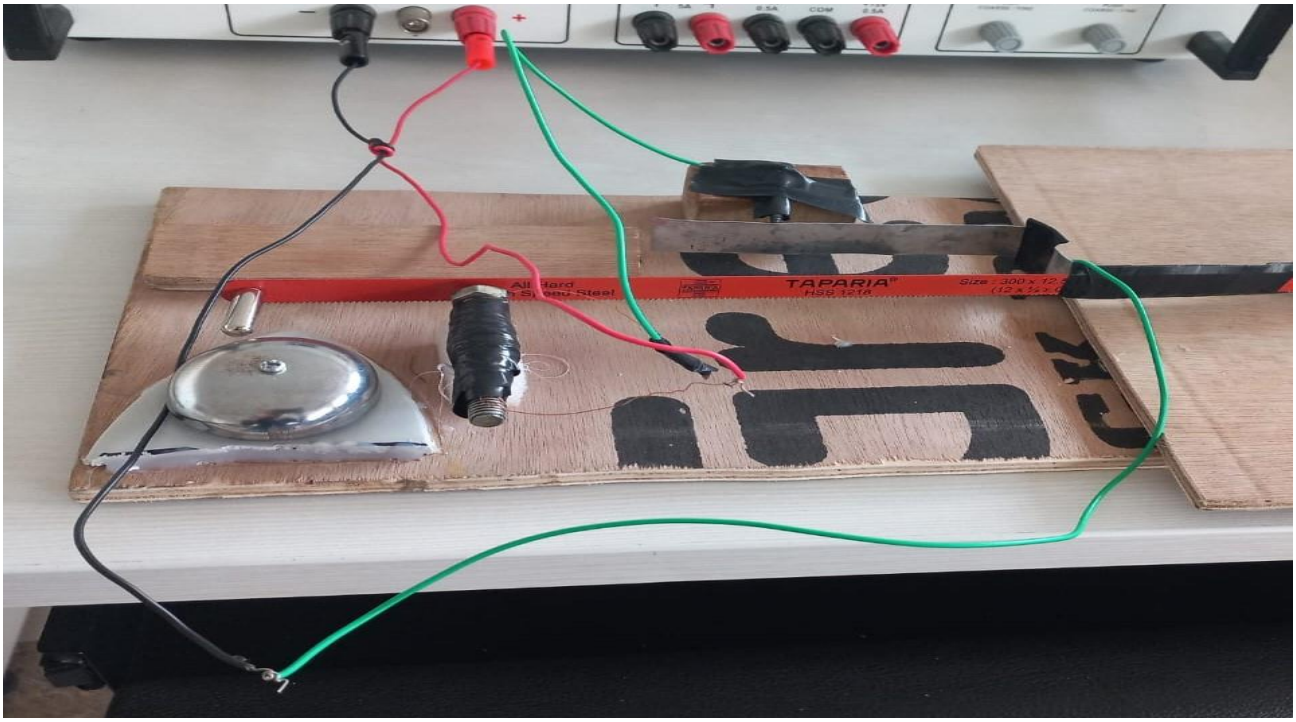
PH 102 Project Report



Calling Bell by method of induction (Motor less bell)

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AIM OF THE PROJECT

Designing and constructing a Motor Less Calling Bell by method of Induction

MATERIALS REQUIRED

1. Gong: A half sphere shaped metal part.

2. Two Mild Steel Nails: One to be used as the core material for the Electromagnet, due to its Ferromagnetic Properties.

The other one to be used as a contact making and breaking point in the Circuit.

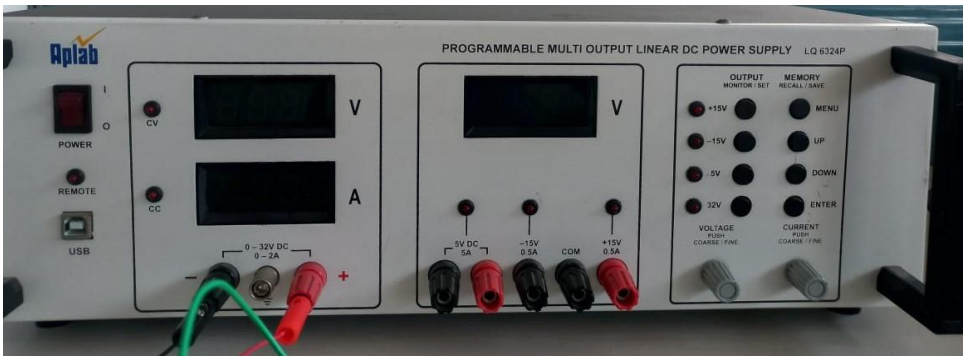
3. Enameled Copper Wire (diameter – 0.25mm): Used as the winding wire on the electromagnet core.

4. Galvanized Iron metal Strip

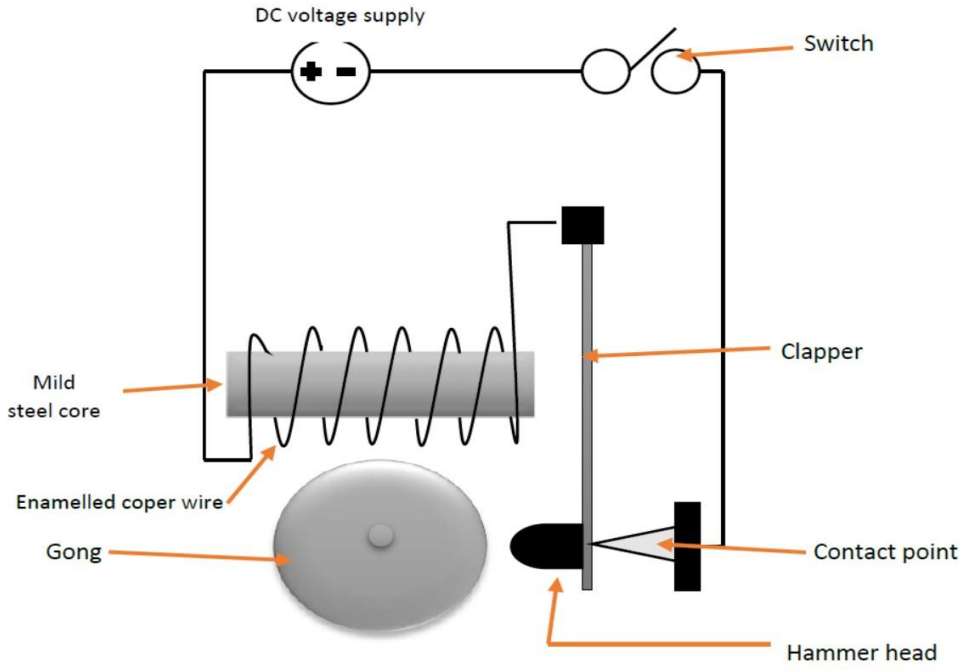
5. Clapper: material is High speed steel (HSS)

6. Hammer head: From the three-plug switch pin.

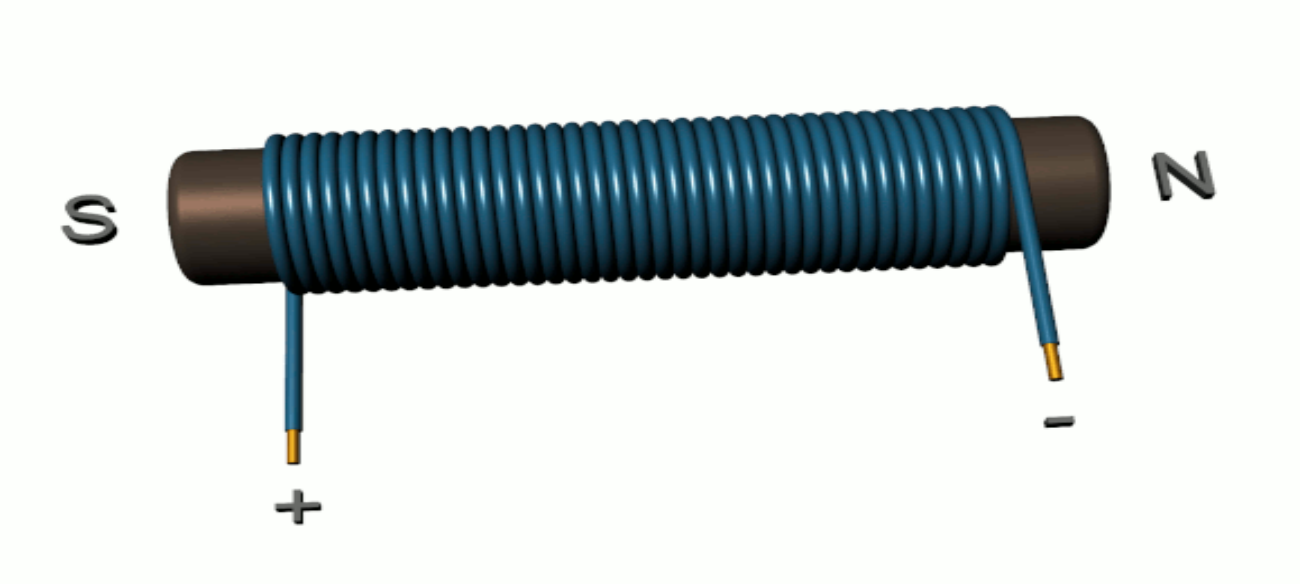
7. Linear DC Power Supply (0-30V, 0-2A)



CIRCUIT DIAGRAM



WORKING PRINCIPLE OF AN ELECTROMAGNET

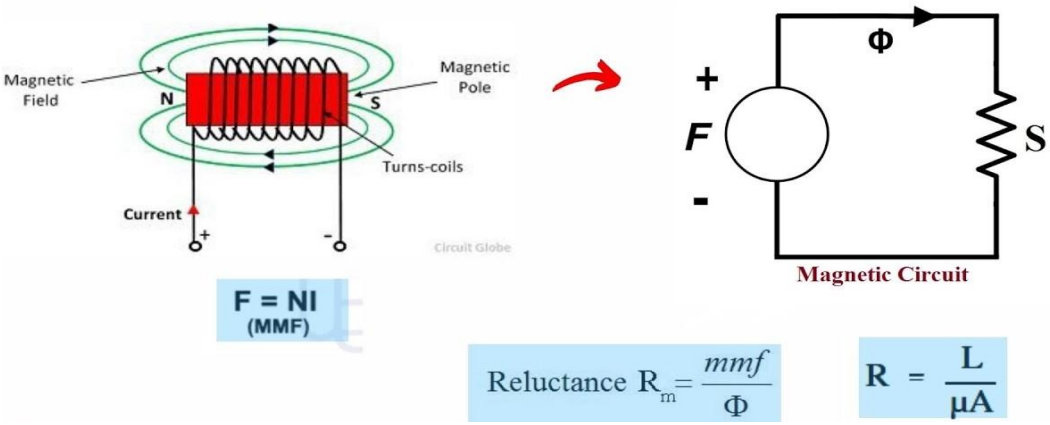


An Electromagnet can be constructed by winding an insulated copper wire on a ferromagnetic material.
An electromagnet works on principle of electromagnetic induction.
When electric current is passed through the windings the particles of the ferromagnetic material get charged and align and magnetic field is induced in the material.

The strength of the Induced Magnetic field depends upon:

1. Magnetizing Current(I): Increasing the current value leads to increased mmf, hence magnitude of Magnetic flux also increases.

2. Number of turns of the winding(N): Increasing the Number of turns again leads to increased mmf and hence increased induced Magnetic flux.
3. Core Material: Every core material will have its own value of permeability. More the permeability(μ), lesser will be the Reluctance and more will be the Magnetic flux through the core material.
4. Wire Material: Most commonly used windings are copper wires, Aluminum being a good alternative for economical reasons but due to its lower conductivity it will require a larger cross-sectional area to flow the same amount of current in it. Oxygen free copper (OFC) is often used as winding when higher amount of heat is generated.



B = μH , Where

N = Number of turns of the winding around the core

I = Magnetizing Current

F = Magnetomotive force

B= Magnetic flux density,μ= Permeability of the core material

Based on these parameters the electromagnet can be designed that will produce the required amount of Magnetic flux density and also the most economical. Like every Wire has a limit current rating which should not be crossed but if more Magnetic flux is to be induced increasing the number of turns or using a core having higher μ value will help in getting the required result.

WORKING OF THE CALLING BELL

1. When the wires are connected, and the power supply is turned on the circuit is completed and current starts flowing through the circuit.
2. The current through the windings on the core of electromagnet acts as magnetizing current and induces magnetic flux through the mild steel core.

3. This turns the mild steel core in a temporary magnet known as an Electromagnet.

4. This electromagnet attracts the metal strip of the clapper and then two things happen at the same time: (1). The metal hammer head of the clapper strikes the gong and a ringing sound is produced. (2). The connection in the circuit is broken as when the clapper moves towards the electromagnet it loses its contact with the contact nail, through which

the current was flowing in the clapper.

5. The broken connection leads to no current in the winding, so the core loses its magnetization and the clapper, no longer being attracted towards the magnet, returns back to its original position.
6. The connection is again made between the metal strip of clapper and the contact nail
7. The current flows again, magnetic field is induced again and the bell rings again.
8. This keeps happening until the power supply is turned off.

CHALLENGES FACED

- Supply of enough magnitude of magnetizing current: A 9V DC battery could not supply enough power to

the circuit to magnetize the electromagnet's core. Hence, a Linear DC Power Supply is used to supply the voltage of 11V across the circuit. This happened due to the load resistance in the circuit being too high that could not be overcome by the 9V DC battery.

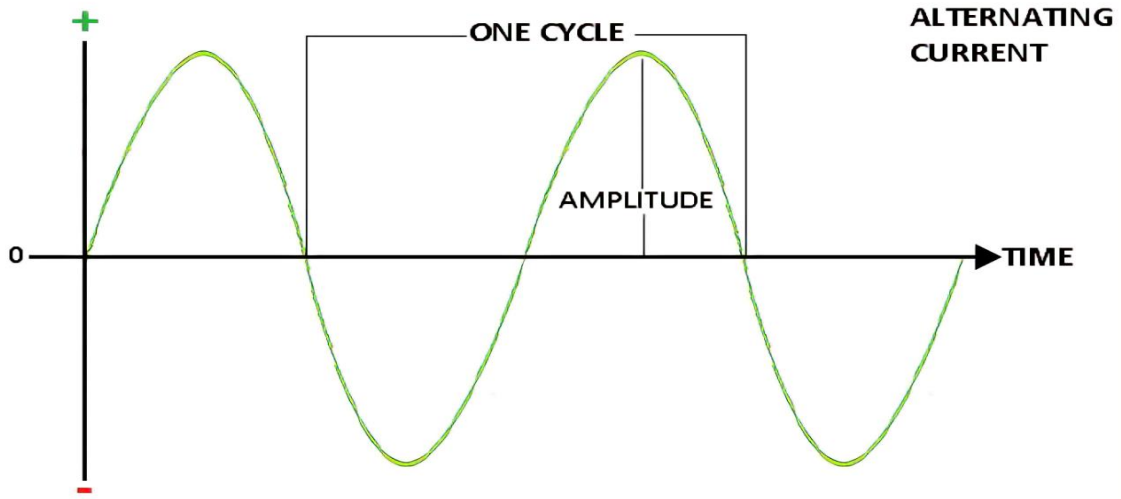
- Thin layer of insulation on the magnet wire (winding wire): Usually the wires that are used in the construction of transformers, inductors, motors, electromagnets etcetera are enameled. Wire enamels are applied on the wires with heat and provide electrical insulation. But in the circuit the current flowing is already a few amperes is obstructed from its flow by that the insulation making it difficult for the core of electromagnet to be magnetized. So, the coating needed to be burned off burned off from the ends where the connections were to be made. Some examples of wire enamels:

Nylon enamels, polyester enamels etcetera.

- Limit to magnetization of the core material: Mild steel is magnetized to lesser amount as compared to iron, due to the presence of carbon in it, which is not ferromagnetic. Hence, magnetic flux generate is also less.

OTHER WAYS OF CONSTRUCTING THE BELL

- Using an AC power Source: The most important aspect of the electric bell is magnetization and demagnetization of the electromagnet's core. As AC changes its magnitude and direction periodically with time, So if AC is used as input the there would be no need to make the contact nail and strip mechanism to break the circuit after each strike of the bell. The AC itself will lead to magnetization and demagnetization of the core.



Spring Mechanism: In place of the nail and strip contact mechanism, a small metal rod stuck in a spring of a specific spring constant can be used. As when it gets attracted by magnet and the gong is hit, the spring will extend and a restoring force will at on the spring and the rod, hence pulling it back to its original place. This will happen in repetition and the ringing will continue.

CONCLUSION

Following the invention of Electromagnet by William Sturgeon in 1823, Electric Bells were one of the first invention that used to an electromagnet in its construction. Nowadays, even if Electric Bells are being replaced or almost replaced, they are still used in many ways like as Buzzers, Telephone Bells, Fire Bells etcetera. This Project along with help in gaining more

understanding of the working of an electromagnet, also helped in the aspect of acquiring practical skills for the construction of a motor less Bell.