Alpha Stirling Engine

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Aim of the Project

The Aim of the project is to design, build and test a Stirling Engine. That we will run and test varying parameters of the engine to see how efficient it is.

Background

The Stirling Engine was first made in 1816 by Robert Stirling. The first Stirling was used to pump water from one remote location to another. Stirling first used his engine to pump water into a quarry.

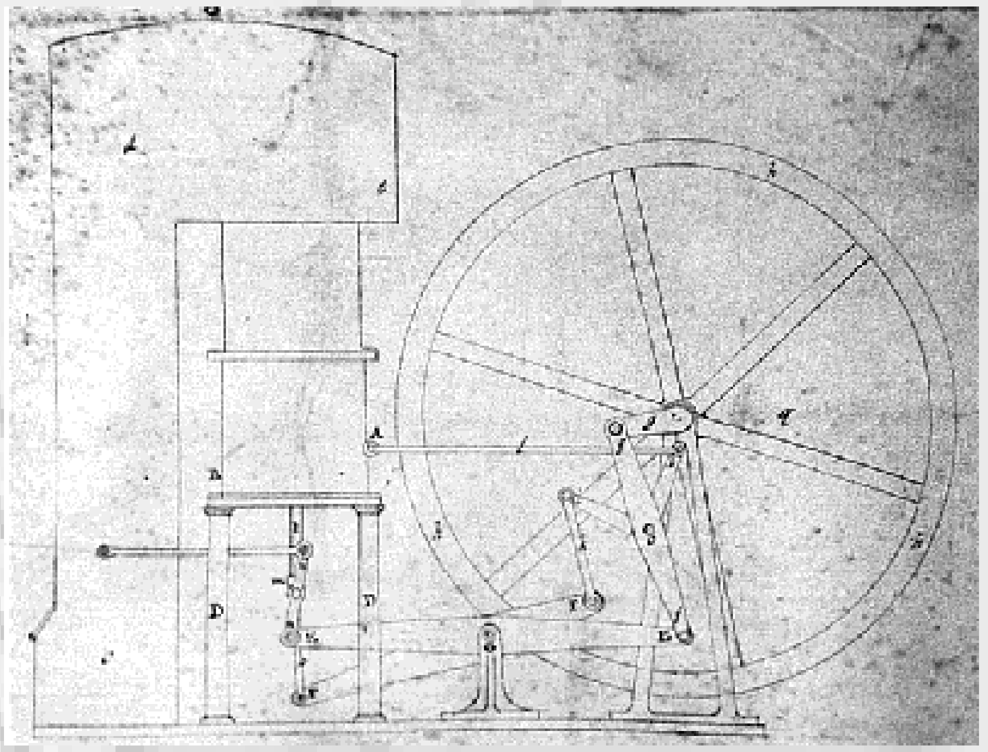

Figure 1: Early Stirling Engine Design

The Alpha Stirling Engine is a heat engine that operates on a Stirling cycle., it uses two cylinders (hot and cold), The engine works by heating the hot cylinder causing the gas to force the hot cylinder back. As the gas cools back down the cold piston retracts, this expansion and contraction is known as the Stirling cycle The Alpha Stirling engine is known for its high efficiency, as it operates closely to the Carnot efficiency limit.

Design

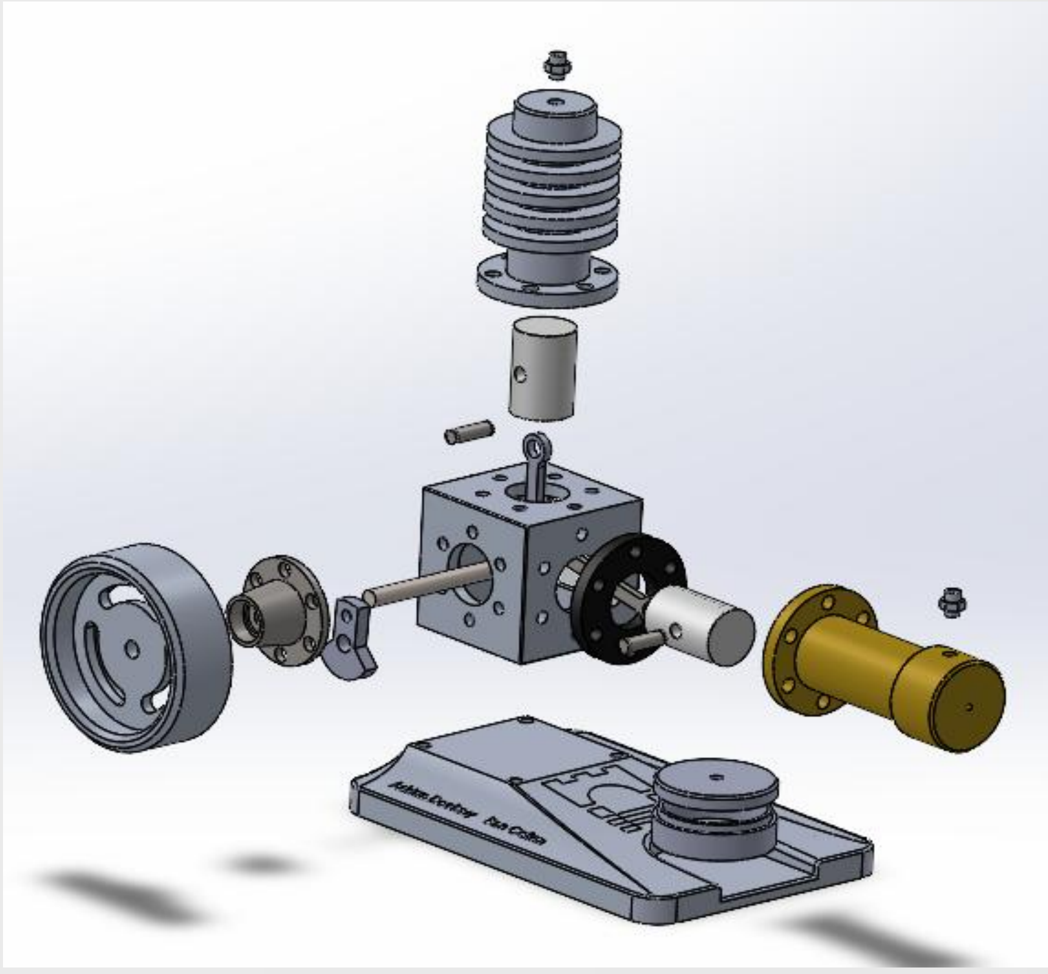

Figure 2 : Exploded View

The components stated in the brief to be designed and manufactured were the , flywheel, base, hot and cold cylinder, hot and cold piston, main body, burner, hot and cold piston arms, thermal brake, piston pins, bearing holder, CAM, Axle. The software used to design the parts was SolidWorks.

Simulation

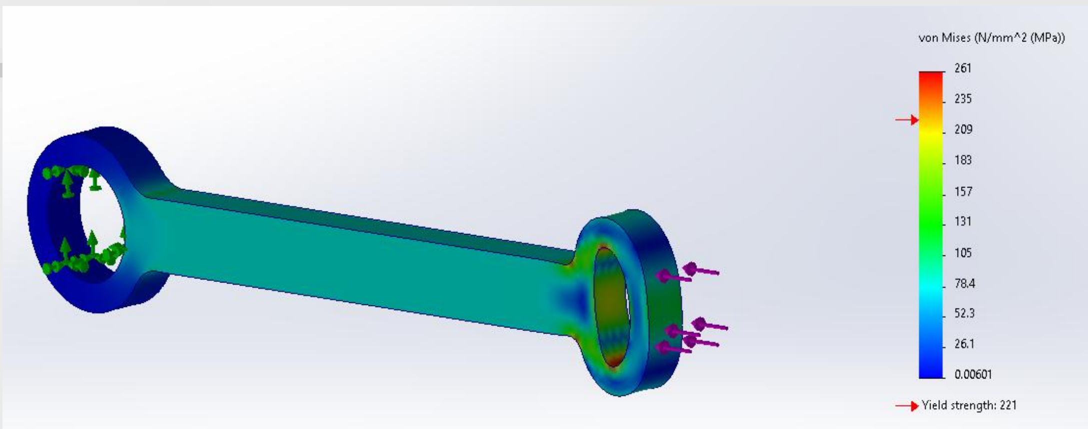

Figure 3 : Force Simulation

We used SolidWorks simulations to test the our parts against the forces the pieces will be exposed to within the engine. Figure 3 above shows simulations on the piston arms being exposed to tensile and compressive forces.

Manufacturing

As the design phase was finished, we now had to focus on manufacturing and assembling our pieces. First, we had to make working drawings and process planning sheets for each of our pieces. We had 3 main forms of manufacturing available for us to use.

Manual Workshop : Majority of our pieces were to be made in the workshop using lathe, mill and bench work. We used a variety of workshop techniques that we have learned over the last two years such as boring, jig making etc. Figure 4 shows the machining of our hot chamber.

Figure 4 : Lathe Work

3D Printing: This was a new area of engineering that we have never used or tried before. With the help of Dr Adrian Chaplin we quickly managed to a get a grasp on how to use it efficiently. Figure 5 shows the main body being printed.

Figure 5 : 3D Printing

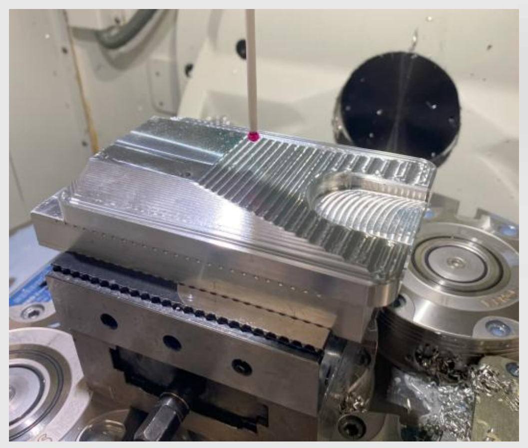

Figure 6 : CNC Probing

CNC Machining: With the use of Solid CAM, we programmed G-Code for the Spinner and the Mazak machines to produce our flywheel, base and burner. These parts were listed in the brief to be manufactured on the CNC. This was a good opportunity for us to use the knowledge we had gained from and CAM module and put it into practice.

Conclusion

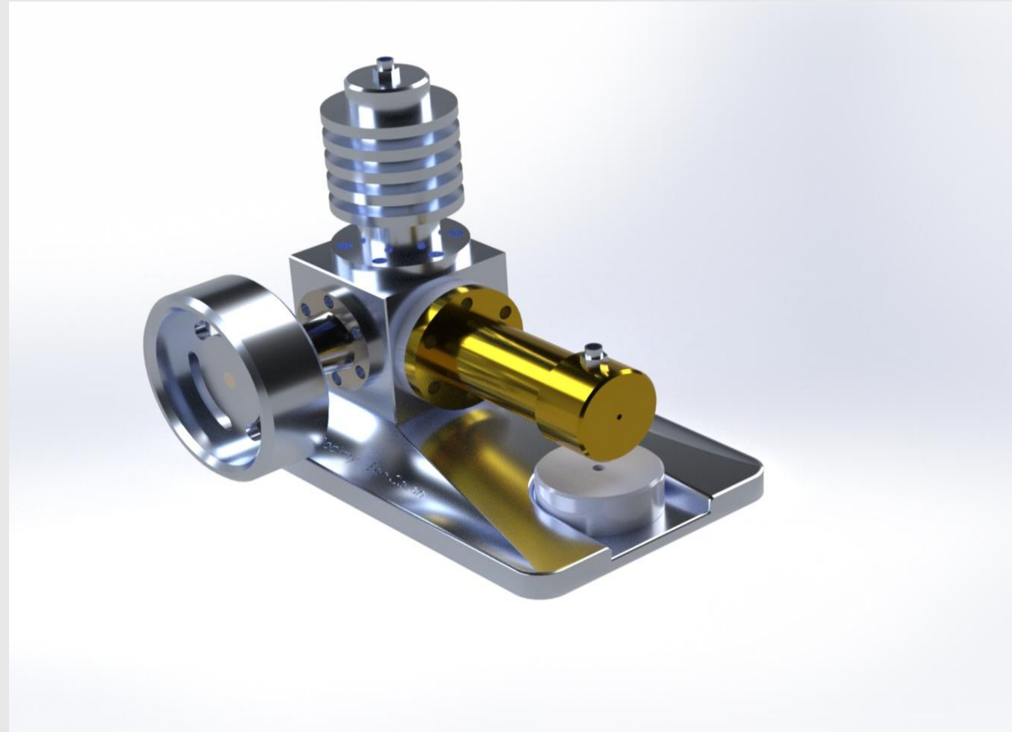

Figure 7 : Finished CAD Assembly

This was a good opportunity for us to use majority of our learnings from the last two years. It also gave us a chance to experience what it is like to work within a team and use each others stronger areas of engineering to our benefit. As a team we worked well and communicated with each other efficiently. We are happy with our final product and look forward to testing it.

Materials

Fly Wheel - Aluminium
Base Plate - Aluminium
Hot and Cold Piston – Aluminium
Hot and Cold Piston Arms - BMS
Piston Pin - Aluminium
Cam - Aluminium
Bearing Holder - PLA
Burner- Aluminium
Axle - BMS

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