Design of an Orbiting Scroll Expander

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

SGM Section de Génie mécanique

Project objectives:

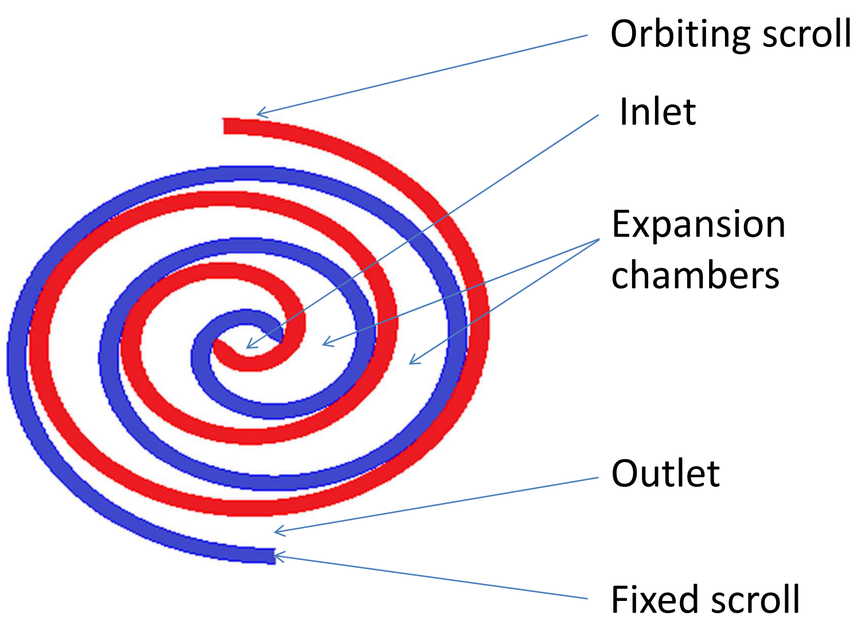
- Thermodynamic and mechanical design of a scroll expander for Rankine cycle

Specifications:

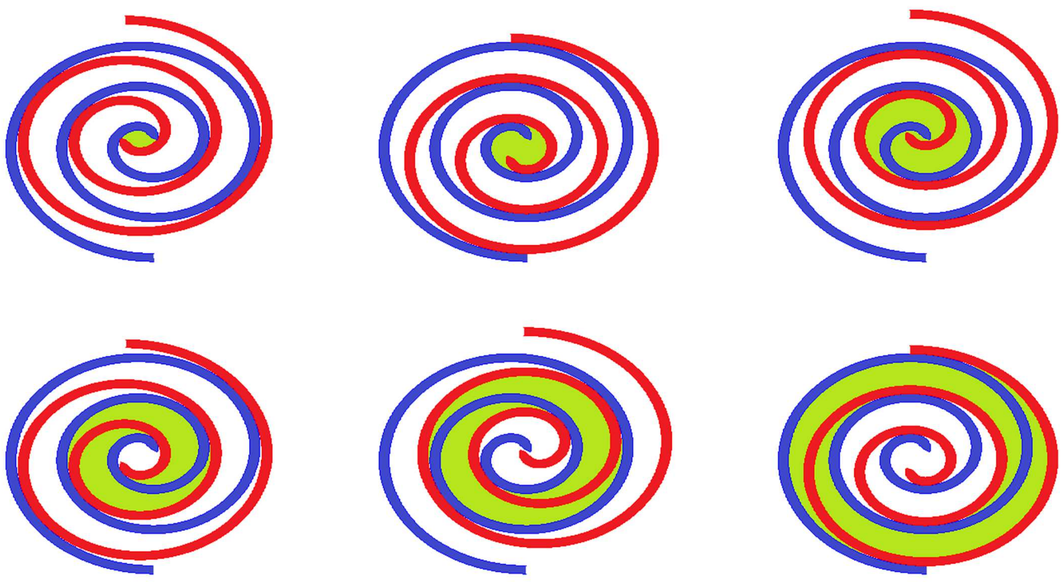
- Output electrical power : $\dot{W} = 5\ kWe$
- Pressure ratio between inlet and outlet : π = 0.25
- Fluid : R-245fa
- Inlet temperature : T = 150 °C
- Rotational speed : N = 6000 RPM

Working principle:

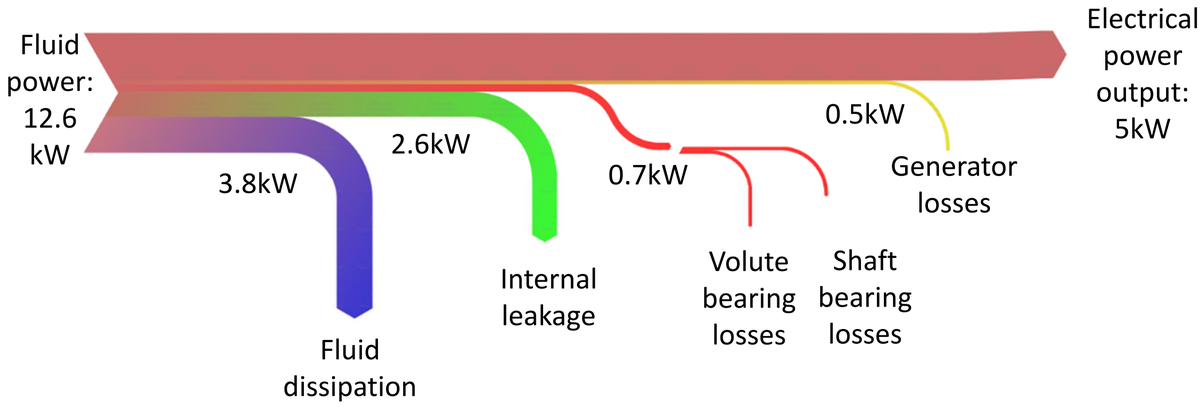
- High pressure fluid enters in the center and exits on the periphery at low pressure
- Expansion drives scroll orbiting movement



Expansion through orbiting:



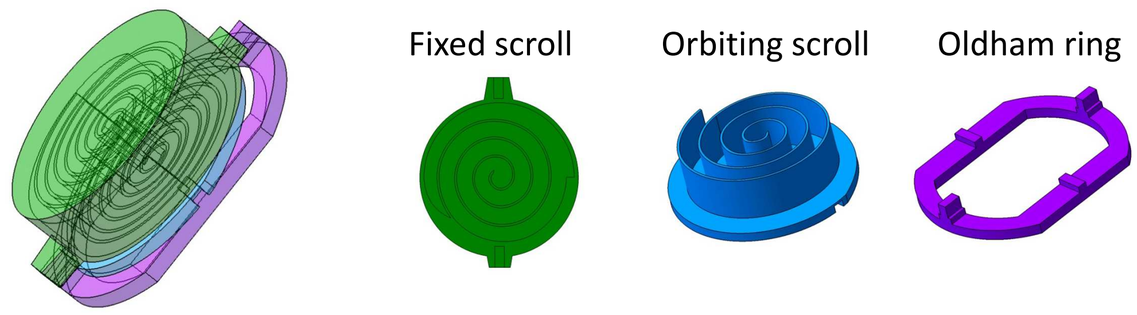
Expander power flowchart:



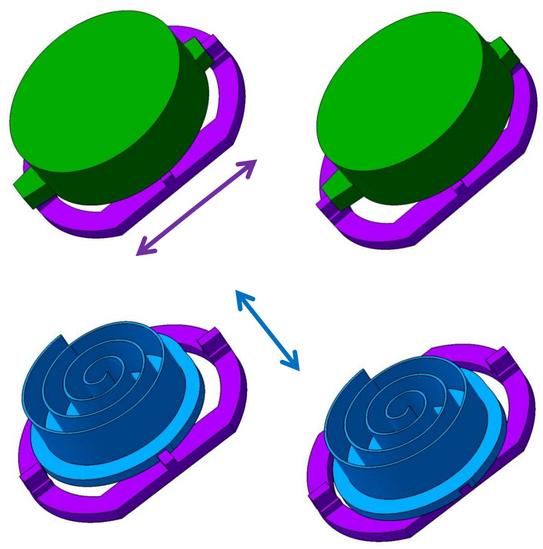
- Overall efficiency: η = 40%
- Volumetric ratio: χ = 0.248

Scroll motion control:

- Goal : Avoid any rotating movement
- Solution : Oldham ring

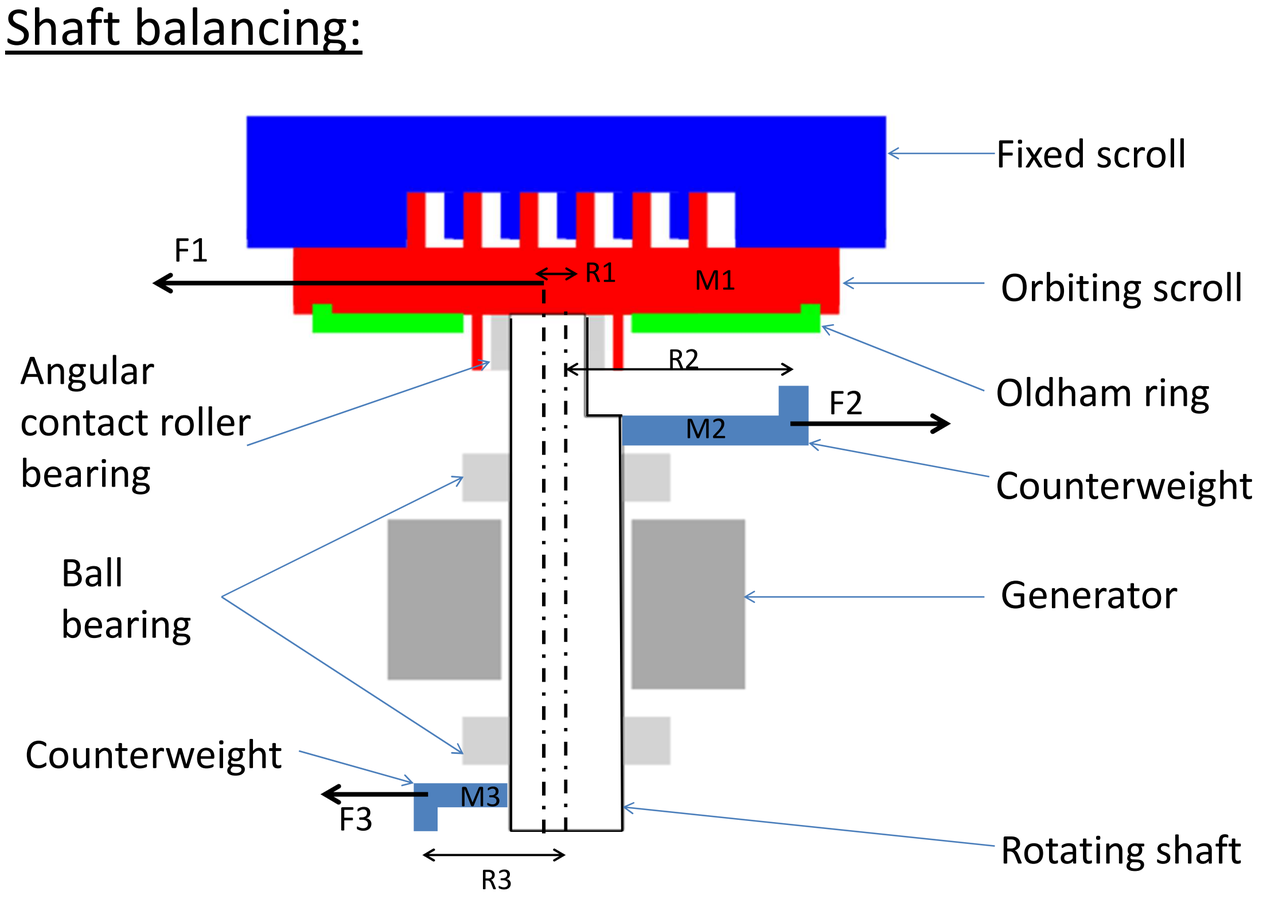


- 2 superposed 90° offset linear motions = 1 orbiting motion



- The Oldham ring moves along a straight line with respect to the fixed scroll
- The orbiting scroll moves on a straight line with respect to the Oldham ring

Shaft balancing:



	F [kN]	M [kg]	R [mm]
1	37.3	6.84	13.8
2	71.1	2.77	65
3	34.1	2.77	31.2

Conclusion:

Design:

- Scroll diameter: D = 24.75 cm
- Scroll height: H = 5.25 cm
- Scroll thickness: e = 6.9 mm

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