

sdmay19-15: Capacitor Gun

Week 5 Report

October 4 - October 12

Client: Max Balzer

Faculty Advisor: Mani Mina

Team Members

Grant Larson — *Test and Report Engineer*

Max Balzer — *Meeting Facilitator and Production Engineer*

Bret Tomoson — *Projectile and Power System Designer*

Brett Nelson — *Safety Engineer*

Mark Fowler — *Test Engineer, scribe*

Zachee Saleng — *Engineer designer*

Summary of Progress this Report

We did a lot of work consolidating ideas into our design plan and other design documents. Also, research was done to a point that all issues could be discussed with knowledge on how to solve the problem.

Past Week Accomplishments

- Design Document and rail specs - Mark
 - Went through design document template and worked through what could be answered with what we have accomplished so far.
 - Researched to attain some preliminary values for all aspects of the railgun to be submitted to our advisor for review and our metal shop for more information on what we can make.
- Materials and projectile research and production- Max
 - I narrowed down my list of dimensions for the rails to 2 different types we want to test. I had to size them due to the amount of current we expect to get from our capacitor bank.
 - We started to think about the amount of heat difference over time of our shot. I had to consider this when making the dimensions of my projectile and rails. We came to the conclusion that the rails aren't the heating problem, it is the projectile we are worried will melt.
 - I have accomplished the task of calculating the amount of current our capacitor bank will output over the time of our shot. This has allowed me to calculate dimensions of rails and projectiles.
 - We have figured out 2 designs for the projectiles which we will test as well. One will be our old sled design because we think it might be better for heat resistance, and the other design is the one piece of metal which we could increase the height of it to account for temperature change.
- Lecture talk presentation and enclosure-Brett
 - Worked on the completing the lecture presentation slide of our project for the lecture talk.
 - Researched materials that would be addressing our problems of high heat and non-conductive.
 - Found that we could use a ceramic fiber blanket for potential solution.
 - This would allow us to wrap this around the rails and then be able to use a strong material to hold everything together.
 - We need to hold everything together due to the force pushing the rails out.
- Solidified design requirements and started charging circuit parts list - Bret
 - There were a lot of pending issues on the project that needed to be understood with physics so the team worked together to identify all outlying design issues.
 - Each member then teamed up to find a solution for all of the issues that can be consolidated in a document with links. This document will help build the parts list.
 - I also started work on the charging circuit parts list.

- Gathered dimensions to further final calculations for our design -Grant
 - Used our desired muzzle energy to calculate the current needed
 - Used the desired current to calculate how many capacitors of a certain size we needed
 - Used the current to estimate the energy and velocity of the projectile

- A formula was derived that describes the relation of the magnetic field to the current of a capacitor utilizing Lorentz force. - zachee
 - Went through design document template and worked though different questions
 - The progress on the ... **cross section** ... was reported on in the design document
 - Elaborated some calculations to define the type of material that will be used
 - To find the current supplied by the capacitor the properties of the copper wiring were calculated
 - The effect of current and magnetic field has on the projectile velocity was researched.

Pending Issues

- Our projectile will experience more heat due to friction than both of the rails individually so we need to make our projectile large enough so it doesn't melt.
- The sizing of the rails will determine the strength and durability of the firing and must be researched.
- The parts list needs to be finished.
- Need to figure out ways to potentially charge 450V capacitors

Plans for Upcoming Reporting Period

Use our research and discuss what a realistic model of the project will include. This will require definite answers from the pending issues to drive all dimensions. Also a parts list will be needed for all auxiliary components that have been determined as necessary.

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
Grant Larson	I had a meeting with Professor Neihart to discuss our design. We talked about our goals and described the physics behind the design. Professor Neihart helped me more fully understand capacitors and how to calculate their energy release as well as the current running through the rails. He also helped point us towards some design considerations to be aware of as well as limitations we may come across.	7	30
Max Balzer	The rails and projectile dimensions still pose a major problem we need to complete. Also, calculating the temperature change and the amount of heat our metals accumulate in a period of time is an issue. Overall, I will still need to work on dimensions of the projectiles	10	34

	and I will have to try to figure out temperature difference of the projectile through the magnetic field.		
Bret Tomoson	Found the capacitors needed for the project and added them to the parts list. Worked with team to determine physical requirements of	10	28
Brett Nelson	Look into how to house the rails of the railgun. Found we could use a ceramic fiber blanket and wrap that around the rails to contain the heat. Once done that, we can then a different material to hold everything together. Lecture presentation slides.	9	30
Mark Fowler	Design Document and rail specifications	7	25
Zachee Saleng	Design Document. Dimensions for the rails to 2 different types we want to test. Sized according to the amount of current we expect to get from our capacitor bank and the estimate value. Resistance of the rails at each material (on going)	8	31

Plans for the Upcoming Week

- In the coming weeks we will be working on: "on going" - Zachee
 - the dimensions of the projectile is large enough so it doesn't melt.
 - Will need to find equations for that.
 - Sizing, using the standards, the bus bar .
 - Temperature coefficients of copper and aluminum
- Design Document and parameters - Mark
 - Worked on parameters page with the rest of the group to show how we got to our values
 - Finalize material list and schematics so they can be presented them to the metal shop and get a better idea what we can accomplish there.
- Calculating force and losses through the field - Max
 - One problem we have come across is the losses in the magnetic field. The projectile will experience air resistance and losses due to friction.
 - I will need to calculate the temperature difference due to friction on the projectile to make sure the dimensions of the projectile is large enough so it doesn't melt.
 - To account for losses, I will need to find equations for that.
 - Our metal shop guy wants clear and precise values for what we want so that he can help. By next week we will have the clear values he needs and I believe we will be to the point where we can start machining our metals.

- Projectile research and design document - Brett
 - Figure out the size of the projectiles for both the small scale design and the large scale design.
 - Also what kind of shapes to test: bullet like, missile like, etc.
 - Determine whether or not the projectile will be housed in a material that will separate when exiting the rails
 - Work on completing the design document.
 - Charging circuit design - Bret
 - Finish parts list for charging circuit components for 12V-450V.
 - Create complete formula sheet for all calculations to do with the Rail Gun - Grant
 - Write down how to easily find energy, current, and other variables given design dimensions
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Gitlab Activity Summary

Nothing to report.
