CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

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Project Number

J0811

Project Title

Determining the Effectiveness of Series vs. Parallel Augmented Design on Rail Gun Performance

Abstract

Objectives/Goals

The purpose of my project was to compare two types of rail gun designs, series augmented and parallel augmented, and determine which was best at increasing the speed of a projectile. My hypothesis stated that a series-augmented rail system would be more effective than parallel rail system, because the increased electromagnetic field would be directed between the rails and toward the projectile, instead of just around the rails.

Methods/Materials

A railgun is basically made up of four (4) separate systems--an air injector, a power supply, a capacitor bank, and the rails. The bench power supply I am using can provide 18VAC and up to 400VDC. The capacitor bank is charged up using the DC; each of the four capacitors that I hooked up in parallel are each rated for 3900Aµf and 400V. First, for each test run I loaded the injector with 35 PSI of air from a rechargeable air pump. Second, after setting the bench power supply to DC mode, I charged up the capacitor bank, which takes several seconds. After positioning the projectile, and once the capacitor bank was fully charged, I switched the power supply to AC mode. Pressing the launch button, the valve (which runs on AC) on the injector opened and released the compressed air. The projectile is then pushed by the air down the track where it makes contact with the rails and is then accelerated as a result of the Lorentz forces produced by the metallic projectile completing the electric circuit. The above steps were repeated for no augmentation (my control), for parallel- and for series-augmentation. I calculated the â#ospeedâ## of the projectile for each test using the formula, speed = d * SQRT(g / 2h), where d is horizontal distance traveled by the projectile, g is a constant for gravity (32 ft/sec2), and h is height of the projectile above the floor.

Conclusions/Discussion

The results of my testing showed that the series augmented rail system was able to accelerate the projectile more efficiently than the parallel augmented rail system, and my hypothesis was proven to be correct. If I were to make modifications to my project, so that the parallel-augmented rails had a greater effect on performance, I would probably move the augmenting rails closer to the main rails and/or increase the voltage of the augmenting rail power source.

Summary Statement

My project determines whether parallel- or series-augmented rail design is most effective at improving the performance of a rail gun.

Help Received

My father helped me purchase some of the components that had to be mail-ordered and also checked all of my electrical connections before I started each test run. My uncle taught me how to use his router to cut my acrylic plastic pieces.