

# Operation Stirling Silver

Energy Regeneration Through Heating and Cooling

B. Gottman, M. Hughes, R. Traum

Team #10, Mechanical Engineering, Northern Illinois University

**Abstract – The purpose of Stirling Silver is to repurpose wasted energy thermal energy in a house or building and regenerate it into electrical energy. This project primarily uses a Stirling engine, an alternator, and a furnace exhaust flue to achieve this goal. Most people have realized that energy consumption is a primary focus of concern and that efforts need to be made to both reduce current energy wastes as well as lower the overall demand for energy consumption. Stirling Silver is a unique and efficient way to meet those demands**

**Keywords: Stirling Engine, Piston, Displacer, Lathe, Mill, Exhaust Flue**

## I. Introduction

Given the ever-increasing demand for renewable energy in today's society, the desire for new and efficient renewable energy has become an engineering priority. Current renewable energy sources commonly used include solar, wind, geothermal, biomass, and hydropower. Combined, renewable energy accounts for around 13.5% of the world's total energy supply. These energy sources primarily exist as large-scale systems. Contrarily, Operation Stirling Silver aims to create renewable energy on a smaller scale that can be utilized in nearly every building or home.

Operation Stirling Silver's main device is a Stirling engine. Stirling engines are sealed engines that create rotation energy by converting translational energy created by a piston affected with changing temperatures and pressures. In comparison to the common internal combustion engine,

Stirling engines use heat created outside their cylinders to provide the temperature changes necessary for thermal expansion. Stirling engines can be found in three different configurations: alpha, beta, gamma. Operation Stirling Silver specifically uses a beta configuration. This style uses a single cylinder with two pistons. One of the pistons acts as a displacer. This means it has a smaller diameter than the cylinder so as to displace the gas, air in this case, back and forth between the heated and cooled ends. The other piston is forced up by the changing pressures. Together, the two pistons work to turn a crankshaft which then is connected to an alternator to generate electricity

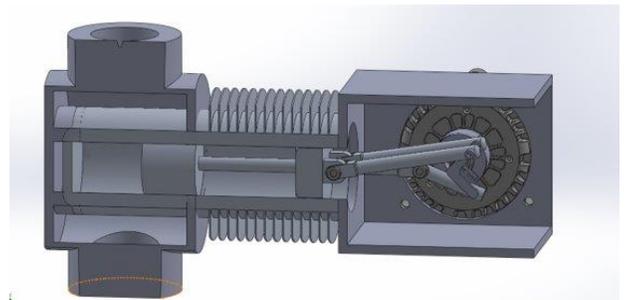


Figure 1: Beta Config. Stirling Engine with Flue Sleeve and Alternator

What makes Operation Stirling Silver unique is that it is adapted to be powered by an ordinary furnace. The exhaust on a furnace is essentially wasted heat energy being expelled into the atmosphere. The temperature of this air can reach as high as 500 degrees Fahrenheit. As you can see this is a non-insignificant amount of energy being wasted that our Stirling engine can then convert back into mechanical energy to create usable electricity.

## II. Materials and Methods

Operation Stirling Silver is primarily constructed of 6061 aluminum. Aluminum was chosen due to its properties as a strong, lightweight material that has good thermal conduction. These factors provide optimal conditions for a Stirling engine to operate. Aluminum also provides the added benefit of being readily available and reasonably priced in comparison to other metal building components.

- The production of the Operation Stirling Silver device requires multiple machines. Lathes, mills, saws, welders and other tools are used to build this device.
- The lathe is primarily used for ensuring that the piston, the displacer, and the cylinder housing are all properly shaped and sized.
- The saws are used for cutting all of the various shaft lengths needed for the piston and displacer as well as for the crankshaft.
- The mill is used for cutting and shaping the various sheet and block metals for housing, fins, and brackets.
- The welder is used to assemble any parts that can't be affixed by screws or bolts.

## III. Applications

Stirling engine devices have many applications. Operation Stirling Silver specifically is to be used to collect wasted heat from a furnace. However, the device is capable of operating given any reliable heating source. We have designed a housing to be placed on a furnace exhaust flue, but any heat can be applied. These could include, but are not limited to: A direct flame, induction heating, and radiated heat focused onto the device. Operation Stirling Silver can be used in many applications and can provide usable energy.

## IV. Conclusion

This project is designed to increase thermal and electrical efficiency in homes

and businesses. Energy needs have always been and always will be a vital and ever-growing aspect of society and the demands of the industry do not appear to be going down in the foreseeable future. We believe this project is an important step towards limiting our energy waste as a society. This Stirling engine application is unique in that it will be simplistic enough to be adapted to almost any high heat loss device but efficient enough to warrant the installation and long-term maintenance.

A thermal study was conducted as well as a real-world 3D printed prototype to provide proof of concept of the device

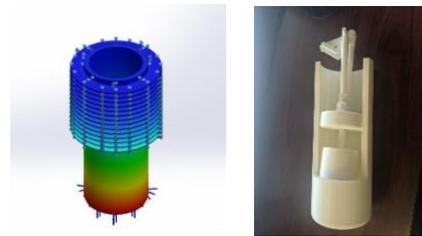


Figure 2: Thermal Study      Figure 3: 3D Prototype

## V. Acknowledgments

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## VI. References

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