Stirling Engine: Team C3
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Aim of the Project

The aim of this team-based project is to design, manufacture and test a Stirling engine. A Stirling engine is an external heat engine, which means it produces power from heat. The heat source is external to the engine.

Objectives

- Research about the Stirling Engine and its different configurations.
- Create concept designs of the Stirling Engine
- Create parts with an assembly using SolidWorks.
- Order Parts and Manufacture the Stirling Engine using the Mill, Lathe and CNC.

Background

The Stirling Engine Is an external Combustion Engine that is based on a closed cycle. The basic Principle of a Stirling engine is that the fluid used is compressed in a cold cylinder volume and then expanded in a hot cylinder.

It converts thermal energy into mechanical work. It can operate on almost any fuel, e.g. gasoline, natural gas, solar energy, etc. It uses a temperature difference in space to create movement. Unlike a gas engine that would have to continuously burn something, or a steam engine that has to create and release hot gas.

Design

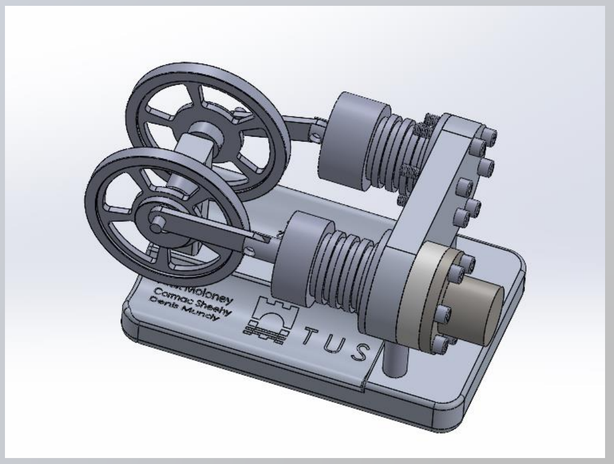


Figure 1: Completed Assembly

SolidWorks was a vital tool that we used in designing and manufacturing our Stirling engine. The SolidWorks software aided us in exploring new designs, visualizing our final concept design, and created drawings with dimensions and tolerances which we could reference when machining our design in the workshop and while using Solid CAM.

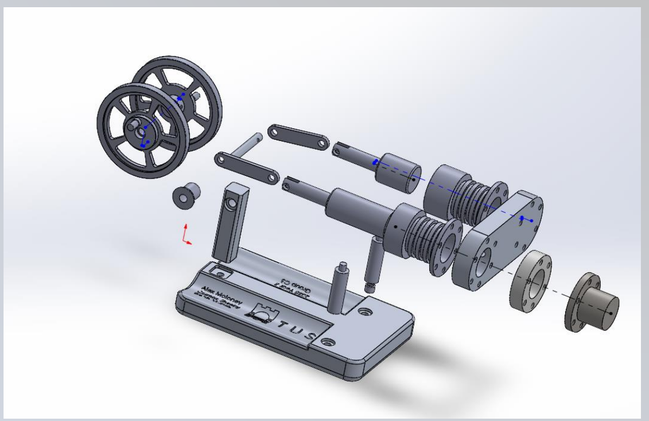
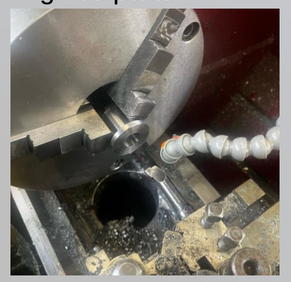


Figure 2: Exploded Assembly

Manufacture/Assembly

The Manufacturing of this Stirling Engine involved many different Machining processes.

- Manual Machining: This involved the use of Lathes, Mill Machining and Bench Work. This was used to manufacture the majority of the Engines parts.



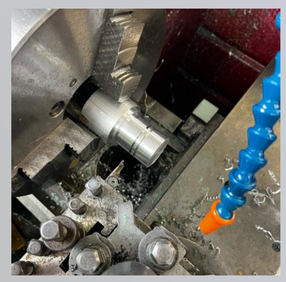


Figure 3 & 4: Parts being machined on the lathe

- CNC Machining: In accordance with the brief the parts machined on the CNC machine were the Base, the Flywheels and the burner. These parts were designed specifically to ensure clamping and machining can be completed successfully in the Limerick IT Spinner U-620 machine.

Figure 5: Completed Base Mounted in CNC Machine

- 3D Printing: Stated in the brief, the Stirling Engine must be designed so it can be connected to a torque meter. For this a drum will be 3D printed and placed in the assembly.

Bearings, Nuts, Bolts and pins were also ordered to assemble the parts together. A thermocouple was provided to allow for the gas temperature to be tested.

Conclusion

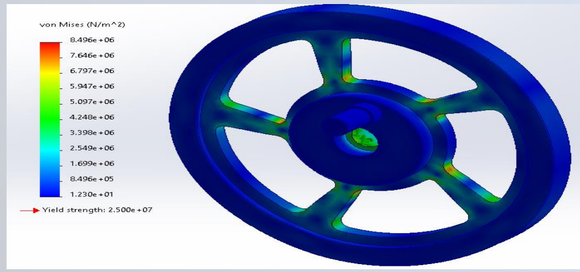


Figure 6: FEA analysis of Fly Wheel

- Understanding how a Stirling Engine operates was crucial in designing and manufacturing a functional Engine.
- Creating concept designs allowed us to explore different ideas and come about the most efficient design.
- While the manufacturing took place the team ensured to stay within the boundaries of the brief.
- Although we had a final design before manufacturing certain aspects changed throughout. For example the PCD for the holes on the cylinders had to change.
- An FEA Analysis was carried out as shown above.
- Overall the team were happy with how the Stirling Engine turned out.

References

Stirling engine - Energy Education

Efficiency of Stirling Engine (Formula & Diagram) | Linquip

Acknowledgements

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