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Capacitor Driven Coil Gun

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Abstract:- **In this paper we have to discussed about single stage capacitor driven coil gun. In this coil gun we can take a solenoid metal pipe on which number of turns of copper wire are wounded. because of that winding when we applies a electric supply to the windings there is a magnetic field is produced in that winding. Which is helpful us to target our object with high speed and accuracy. In whole process the acceleration projectiles are plays very important role. In this coil gun we have to study about charging capacitors, voltage booster circuit and calculations of speed and velocity of bullet. Basically capacitor driven coil gun works on the principle of Magnetic Induction. Also it has applications such as high speed transit, military defense purpose and space vehicle launching.**

Keywords*:* Coil gun, Electromagnetic Launchers, Magnetic Induction, Projectiles.

I. INTRODUCTION

A coil gun its basic form consists of launch coil, a high voltage capacitors power bank, a low voltage power source, trigger and mechanism of sudden discharge of energy stored in the capacitor bank through launch coil and projectiles. When trigger switch is ON the launch coil produces acute magnetic field that draws the ferromagnetic projectiles into the solenoid metal pipe. When the projectiles reaches to the launch coil, the magnetic field turns off that is results in the projectiles continuing down the solenoid pipe at high velocity. The high voltage DC generator (DC/ DC boost converter) is used to charge the high voltage capacitor power bank. The sudden high current discharge from the capacitor bank through the trigger and gating mechanism of the launch coil will attracts the ferromagnetic projectile i.e. Bullet due to the induced magnetic field in the coil. Normally the projectiles naturally wants to go to stay at the centre of the launch coil, but when projectiles gets to middle of the launch coil. The capacitor power bank is fully discharged and no magnetic field exists anymore.

II. LITERATURE REVIEW

BACKGROUND STUDY

PROBLEM DEFINITION :

In capacitor driven coil gun a small voltage source is requires to charge the capacitors. Here we need supply every time when we fired a bullet. Because of these there is a possibility of discharge of cells hence we have need permanent supply source.

Also for the firing of bullet we required normally 300 to 400 volt supply. but our primary supply is near about 12 volts. for getting required voltage we had need of voltage booster. The voltage booster is helps to achieve target with high speed and frequency. In coil gun a high insulation is required for the coils which are works on the high voltage Dc. While operating coil gun on high voltage there is a possibility of lightning strike may occurs, so we have to careful about that thing.

SCOPE OF WORK :

Using the law of Electromagnetic Induction, through the solenoid coil we can give kinetic energy to the ferromagnetic material and it can be used as gun. The output of coil gun is measured in the speed of ferromagnetic material. In this mechanism we simply convert electrical energy into mechanical energy.

II. METHODOLOGY OF PROPOSED

WORK

Initially the flash circuit of camera is connected to the 12 volt DC supply through the switch. The capacitors are connected in parallel which acts like a bank.

A multiturn solenoid coil which is made up of copper is wound on steel pipe. The reason of choosing steel because the steel is bad conductor of electricity. Two ends of the copper coil are connected to the capacitor bank through trigger switch.

Flash circuit boost the 12 volt DC supply to the near about 400 volt in few micro seconds. Flash circuit generates the pulsating DC voltage and it connected with capacitor bank. This whole circuit is enclosed in fibre gun shaped prototype model.

Before we started , keep in mind that a coil gun involves working with high voltages and fast moving projectiles. Hence the people have to operate it safely because harm that may be caused while working on this project. Proper insulation of all contacts and terminals should be done and safety gear such as rubber gloves, shoes and safety glasses should be worn at all time.

SCHEMATIC DIAGRAM

fig. Camera Flash Circuit

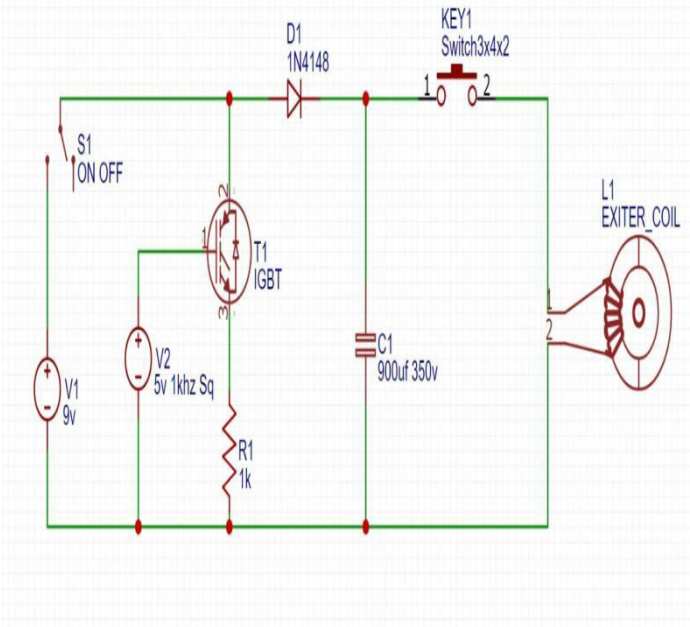
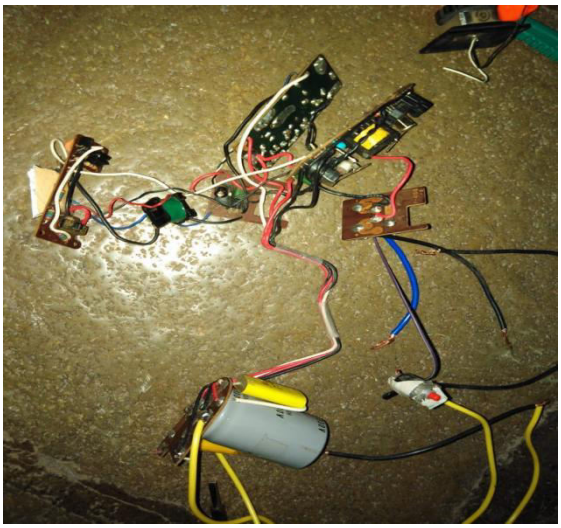
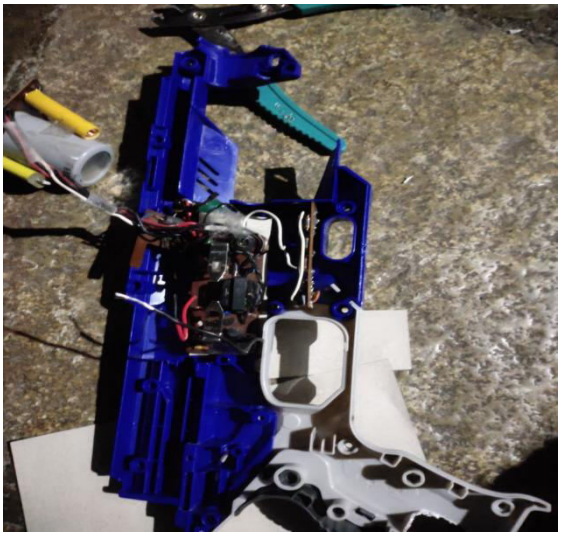


Fig.2Schematic diagram

A coil gun consists of conducting coil arranged along steel pipe. When current passes through the coil we can step up it upto 350 volt by using flash circuit. it induces a magnetic flux through their centre. As ferromagnetic projectile approaches the magnetic flux lines created by the coil, it gets magnetized and the magnetic attraction pulls the rail towards the centre of the coil. After trigger switch is ON the capacitor gives sudden discharge of stored energy. Because of that in the coil the magnetic flux pulls the projectile towards its centre. After that process the projectile can reach tremendous velocities.

EXPERIMENTAL / WORING SETUP





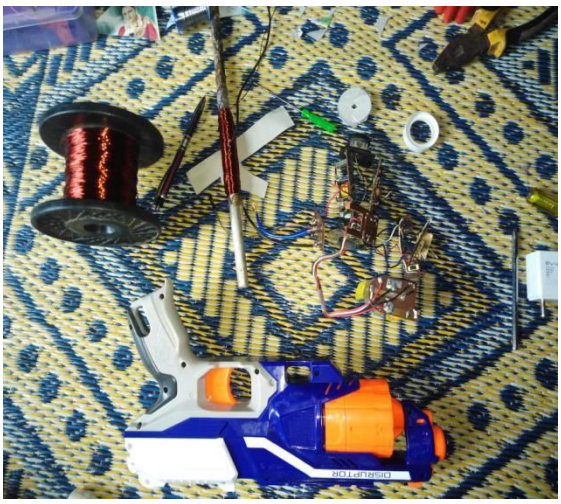


fig. Prototype Fibre Model of coil gun

RESULTS& CALCULATIONS

In the part of calculation we have to calculate speed, acceleration .

The projectile acceleration should be described by the equation,

$$\text{Projectile Acceleration (a)} = \frac{F}{m}$$

where,

F is the difference between the magnetic and gravitation force.

m is the weight of moving element (projectile).

The speed of projectile is,

$$\text{Speed (S)} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Acceleration(a)} = \frac{\text{Speed}}{\text{Time}}$$

Given :

Distance(d) =2m

Time(t) = 0.5s

Mass(m) = 0.5g

Solution :

$$S = \frac{2}{0.5}$$

$$S = 4m/s$$

$$a = \frac{4}{0.5}$$

$$a = 8m/s^2$$

$$F = m \times a$$

$$F = 0.5 \times 8$$

$$F = 4N$$

V. CONCLUSIONS

The paper presents the actual construction and working of single stage capacitor driven coil gun. An improved projectile model is presented for accurate eddy current calculation. An equivalent circuit model is used to calculate performance of capacitor driven coil gun. The objective function is to achieve the maximum velocity at the end of driver coil and we get exact results.

REFERENCES

[1] W. Ying, R. A. Marshall and C. Shukang, Physics of Electric Launch. Beijing, China: Science Press, 2004.

[2] M. S. Aubuchon, T. R. Lockner, R. J. Kayne, and B. N. Turman," Study of coilgun performance and comments on powered armatures", in Proc. IEEE Int. Power Modulator Conf. May 2004, pp.141-144.

[3] S. Williamson and A. Smith," Pulsed coilgun limits", IEEE Trans. Magn.,*Vol.33,no.1,pp.201-207, Jan.1989.*

[4] K. McKinney and P. Mongeau," Multiple stage pulsed induction acceleration", in proc.2nd symp. Electromagn. Launch Technol., Oct. 1983.

[5] K.-T. Hsieh and B. Kim,"One kind of scaling relations on electromechanical systems", IEEE Trans. Magn., *vol. 33, no.1, pp.240-244, Jan.1997.*

[6] https://youtu.be/QTDcFxTq1Fw

[7] https://youtu.be/hfW9mMrlZRQ

[8] H. D. Yun," EM gun scaling relationships," IEEE Trans.Magn.,*vol.35, no.1, pp.484-488, Jan.1999.*

[9] J. L. He, E. Levi, Z. Zabar and L. Birenbaum," Concerning the design of capacitively driven induction coil guns," IEEE Trans. Plasma Sci., *vol.17, no.3, pp.429-438, Jan.1989*

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