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Electro Magnetic Projectile Launcher

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***Abstract*: To demonstrate the capability to accelerate a ferromagnetic projectile to high velocity. This paper summarizes all important steps during coil gun design, such as physical laws of the coil gun, preliminary calculations, the testing device and final product. The electromagnetic FEA model of the capacitor-driven inductance coil gun was constructed to be able to optimize the coil's dimensions. The driving circuit was implemented as dynamic model for simulation of current. The coil gun is designed for an exhibition centre as an exhibit. It is not designed for a really shooting applications, this means the projectile is accelerated at relatively low speed.**

***Keywords*: electromagnetic, projectile launcher**

1. Introduction

An electromagnetic projectile launcher provides acceleration of a super conducting projectile through the diamagnetic repulsion of the super conducting projectile. A super conducting layer is provided after the projectile, either directly on the projectile or on a platform upon which the projectile is carried, and a traveling magnetic field is caused to propagate along a magnetic field drive coil in which the projectile is disposed. The resulting diamagnetic repulsion between the superconducting projectile and the traveling magnetic field causes the projectile to be propelled along the coil. In one embodiment, a segmented drive coil is used to generate the traveling magnetic field.

A. Principle

The operation of the EM launcher is based on energizing electromagnets that pull a projectile forward and then turn off. Applying a short high-current pulse to the coils produces magnetic field forces that move the projectile through the coils and launch it with a very high velocity.

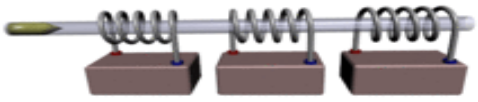

Fig. 1. Working principle

B. Construction

1) Required components

- Ferromagnetic projectile
- Switches
- Resistor
- Capacitor

2) Ferromagnetic projectile

For ferromagnetic projectiles, a single stage coil gun can be formed by a coil of wire, an electromagnet, with a ferromagnetic projectile placed at one of its ends. This type of coil gun is formed like the solenoid used in an electromechanical relay, i.e. a current-carrying coil which will draw a ferromagnetic object through its centre. A large current is pulsed through the coil of wire and a strong magnetic field forms, pulling the projectile to the centre of the coil. When the projectile nears this point the electromagnet must be switched off, to prevent the projectile from becoming arrested at the centre of the electromagnet.

Fig. 2. Ferromagnetic projectile

3) Power circuit board

The PCB is designed such that all the controlling components are arranged on the board. This consists of resistors, capacitors, inductors, diodes, thyristors, indicators, power supply pins and battery.

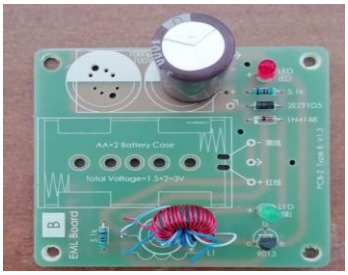

Fig. 3. Power circuit board

4) Resistor

The electrical resistance of the coils and the equivalent series resistance (ESR).

5) Capacitor

We designed a capacitor bank of 20,000µf, 50v capacity. The capacitor plays a major role in this project because the distance travelled by the projectile is completely based on the amount of discharge.

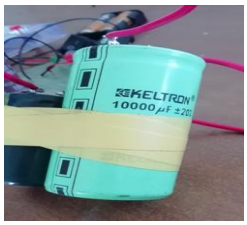

Fig. 4. Capacitor

2. Conclusion

This paper presented the implementation of electromagnetic projectile launcher.

References

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