A brief Stirling engine history

Reverend Robert Stirling
On September 27, 1816, Church of Scotland minister Robert Stirling applied for a patent for his economiser in Edinburgh, Scotland. The device was in the form of an inverted beam engine, and incorporated the characteristic phase shift between the displacer and piston that we see in all Stirling Engines today. The engine also featured the cyclic heating and cooling of the internal gas by means of an external heat source, but the device was not yet known as a Stirling Engine. That name was coined nearly one hundred years later by Dutch engineer Rolf Meijer to describe all types of closed cycle regenerative gas engines.

Stirling engines are unique among heat engines because they have a very high theoretical Carnot efficiency, in fact it is almost equal to their theoretical maximum Carnot efficiency. Stirling engines are powered by the expansion (heating) and contraction (cooling) of gas. The fixed amount of gas inside a Stirling engine is transferred back and forth between a hot end and a cold end, which cyclically expands and contracts the gas.

Robert Stirling continued to work on his engines throughout his life. In the 1820's he was joined by his younger brother James, whose major contribution was to suggest pressurizing the internal gas to increase the power output. Further improved design patents were applied for in 1827 and 1840.

Professor Ivo Kolin
Early in 1983, Professor Ivo Kolin of the University of Zagreb, Croatia, demonstrated the very first low temperature differential Stirling engine to an amazed audience. This engine ran on a temperature difference of 100°C, which at the time was an astonishingly low figure. The demonstrated engine ran for a long time as the temperature differential lowered, eventually stopping when the difference dropped below 20°C.

This feat was all the more remarkable when you consider the engine was constructed entirely with hand tools. The engine had no power piston and cylinder, instead relying on a rubber diaphragm to transmit the power from the square main chamber. A feature of this engine was the 'slip-link', a device for imparting an intermittent motion to the displacer inside the main chamber. At the low speed that this engine ran at, a dwell at each end of the displacer stroke was very beneficial.

During the 1980's, Professor Kolin continued to refine his low temperature engines, still relying on a diaphragm but simplifying the original complex displacer drive mechanisms.

Professor James Senft
During the late 1980's and the early 1990's Professor Senft of the University of Wisconsin took up the idea of low temperature differential Stirling engines. The first models he produced were Ringbom engines, where there is no direct connection between the flywheel and the displacer, the Ringbom engine is reliant on the changing pressure inside the main chamber to move the displacer back and forth. Professor Senft, working closely with Professor Kolin, continued working with stirling engines, working out many of the design solutions that are used today in low temperature differential Stirling engines.

In 1992 Professor Senft was asked to design and build a low temperature differential engine for NASA. This engine, called the N-92, was optimised for hand held operation, with a temperature difference as low as 6°C enough to power it. Professor Senft continues to work with Stirling Engines, and has written several books detailing the history and manufacture of Stirling engines.

Kontax Engineering Ltd
The KS range of low temperature differential Stirling engines was designed and developed in England in 2002, and has been in continual production ever since. Kontax use modern production machinery to manufacture most of the parts in-house, which allows for very strict quality control.

The Future
Because Stirling Engines are able to operate from a wide variety of heat sources they have attracted a lot of attention in today's energy conscious world. Inefficient combustion of fuel need not take place in a Stirling engine power plant, the combustion can take place externally thus allowing for harmful emissions to be controlled and drastically reduced. Many countries and institutions are now researching Stirling Engines. In countries that have a lot of geothermal activity, such as New Zealand, Stirling engines are seen as a viable alternative to fossil fuels and nuclear power. Stirling Engine powered vehicles are being investigated. Units designed to extract power from the waste heat generated by domestic gas-fired boilers have been built. Stirling Engine applications are being investigated by NASA, for use in spacecraft. With the recent ratification of the Kyoto Protocol by 141 countries, Stirling Engines would seem perfectly placed to take up the challenge presented by an energy conscious world.