Stirling Engine Project

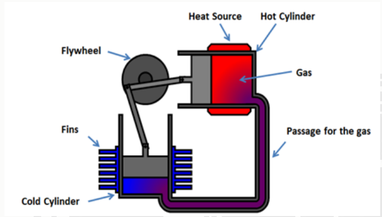
Team B4 : Daniel Gammell, Nathan Kilane, Stanislav Matsuta, Cian Gubbins

Aim of the Project

The Aim of the Project is to Design, Manufacture and Test a Stirling engine

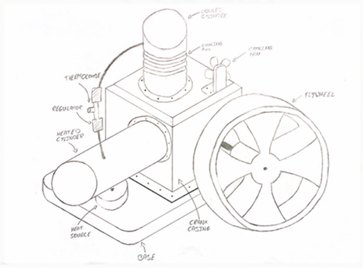
Background

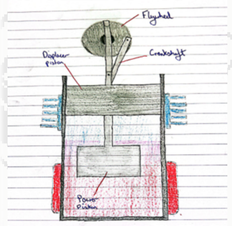
The main principle of a Stirling engine is converting heat energy from an external heat source into kinetic energy. This works by heating up the air within the hot piston which expands the air, causing the piston to move back and simultaneously turning the crankshaft. The movement of the crankshaft causes the cold piston to move, this creates the full cycle of the engine.



Concept Ideas

The Stirling engine has 3 different types of design, The alpha configuration, the beta configuration and the gamma configuration. We were all tasked with the research and making concept sketches for each configuration. We then proceeded to rate each configuration with points, in the end we picked the alpha configuration.



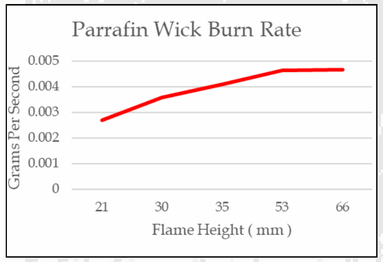


Final Design

Our main goals were to create a functional assembly and to design for manufacture. The Final Design comprised of a main block that would
hold the full assembly together, in order to reduce the complexity and number of parts. The cylinders were bolted to the block, which is at an angle to allow for a larger volume burner. A thermal break was included to reduce heat transfer from the hot end to the rest of the body, and gasket paper was used to seal all the components for a higher compression. The flywheel was designed to be weighted on the outer rim as to create more momentum to keep the crank rotating.

Research and Testing

We decided to design an engine proportional to the heat energy available. It was outline in the brief a paraffin/wick type burner would be used.

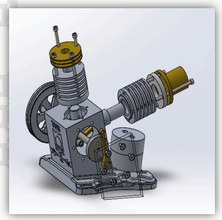


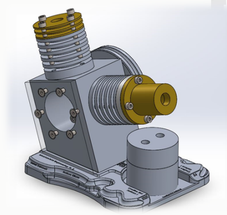
We conducted a calorimetry experiment to measure the heat energy released by paraffin. The experiment found the optimal height to be 55mm which released 128.99 Joules per second of useful heat energy. The final specifications for our engine design can be seen bellow

Engine Specs	Compression Ratio	Piaton stroke	Ideal RPM	Hot Cylider	Cold Cylinder
	1.5	40 mm	3459	19.7 CC	13.13 CC

CAD designing

With the reference drawing we had with the final concept sketch , we proceeded to create the CAD model for the Stirling engine on SolidWorks.

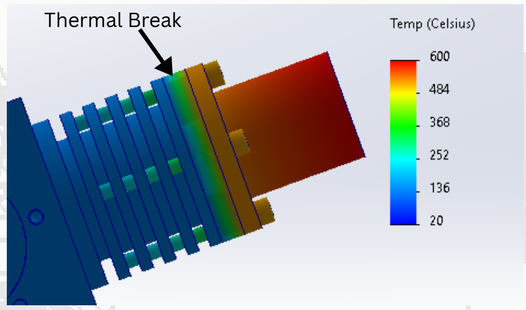




For the CAD modelling, we faced a lot of challenges with the dimensioning as we had limits for dimensions which meant there were a lot of revisions of the engine, but finally we created a model that satisfied these dimensions.

Thermal Break Analysis

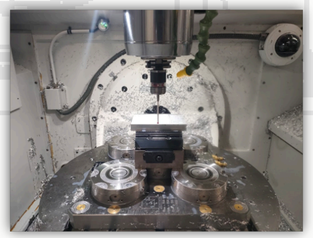
A thermal break was added to the engine to reduce the heat transfer between the hot end cap and the rest of the engine.

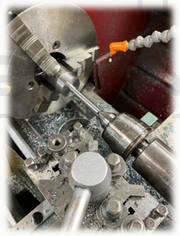


The Thermal Study above was conducted in Solidworks simulation for an 8mm PTFE thermal break. The study illustrated the insulating effects of a thermal break between the hot end cap and hot piston cylinder.

Manufacture

All parts of the Stirling engine were manufactured with the aid of a lathe, milling machine , pillar drill, CNC or bench. They were manufactured using materials such as Aluminum and Steel.
The CNC was done through Solid Cam files which created a program which feed the operations created on Solid CAM to the machine in order to follow the instructions and steps to create the pieces.





Conclusion

In conclusion, We believe we have achieved our objective of the project by designing, manufacturing and testing a stirling engine as it has met the requirements of the brief and has been assembled due to the correct calculations and dimensioning. In addition to this the final product has a unique and tidy look.

QR Code

For more information about our project and research scan the QR code below.

It will be stuck on later