INTRODUCTION:

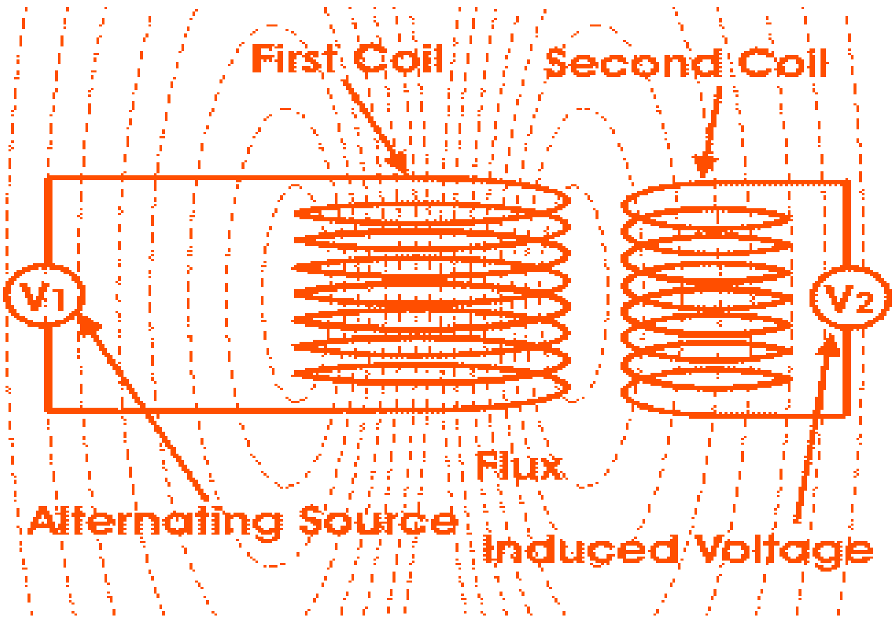
MUTUAL INDUCTION

Self-induction in coil or conductor is actually an induced back emf, which is generated when the magnetic field caused by the current flow cuts the coil or conductor.If the flux lines from the expanding and contracting magnetic field of one coil were to cut the windings of another nearby coil,a voltage would also be induced in that coil.

The amount of emf induced in this way depends on the relative positions of the two coils. Also, the more turns of the second coil that are induced. This inducing of an emf in a coil or conductor by magnetic flux lines generated in another coil or conductor is called the primary, or primary winding, and the one in which the emf is induced is called the secondary

Similarly, the current that flows through the primary is the primary current, and if the secondary is connected to a load so that current flows,
This current is called secondary current. When current flows in the secondary, it sets u its own magnetic field, which induces a voltage back into the primary winding

This effective inductance of two coils that are mutually coupled is called mutual inductance.



AIM :

To study the electromagnetic mutual induction through making a led blub to glow by inducing current on it.

THEORY:

Mutual inductance is the main operating principle of generators, motors, and transformers. It occurs when two coils are brought close together and the magnetic field in one coil links with the other, generating voltage in the second coil. The constant of proportionality between the induced EMF in coil 2 and the current that passes through coil 1 is called mutual inductance. The SI unit of mutual inductance is Henry (H), the same as that of self-inductance. Mutual inductance depends on the geometrical factors of the two coils, such as the number of turns and radii. Its theory is very simple and it can be understood by using two or more coils. It was described by an American scientist Joseph Henry in the 18th century

JOSEPH HENRY

It is referred to as one of the properties of the coil or conductor used in the circuit. The property inductance is, if the current in one coil changes with time, then the EMF will induce in another coil. Oliver Heaviside introduced the term inductance in the year 1886. The property of mutual inductance is the working principle of many electrical components that run with the magnetic field. For example, the transformer is a basic example of mutual inductance. The main drawback of the mutual inductance is, leakage of the inductance of one coil can interrupt the operation of another coil utilizing electromagnetic induction. To reduce the leakage, electrical screening is required

The positioning of two coils in the circuit decides the amount of mutual inductance that links with one to the other coil.

Mutual Inductance of Two Coils:

The mutual inductance of two coils can be increased by placing them on a soft iron core or by increasing the no of turns of the two coils. Unity coupling exists between the two coils when they are tightly wound on a soft iron core. The leakage of flux would be small.

If the distance between the two coils is short, then the magnetic flux produced in the first coil interacts with all the turns of the second coil, which results in large EMF and mutual inductance. (fig1.3)

If the two coils are farther and apart from each other at different angles, then the induced magnetic flux in the first coil generates weak or small EMF in the second coil. Hence the mutual inductance will also be small.(fig 1.4)

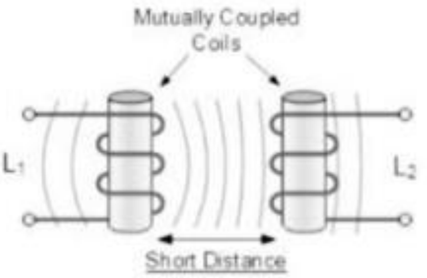


Figure 1.3

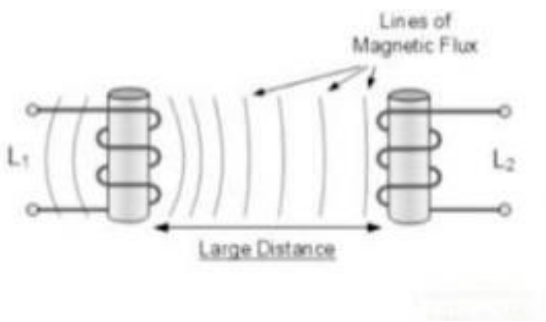


Figure 1.4

Applications

The applications of mutual inductance are :

- Transformer
- Electric Motors
- Generators
- Other electrical devices, which work with a magnetic field.
- Used in calculation of eddy currents
- Digital signal processing

MATERIALS REQUIRED:

1) Copper wires
2) Solenoid
3) Push Switch
4) Battery
5) Compact fluorescent lamps (CFLs)

PROCEDURE:

1) Connect the copper wires on both the terminals of the battery

2) The switch should be connected to the wire from the positive (‘+’ ve)
terminal of the battery

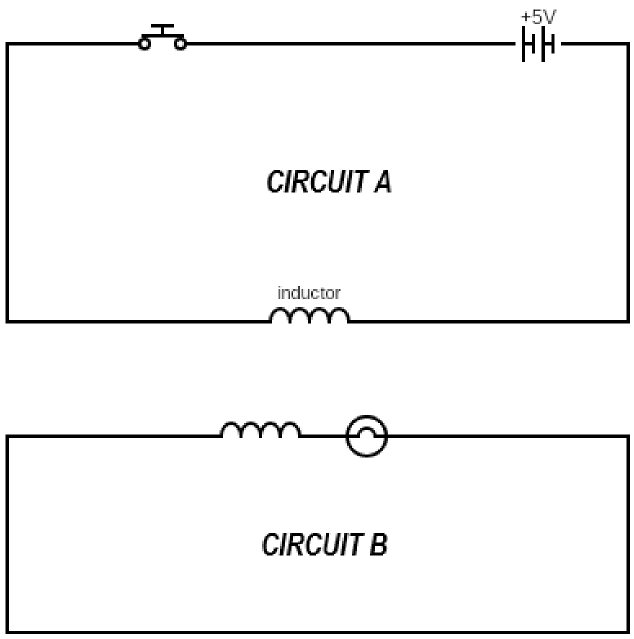
3) Connect the solenoid carefully to the switch.Then complete the circuit A by making it closed.

4) Construct another circuit (B), Connect the Copper wire to another inductor.

5) Join the Inductor to the compact fluorescent lamps (CFLs)

6) Close the circuit

7) Place the two Circuits (A and B) to near to each other separated by a short distance.



OBSERVATION:

- When the switch is closed we can observe that current flows through the copper wire as the solenoid starts inducing current on another solenoid.

- The induced current supplied through the solenoid connected in the circuit B starts passing the current to the compact fluorescent lamp (CLFs)and the blub starts to glow

- With separation of the two circuits with a large distance. There is no induction of current between both the circuits.

PRECAUTIONS:

1) Make sure if the switch is functioning well.

2) Make sure that the wires are connected properly to the all the devices in the circuit.

3) The circuits should not be separated by a far distances

4) Check for faulty devices

RESULTS:

The bulb glows brightly due to the passing electricity caused by the mutual induction of current from solenoid of circuit A to circuit B.

CONCLUSION:

In this project on Electromagnetic Mutual Induction, we successfully demonstrated the fundamental principles underlying the phenomenon. By constructing two circuits, A and B, each containing a solenoid, we illustrated how a changing magnetic field in one circuit can induce an electromotive force (EMF) in another.

When electric current was passed through the solenoid in Circuit A, it generated a magnetic field. Bringing Circuit A close to Circuit B, which also contained a solenoid, allowed this magnetic field to influence Circuit B. As a result of Faraday's Law of Electromagnetic Induction, the changing magnetic field from Circuit A induced a current in the solenoid of Circuit B. This induced current was sufficient to power a small LED bulb, causing it to glow.

This experiment not only confirmed the theoretical predictions of mutual induction but also highlighted the practical applications of this phenomenon in various technologies such as transformers, wireless charging systems, and inductive coupling devices. The results reinforce the concept that a time-varying magnetic field is a powerful method to transfer energy between two circuits without direct electrical contact.

Through this investigation, we have gained a deeper understanding of electromagnetic induction, the relationship between electric currents and magnetic fields, and the importance of mutual induction in electrical engineering and modern technology.

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