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Notes on the Operation of the Stirling Engine

Janusz Mysłowski[1], *Jaromir Mysłowski*[2]

[1]*Koszalin University of Technology, Śniadeckich* 2, *Koszalin, Poland*
[2]*West Pomeranian University of Technoligy in Szczecin, Aleja Piastów 17, Szczecin, Poland*

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Abstract. The problem of using the Stirling engine for traction purposes has attracted researchers and constructors for many years. Unfortunately, the current state of the art and its structural properties do not allow for its use on a wider scale. apart from the prototype test vehicles
Key words: Stirling engine.

INTRODUCTION

An overview of the possibilities of using the Stirling engine for traction purposes has been presented in the article on its use in motor vehicles [2]. It is a description of possible implementations and attempts to date which have ended with failures, as the authors have stated. Their analysis lacks a broader discussion of the reasons for this state of affairs. Their statements should be supplemented with an analysis of the operational reasons that have caused little interest in this kind of vehicle propulsion. In general, publications regarding this subject lack reference to such parameters as motor flexibility, labor economics and inter-repair runs (which it is too early to discuss). First of all, the information should be given what operating medium is used in a given engine, because this is what its efficiency depends on (Fig. 1).

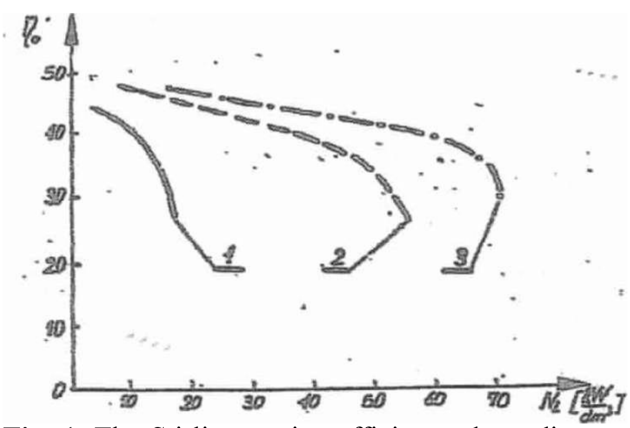

Fig. 1. The Stirling engine efficiency depending on the working medium [1,3]

The practical solution for the design of the engine operating according to the Stirling cycle amounts to the solution of three technical problems contained in the basic national publications on this subject [3]:

– continuous movement of the positive displacement element,
– displacement of the total mass of gas from the space covered by the low temperature heat source into the space covered by the high temperature heat source without changing its volume,
– completion of the full heat regeneration process during one cycle.

The practical implementation of this idea are double-acting engines. The practical solution consists in the fact that the upper and lower part of each piston is used in the implementation of thermodynamic transformations in two separate working planes containing separate volumes of gas (Fig. 2).

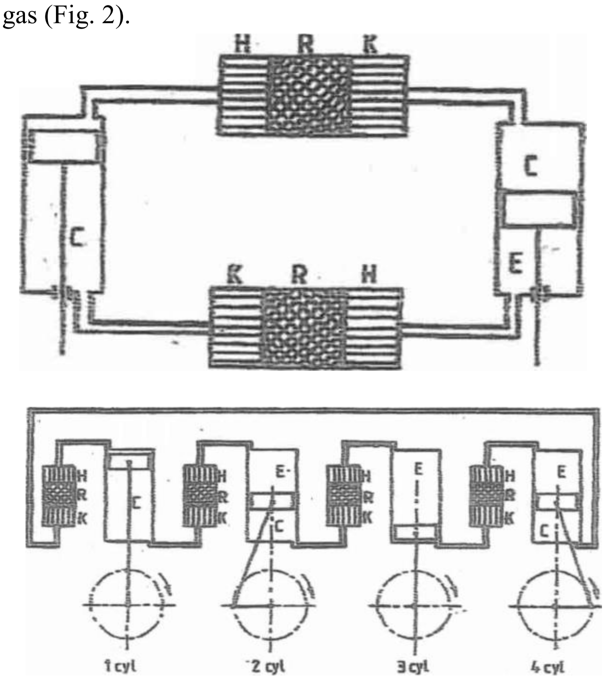

Fig. 2. Constructional solution for double-acting engine, scheme [3], H – heater space, R – regenerator space, K – radiator space, E – expansion, C – compression

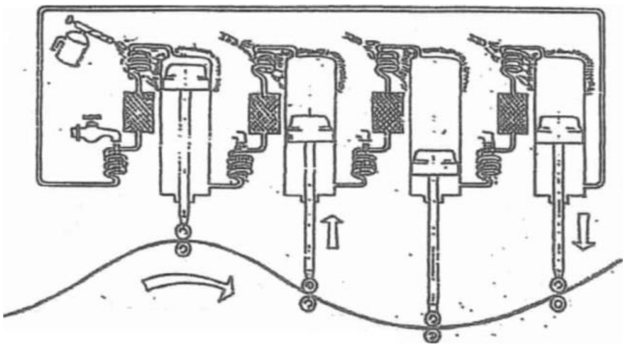

Fig. 3. Diagram of double-acting engine operation [1]

PRACTICAL IMPLEMENTATION

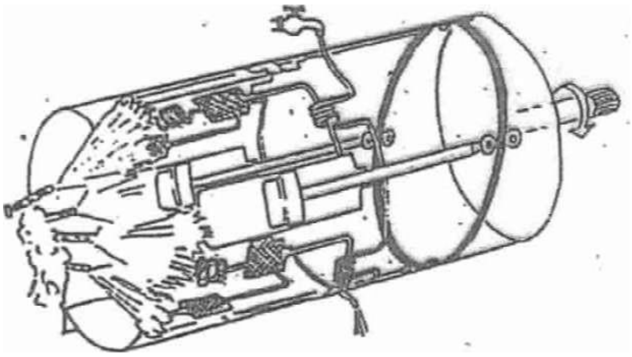

Fig. 4. Practical implementation of a double-acting piston engine [1]

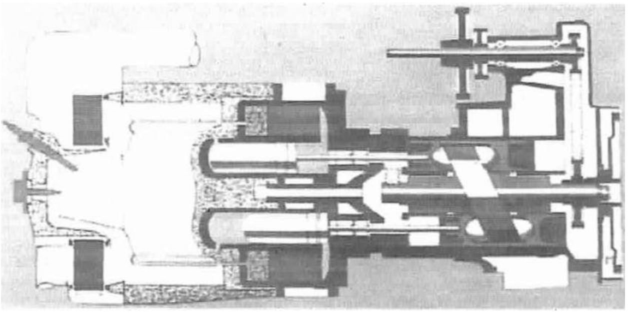

Fig. 5. Cross-section of the A-215 engine [3]

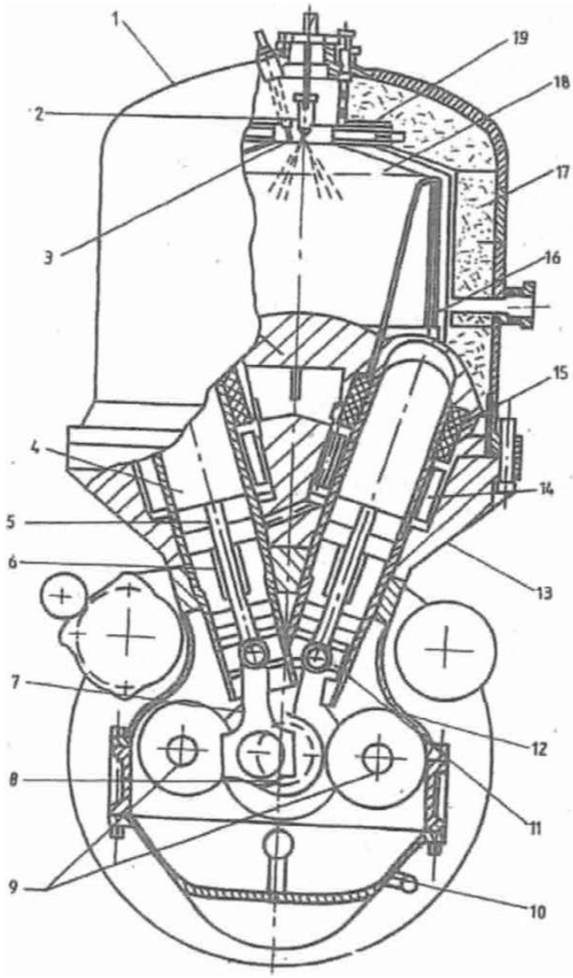

Fig. 6. Cross-section of the V4-275R engine [3]

1-pressure tank, 2-fuel nozzle, 3-glow plug, 4-piston, 5-piston rod, 6-piston rod sealing, 7-connecting rod, 8-crankshaft, 9-shafts of the inertia balance system, 10-oil sump, 11-slider, 12-crankcase, 13-cylinder block, 14-cooler, 15-regenerator, 16-heater, 17- insulation, 18-combustion chamber, 18 - ejector tubes

These engines (Fig. 5), with the designation Philips A-215, were supposed to drive the Foid Tarino car. The rated power was 63-70 kW at the rotational speed of 4500 1/min, with the general efficiency of 20-21% [2, 4]

Whereas the production version were the United Stirling engines, designed for the propulsion of underwater vehicles at the draft of up to 600 m (Fig. 6) [3]. In these engines the combustion system of hydrocarbon fuels in pure oxygen was used, whose consumption in the Y4-275 R engine was 820-950 g/kWh.

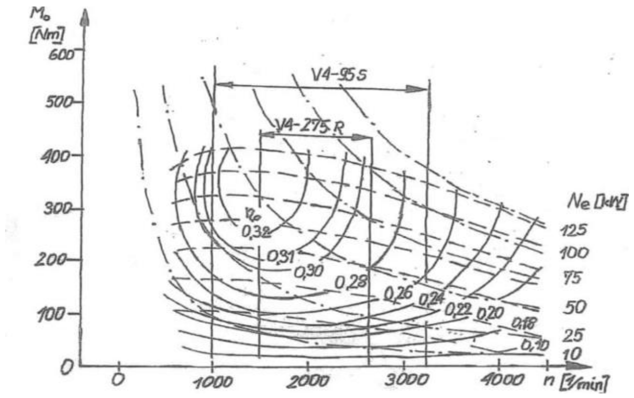

Fig. 7. Universal characteristics of the Stirling engines of the United Stirling Company

Table l. Parameters of the Stirling engines of the United Stirling Company

Engine designation	V4-95 S	V4 - 275 R
Number of cylinders	4	4
Stroke volume	*380cm'*	1100 cm'
Durable engine power	Depending on the working medium	
Helium	10-20 kW 1800 l/min	75 kW 1800 l/min
Hydrogen	10-20 kW 1800 l/min	100 kW 1800 l/min
Rotational speed of engine	1000-3200	1500-2600 1/biin
Mass	430 kg	600 kg

Fig. 7. and Tab.1 show the ranges of operation of production engines that indicate the possibility of their use and inconveniences that prevent their use in road transport. At the speed of 4000 l/min, their efficiency ranges from 0.10 to I.17.1. 24. whereas the fexibility coefficient of the engine, and thus the ability to adapt it to changing operating conditions, is 1.97 at 2.87 for engines of comparable power (VW and SAAB) used in cars. Hence, numerous problems of exploitation nature arise, causing the lack of interest of car manufacturers in this drive source and orientation of interest towards drives using electric energy.

REFERENCES

1. **Mysłowski J. 1982:** Silniki pojazdów samochodowych. Album Rysunków. Politechnika Szczecińska. Szczecin.
2. **Zdanowicz A., Chojnacki J.:** Wykorzystanie silnika Stirlinga w pojazdach samochodowych. AUTOBUSY 7-8/2017.
3. **Żmudzki S. 1993:** Silniki Stirlinga. WNT Warszawa.
4. https://archive.org/details/C-1978-4997