Wood gas suitability for stirling engine

History

Engine type, invented by a Scottish minister Robert Stirling in 1816. He received a patent invention in 1817. In the first hot-air engine was a vertical cylinder with a diameter of 60 cm. The engine produced 1.5 kW of power. The machine worked two years before the hot cylinder head burned out. Wear and sealing of the cylinder was a problem.
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Alpha-type Stirling Engine

Beta-type Stirling Engine

Gamma-type Stirling Engine

SOURCE: SCHMIDT THEORY FOR STIRLING ENGINES
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“Crown”
Regenerator
Cooler (heat exchanger)
Expansion piston
Compression piston
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PV process of an ideal Stirling-cycle

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>gas compressed to higher pressure at a constant temperature</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>gas heated to higher temperature at a constant volume</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>gas expands at a constant temperature</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>gas cooled to lower temperature at a constant volume</td>
</tr>
</tbody>
</table>
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CENTRIA`s modification

Heat exchanger
Stirling engine
Gas burner
Bentone BG 300
Pipe of wood gas
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CENTRIA`s modificaton

"Crown"
Blower
Gas burner
Benton
Flame 1000°C
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CENTRIA`s modificaton

Diagram: Flowchart of wood gas production and cleaning system.
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CENTRIA`s modificaton
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MEASUREMENTS and RESULTS

Stirling-moottori puukaasukäytössä

Sähkö- ja lämpöteho Kw

Poltinteho kW

Hyötysuhde %

Kokonaishyötysuhde
Sähköhyötysuhde
Sänköteho
Lämpöteho
# Wood gas suitability for stirling engine

## GASEOUS EMISSIONS

<table>
<thead>
<tr>
<th>Gas:</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen N₂</td>
<td>57.99</td>
</tr>
<tr>
<td>Hydrogen H₂</td>
<td>14.20</td>
</tr>
<tr>
<td>Carbon monoxide CO</td>
<td>11.19</td>
</tr>
<tr>
<td>Methane CH₄</td>
<td>1.33</td>
</tr>
</tbody>
</table>

### Input: Wood gas

- Burner -> Stirling -> Electricity+Heat

### Output: Exhaust

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H₂O</td>
<td>9.1 til%</td>
</tr>
<tr>
<td>CO₂</td>
<td>9.0 til%</td>
</tr>
<tr>
<td>CO</td>
<td>0.0 ppm</td>
</tr>
<tr>
<td>N₂O</td>
<td>4.0 ppm</td>
</tr>
<tr>
<td>NO</td>
<td>23.2 ppm</td>
</tr>
<tr>
<td>NO₂</td>
<td>0.7 ppm</td>
</tr>
<tr>
<td>SO₂</td>
<td>7.6 ppm</td>
</tr>
</tbody>
</table>
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DUST EMISSIONS acc. ASTM: D2156-80 / DIN 51402

Sample is sucked ten times with the pump through a filter paper, filtering point color compared to the reference value.

Samples one and two correspond to the value zero or one.
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Combustion of wood gas is very clean

Contamination of the crown has been an obstacle to the use of biofuels.

Upper picture sows the situation before use.

Lower picture is after forty hours test period.
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Thank you for your interest!

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STIRLING-MOOTTORI PUUKAAŠUKÄYTÖSSÄ