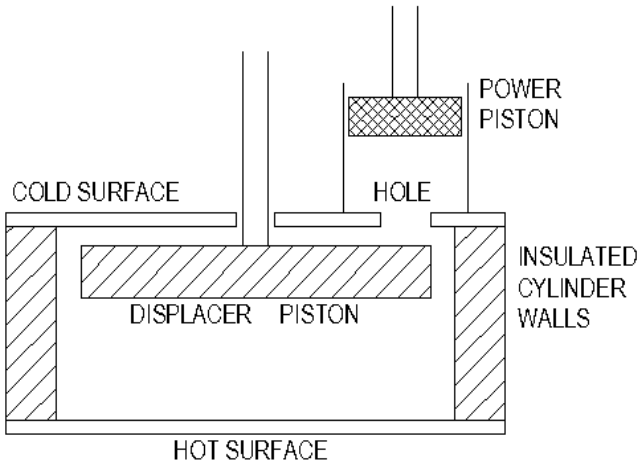
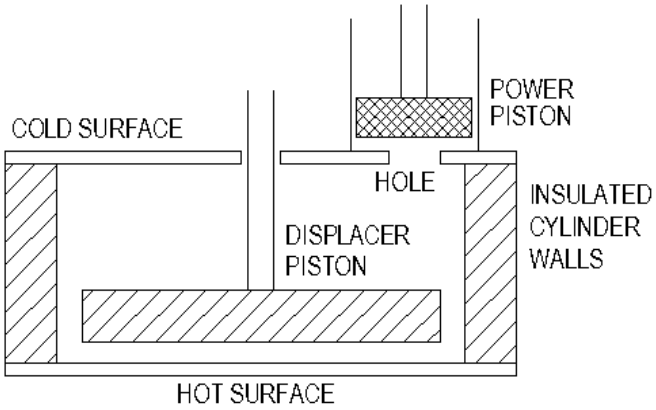
The Stirling Engine

In the early nineteenth century a young Scottish minister named Robert Stirling was concerned about people being killed or maimed by exploding steam engines. So he invented an engine that could not explode. Today, his engines are still the world's most efficient.



Referencing the drawing left, the energy is obtained from the temperature difference between the COLD SURFACE and the HOT SURFACE. These two surfaces are separated by a cylinder of an insulating material so that the two surfaces will not cancel each other out by conduction.

The DISPLACER PISTON is also of an insulating material, and fits loosely so that air can move freely around its outside edges. It is shown here next to the COLD SURFACE. Since the air itself in this case is in contact with the hot surface it is in its expanded state and the power piston is at the top of its stroke.



In this next drawing the displacer piston has been pushed downward. Since the air was able to flow freely around its perimeter, it took no significant energy to move it.

The air however, has now been forced into contact with the cold surface and has contracted. This has sucked air through the hole, pulling the power piston to the bottom of its cylinder.

Stirling then connected both pistons to the same crank shaft, with a flywheel to keep the motion smooth.

By having the displacer piston lead the power piston by 90 degrees, the pressure in the system was always changing just ahead of the power piston. By the time the power piston was at top dead center because the air had just been heated, for instance, the displacer piston was already halfway back down, beginning to create a vacuum. In this way the power piston was always chasing the displacer piston.

Stirling had yet another trick: He forced the shuttling air through a substance that could store heat or cool. In this way, hot air on its way to the cool side would leave some of its heat, and pick it up on its way back to the hot side. This "regenerator" is what makes a true Stirling engine so efficient.

There are many clever variations of Stirling engines available, but they all involve heating and cooling air to continually change its pressure. True Stirlings include some form of regenerator.

This category of engine is the most promising technology for sustainable energy for several reasons:

- It is the omnivore of the engine world. Unlike internal combustion engines, it doesn't care what you feed it – as long as it's hot.
- It can be configured to operate on low temperature differences. I have seen model Stirling engines animated by setting them on a cup of hot water (I suppose that would animate most of us), and it would change directions when my friend would move it over to a cup of ice water.
- Unlike internal combustion engines, they are not noisy; all the motions are smooth free.