer is converted into an ammeter by connecting a low resistance in parallel with the galvanometer coil (this parallel low resistance is called shunt).

Question.30.How the low resistance is parallel (shunt) gives required properties to the galvanometer?
Answer. The shunt reduces the overall resistance of the ammeter (converted galvanometer) and increases its current-carrying capacity.

Question.31.What is the order of resistance of an ammeter?
Answer. The ammeter resistance is nearly equal to the shunt resistance.

Question.32.What do you understand by range of an ammeter?
Answer. It is the maximum value of the current which an ammeter can measure.

Question.33.Which has lesser resistance—a 1 ampere range ammeter or a 10 ampere range ammeter?
Answer. Higher the range, lower the resistance. A 10 A ammeter has lesser resistance.

Question.34.What is a milli-ammeter?
Answer. It is an ammeter which measures current in milli amperes (mA = 10^{-3} A).

Question.35.What is a micro-ammeter?
Answer. It is an ammeter which measures current in micro amperes (μA = 10^{-6} A).

Question.36.What is full name of an ammeter?
Answer. Full name of an ammeter is ampere-meter.

Question.37.Can we increase/decrease the range of an ammeter?
Answer. We can increase the range but cannot decrease the range of ammeter because for $I < I_g$, the value of shunt resistance becomes negative which cannot be possible.

Question.38.What happens when an ammeter is placed in parallel with the circuit?
Answer. It cannot measure the current in circuit because it only measures the, current which is passing through it.

Conversion of a galvanometer into a voltmeter

Question.39. Why is a galvanometer not suitable to work as voltmeter?
Answer. A galvanometer has less resistance and more current-carrying capacity from those required by a voltmeter.

Question. 40. How is a galvanometer converted into a voltmeter?
Answer. A galvanometer is converted into a voltmeter by connecting a high resistance in series with the galvanometer coil.

Question. 41. How the high resistance in series gives required properties to the galvanometer?
Answer. The series high resistance increases the overall resistance of the voltmeter (converted galvanometer) and decreases its current-carrying capacity.

Question. 42. What is the order of resistance of a voltmeter?
Answer. The voltmeter resistance is of the order of series high resistance (R is in ten thousands, G is in hundreds).

Question.43. What do you understand by the range of a voltmeter?
Answer. It is the maximum value of the potential difference which the voltmeter can measure.

Question.44. Which has more resistance—a 1 volt range voltmeter or a 10 volt range voltmeter?
Answer. Higher the range, higher the resistance. A 10 V voltmeter has higher resistance.

Question.45. What is a milli-voltmeter?
Answer. It is a voltmeter which measures potential difference in milli-volts (mV = 10^{-3} V).

Question. 46. What is a micro-voltmeter?
Answer. It is a voltmeter which measures potential difference in micro-volts (μV = 10^{-3} V).

Question.47. Does ordinary voltmeter have infinite resistance?
Answer. No.

Question.48. Name a voltmeter which has infinite resistance.
Answer. Electrostatic voltmeter has infinite resistance. It is also called electrometer. An electronic voltmeter, called Vacuum Tube Volt Meter (VTVM), has nearly infinite resistance. It makes an accurate measurement of potential difference. The potentiometer, at null point, also acts as an ideal voltmeter (infinite resistance).

Question.49. Can we increase/decrease the range of a voltmeter?
Answer. Yes. The range of voltmeter can be increased by connecting a suitable high resistance in series and can be decreased a suitable resistance in parallel.

Question. 50. What happens when a voltmeter connected in series in a circuit?
Answer. The voltmeter cannot measure the actual p.d. in the circuit because overall resistance of circuit increases.

Question. 51. What is shunt? State its S.I. unit.
Answer. A small resistance connected in parallel with a galvanometer is called shunt. Its S.I. unit is Olim.

Question. 52. Can moving coil galvanometer be used to detect an a.c. in a circuit? Give reason.

Answer. It cannot be used to detect a.c. in a circuit since it measures the average value of current which is zero over a cycle.

Question. 53. Is the working of MCG affected by the earth magnetic field?

Answer. No. The earth magnetic field is very weak as compared to strong radial magnetic field.

Question. 54. Which has more resistance (a) Ammeter or voltmeter (b) millimeter or ammeter (c) milli voltmeter or voltmeter.

Answer. (a) Voltmeter, (b) millimeter, (c) voltmeter.

Question. 55. What do you mean by the resistance of a galvanometer?

Answer. The resistance offered by the coil of galvanometer to the flow of current through it is known as resistance (G) of the galvanometer.