Split Cycle Engine Concept

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CEREEV
the **German inventor** of the first **internal-combustion engine** to efficiently burn fuel directly in a **piston** chamber.
He invented what he called the *Heat Economiser* (now generally known as the *regenerator*), a device for improving the thermal/fuel efficiency of a variety of industrial processes, obtaining a patent for the economiser and an engine incorporating it in 1816.

About 10 years before Carnot’s work on heat engines.
Main components of the twin-regenerator gas turbine:
(A) accessory drive; (B) compressor; (C) right regenerator rotor;
(D) variable nozzle unit; (E) power turbine; (F) reduction gear;
(G) left regenerator rotor; (H) gas generator turbine; (I) burner;
(J) fuel nozzle; (K) igniter; (L) starter-generator; (M) regenerator drive shaft; (N) ignition unit.
Minimise Compression Work

Compressed Air at high p and T with fast injection

Mix and burn fuel as fast as possible
No prior knowledge

Expansion process can be specified independently from compression and matched with exhaust systems

Control of scavenging for emissions control
Split Cycle Engine Issues

Compression:
1. Number of stages (turbocharger?)
2. Optimisation (e.g. Isothermal)

Combustion:
1. Type (multi-fuel?)
2. Filling ($\frac{1}{10}$th of time)
3. Closing
4. Air motion
5. Expansion stroke
6. Rate of combustion

Reservoir:
1. Size
2. Exhaust heat recovery
3. Maximum temperature
Simple Cycle

Compressor

Combustor
Split Cycle Engine – R&D challenges

Compressors

Heat Exchanger

Turbocharger

Combustors

Split Cycle Engine
LOW technical Risk - Problem / solution well defined

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Isothermal Compression:
LOW technical Risk - Problem / solution poorly defined

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Compressors

Engine:
Cold starting
Load Control

Heat Exchanger

Compressor:
flow rate and temperature control

Turbocharger

Combustors
Split Cycle Engine

Heat Exchanger: Thermal design

Integration of heat exchanger and combustor

Turboccharger

Thermal design of combustor components

HIGH technical Risk - Problem / solution well defined
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HIGH technical Risk - Problem / solution poorly defined

Split Cycle Engine

Compressors

Pin
Tin

Pex
Tex

Combustors

Pamb
Tamb

Pamb
T4

Combustor:
Air induction
Combustion process

Methods for onboard isothermal compression

Heat Exchanger

Pex
Tout

Pex
Tex

Pin
Tdev

P2
T2
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