The Condensing Engine Project NEWSLETTER

No 1 - November 2019

The newsletter is published monthly, and reports things of interest about the project itself, about activities in this field worldwide, as well as ongoing research work in the area of low-temperature heat engines.

Editorial: Welcome to the Condensing Engine Project, where we want to demonstrate a new (well, actually a very old, but mightily improved) technology to generate electricity from low temperature heat (70 to 120C): the condensing engine. This engine is simple, and efficient and has the potential to provide a cost-effective solution.

We want to build such an engine with a power of ½ bhp or 400 Watts to demonstrate that it works, and that it is a cost-effective technology. For this we need funding.

Energy from heat

There are many ways to generate energy from renewable sources, and to improve our CO2 budget. Ideally of course, such technologies should also reduce our expenditure. One possibility is to produce power from e.g. wind or the sun, another to use waste energy from existing processes.

There are a lot of very efficient technologies around to utilise thermal energy with temperatures of more than 150C, such as steam turbines, or Stirling engines. Unfortunately however, the bulk of the available waste heat is in the lower temperature range between 70 and 120C. In order to exploit this resource, we decided to go back in time for inspiration, see Fig. 1:

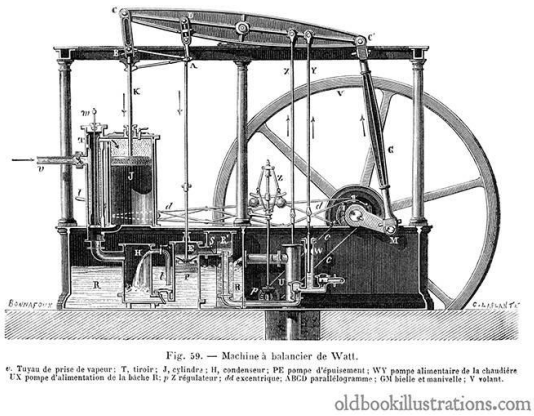

Fig. 1: Old technology: Watt's Condensing Engine

The condensing engine developed by James Watt in 1796 employs the condensation of steam and the arising vacuum as driving force and therefore has an operating temperature of only 100C. However, the theoretical efficiency is only 6.4%, and the actual measured efficiency is around 3.8%, a bit on the low side. We should however remember that the maximum theoretically possible of an engine in this temperature range, the so-called Carnot efficiency) is only 19%.

Using modern thermodynamics, we could to improve this efficiency by employing steam expansion. Tis gave a theoretical efficiency of 15%. In test, a 25 W engine has already reached 5.8%. We also of course included modern features electronic valve control which sounds trivial. But, it made a huge difference since it allows for steam expansion and therefore much higher efficiencies.

We also expanded the theory of the condensing engine into the temperature range from 60 to 100C. So, this engine can run at 70C still using water and steam as working fluids. How can that be, when water only evaporates at 100C?

Rad more about this technology in the next Newsletter.

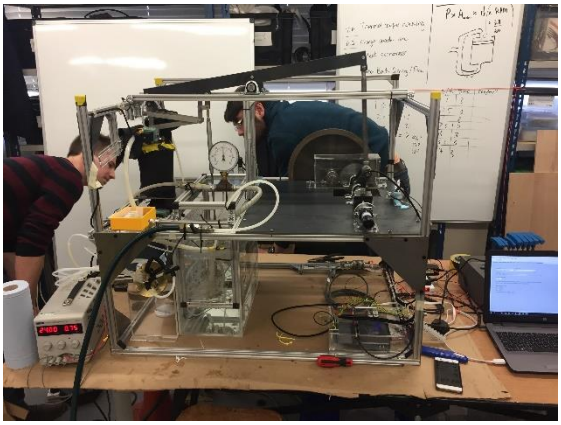

Fig 2: Our 25 W engine

Available heat energy

Waste heat is generated everywhere in industry. Low-temperature thermal energy also comes from renewable sources such as geothermal energy, solar thermal energy, from biomass plants or simply from burning low-grade organic matter.

Currently, much or better most of that energy is wasted since there are no cost-effective technologies, especially in the lower temperature range and in the lower power range from 2 to 100 kW. Sometimes waste heat is used for heating, but that is a seasonal use

and in away also wasteful since heating temperatures only need to be in the 60C range, a lot lower than much of the available energy.

Fig 3: Geothermal energy plant

Even in existing geothermal plants, Fig. 3, a lot of energy in the lower temperature range is wasted as steam blow into the atmosphere.

The resource*: waste heat*

Waste heat is a major (negative) factor of our energy balance sheet. Strangely, most of the waste heat occurs in the lower temperature ranges between 70 and 120C.

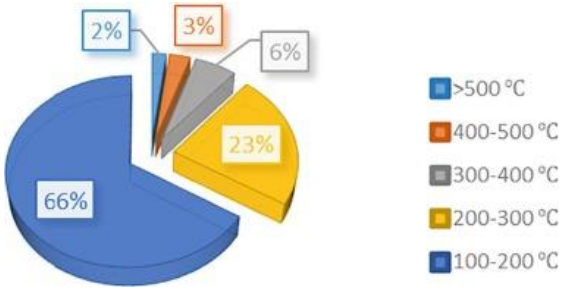

Fig. 4: Waste heat temperatures

In Fig, 4 you can see that the lower temperature ranges have indeed the lion's share of the resource. You can also see that the temperatures below 100C are not listed,. This happens quite often since these temperatures are considered as not technically or efficiently exploitable.

This heat is generated to drive processes such as boiling in the food production (potato peeling), cleaning, textile and leather industries etc. In all, there is a potential of 10-20 TWhrs available in the UK alone. Then there is waste steam, which is used in many industries such as tyre production, and simply blown off into the atmosphere.

The plan:

This begs the question: can we not use this heat to generate electricity?

Well, that's what we are working on. We have improved the theoretical efficiency of the Condensing Engine,and built two laboratory scale (15 and 25 Watt) models already. Currently, a 30 Watt engine is under construction. This engine will incorporate a simplified configuration and a much simpler control system.

Why do we need funds then: well, we want to go bigger and build a full scale, ½ bhp / 400 W engine. I should add, that getting funds to develop such "old-fashioned" technology is actually very, very difficult. The arguments range from "*well, it was not really efficient*" to "*if this was an effective technology then someone else would have developed it further already*" and "*it's an old hat*".

That's the sort of response you get, and the only way to counteract this is by presenting people with facts.

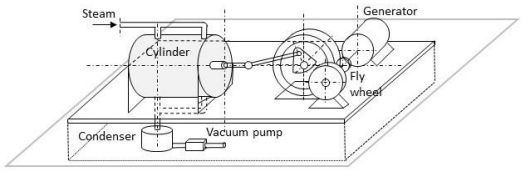

Fig 5: The ½ bhp engine

So, we want to create the facts. With such an engine, we can show people that this technology actually works at a scale which is nearly commercial. In fact, you could drive such an engine using a wood burning stove (well, it would be a larger one of those) using a pot as boiler.

Who are we, actually?

Well, we are a group of researchers at Southampton University's Water and Environmental Engineering Group WEEG. Our work covers the areas of Water and Energy which we consider as the most important issues for the next decades. Our work encompasses hydropower with ultra-low low-head differences, wave power, and low-temperature heat. And, we are looking for technological innovation, believing that cost-effective technology is THE core issue for the utilisation of renewable energy sources.

The emphasis here is on "cost-effective", the technology has to pay for itself within a reasonable time similar to other investments. Otherwise, you could argue, and since much of the costs for a technology is related to the energy required to make it, more energy is used to make the technology than it produces during its lifetime and the world would be better off without it.

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The project web page, where you can subscribe to the Newsletter::

https://the-condensing-engine-project.com/