

The Stirling Engine Society.

Founded 1997

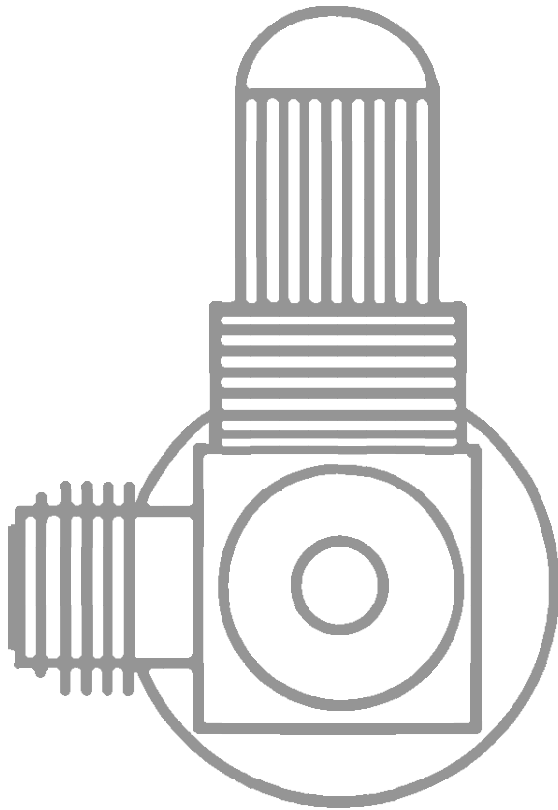
To Develop, Educate and Promote Understanding of Stirling Cycle Engines.

Hon. President: Mr. James G. Rizzo.

Information Leaflet.

What is a Stirling Engine?

A Stirling engine is a machine which converts heat energy into mechanical work. It can be used for pumping water, generating electricity or turning industrial machinery. It does not need to use high quality refined fuels such as petrol or diesel to make it run, but can work on any source of heat. This makes it suitable for applications in Developing Countries, where these fuels are difficult or impossible to obtain, and where other types of combustible materials are locally more readily available. Stirling engines can also work on solar or geothermal energy or waste heat from industrial processes.



How does a Stirling Engine Work?

The Stirling Engine relies on the principle that when a quantity of gas is heated (usually air, but sometimes helium or hydrogen), it will expand, and its volume will increase. If the gas is sealed in a container, then the pressure inside the container will rise. When cooled, the gas contracts, the volume decreases and thus the pressure will fall.

If we connect this container by means of a pipe to a closed **power cylinder**, with an air-tight piston at one end, known as the **power piston**, on heating, the gas pressure will push the piston out until the internal pressure equals atmospheric pressure, and on cooling the internal pressure will fall allowing the piston to be pushed back in by atmospheric pressure. Once a method is devised of repeatedly heating and cooling the gas, then we can make the piston reciprocate, and turn a shaft and flywheel by means of a con-rod and crank, thus producing useful rotary mechanical shaft power.

In practical Stirling engines, rather than alternately heating and cooling the cylinder containing the gas, it is easier and more efficient to move the gas, from one end of the cylinder which is kept hot (typically 500C or red heat) to the other end which is kept cool by means of a water jacket. A loose fitting piston, known as the **displacer**, is made to move back and forth in the cylinder, thus shuttling the gas from one end to the other. As the displacer moves, the gas leaks around the peripheral gap between the displacer and the cylinder wall. The displacer produces no power itself, but uses a little power from the working piston in order to move the gas through the engine and produce the changes in gas pressure. The displacer is moved by means of a rod coupled to the crankshaft, and is set so that it reaches top dead centre, one quarter turn, or 90 ahead of the power piston. There are three basic types of Stirling engine, **Alpha**, **Beta** and **Gamma**. The Beta, or concentric cylinder type, has both displacer and power piston in the same cylinder and is more efficient but the mechanical linkage is more complex.

A Simple Gamma Engine

The Stirling engine includes between the hot and cold ends, a heat store, known as the **regenerator** made of a heat absorbing material such as steel wool or layers of stainless-steel mesh, corrugated or perforated shim. As the displacer piston pushes the heated air through the regenerator, the large surface area of the regenerator absorbs heat from the gas, thus helping to cool it, and conversely restores the heat to the gas on its return trip to the hot end. This reduces the amount of heat which must be put into the gas by the heat source and thus lowers fuel consumption. It also means that less waste heat must be removed from the gas by the water cooling system, and so makes the overall working cycle more efficient. The waste heat from the cooling water is often used for space heating.

To sum up: One end stays hot, the other stays cold, the air is moved between the two ends by the displacer. The air cyclically expands and contracts causing the power piston to reciprocate and thus drive the engine crankshaft.

To find out more about Stirling Engines and membership of the Stirling Engine Society email:

stirlingenginesociety@stirlingengines.org

or write to: Membership Secretary, The Stirling Engine Society ,
P.O. Box 5909, Chelmsford, Essex, CM1 2FG. United Kingdom.