UE2060100

STIRLING ENGINE D

EXPERIMENT PROCEDURE

- **Operate the hot-air engine as a heat engine.**
- **Demonstrate how thermal energy is converted into mechanical energy.**
- **Measure the no-load speed as a function of the thermal power.**

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OBJECTIVE

Operate a functional model of a Stirling engine as a heat engine.

SUMMARY

A hot-air engine is a classical example of a heat engine. In the course of a thermodynamic cycle thermal energy is fed in from a high temperature reservoir and then partially converted into useable mechanical energy. The remaining thermal energy is then transferred to a reservoir at a lower temperature.

REQUIRED APPARATUS

Quantity	Description	Number
1	Wilke-Type Stirling Engine	**1000817**
1	DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)	**1003312 or**
1	DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)	**1003311**
1	Set of 15 Safety Experiment Leads, 75 cm	**1017718**
1	Mechanical Stopwatch, 30 min	**1003369**

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BASIC PRINCIPLES

The thermodynamic cycle of a hot-air engine (invented by *R. Stirling*, 1816) can be simplified by breaking the cycle down into the separate processes of heating, expansion, cooling and compression. These processes are depicted schematically in Figs. 1-4 for the functional model under investigation.

If the hot-air engine is operated without any mechanical load, it rotates at its no-load speed, which is restricted by internal friction and is dependent on the amount of thermal energy supplied. The speed drops as soon as the mechanical power is tapped. This can be demonstrated most clearly by applying a frictional force to the crankshaft.

EVALUATION

Heating:
Heat is introduced when the displacement piston extends thereby pushing air into the heated region of the large cylinder. During this operation the working piston is at its bottom dead centre position since the displacement piston is ahead of the working piston by 90°.

Expansion:
The heated air expands and causes the working piston to retract. At the same time mechanical work is transferred to the flywheel rod via the crankshaft.

Cooling:
While the working piston is in its top dead centre position: the displacement piston retracts and air is displaced towards the top end of the large cylinder so that it cools.

Compression:
The cooled air is compressed by the working piston extending. The mechanical work required for this is provided by the flywheel rod.

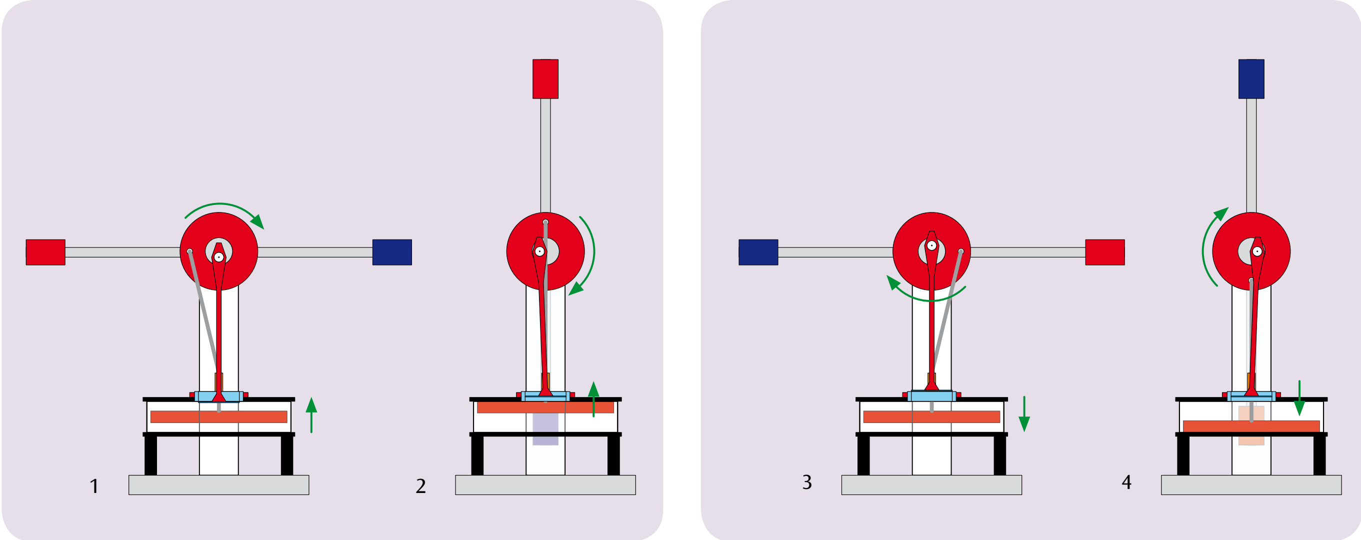

Fig. 1: Heating
Fig. 2: Expansion

Fig. 3: Cooling
Fig. 4: Compression