PRESENTATION OF THE PUMPCHARGER

Oxyfuel technology for ICE (Internal Combustion Engines)

- Present engines
- Vision: Next generation engines

Qualification from present TRL 5 to TRL 6 (Prototype demonstration in a relevant environment)

Market size

MOTIVATION AND BENEFITS

PCT/NO2025/050140 System and method for controlling an internal combustion engine – Written opinion of the international searching authority: Patentable

MOTIVATION 1: EASY CAPTURE OF CO_2

-Easy to capture CO_2 by condensation from the exhaust consisting og water vapor and gaseous CO_2 by adjustment of pressure and temperature

MOTIVATION AND BENEFITS

MOTIVATION 2: COMPACT ENGINES WITH HIGH PERFORMANCE AND EFFICIENCY

-Oxyfuel will allow to optimize the oxygen content into the cylinder and thereby fuel and resulting in:

- Higher power for a given cylinder volume
- Higher efficiency
- Reduced fuel consumption
- Smaller engines

MARKET OR ICE 1 MW AND ABOVE

Stationary ICEs 1-20 MW:	1 million
Marine 1-90 MW:	80 000
Trucks:	Very high

TECHNICAL CONCEPT AND RETROFIT VARIANT WITH SYNTHETIC AIR

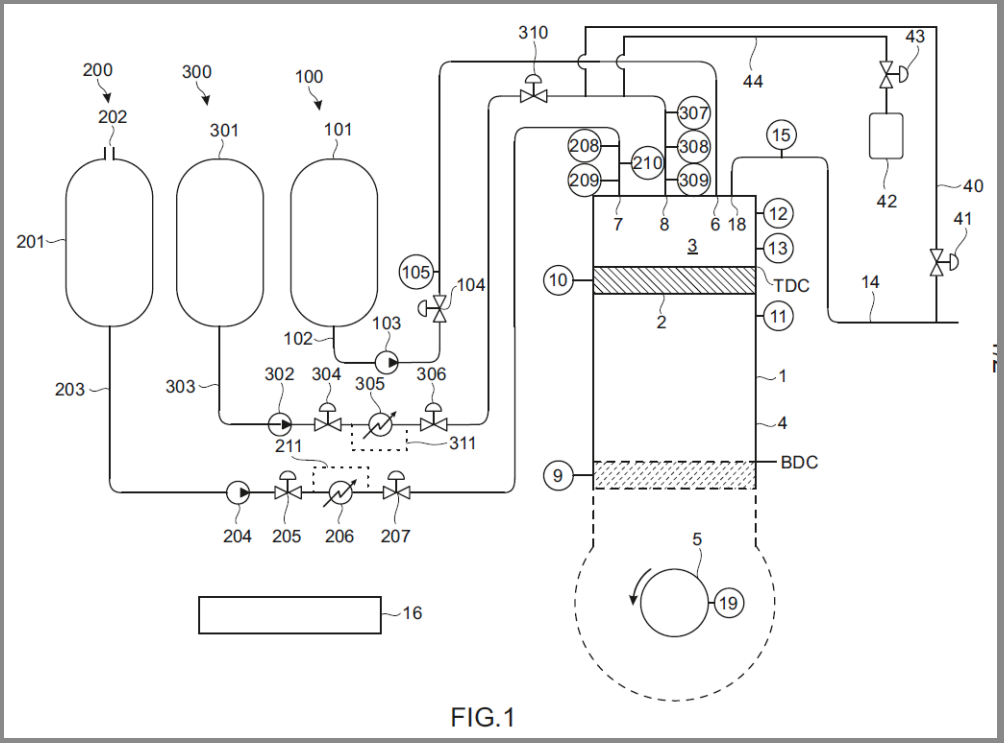


FIG.1

- Facilitates CO2 capture by pressure and temperature adjustment
- Pumps
  - LOX trough an evaporator, say injection at say 4 bar, 0 C
  - LCO2 through an evaporator for injection of gaseous CO2 for dilution of combustion for temperature control
  - Condense water and inject it for flame dilution for temperature control

For existing motors: Inject a mix 27% O2, 60% and 13% H2O that emulates air at a charging pressure of say 4 bar

Future: For instance, must be optimized: 50% O2, 30% CO2, 20% H2O or even 100% O2, injection 4 to 25 bar

CO2 CAPTURE BY PRESSURE AND TEMPERATURE ADJUSTMENT

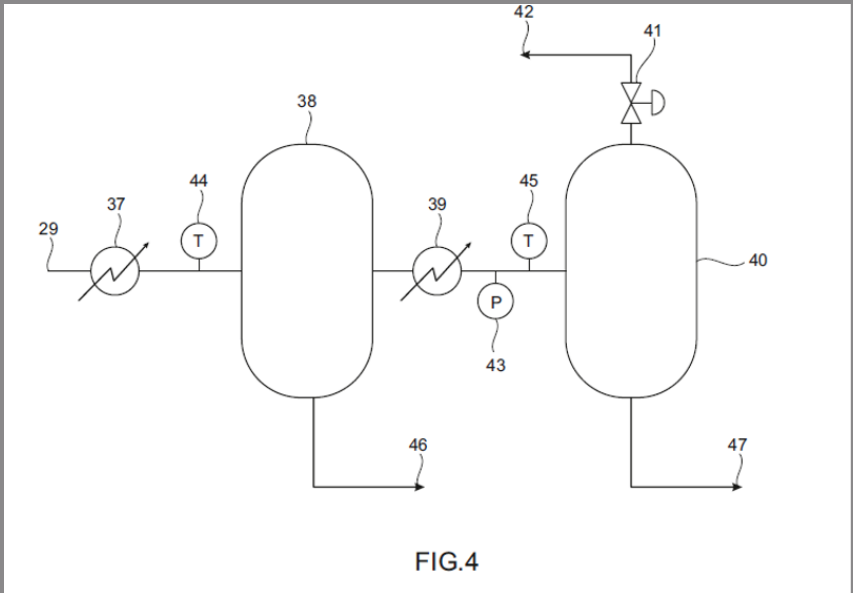
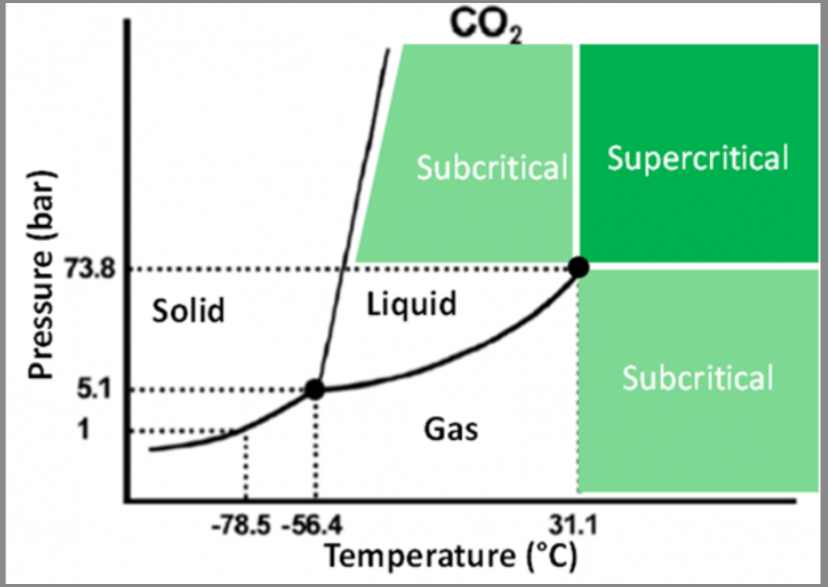


FIG.4



- −20°C to 25 °C 12.5 to 57.3 bar

- Capture of CO2
  - Cooling to 25 °C by seawater
  - Further cooling by evaporation of LOX

Competition:

Now: Amine capture

Future: Hydrogen, Ammonia

COMPARISON TABLE: 20 MW ICE WITH THREE INTAKE GAS VARIANTS

Parameter	Air-Based Diesel ICE	Synthetic Air ICE (27% O_2, 60% CO_2, 13% H_2O) Can be done NOW	100% Oxyfuel ICE Vision
Thermal Efficiency	45 %	55% (est.)	65 %
Power per Liter Cylinder Volume	10 kW/liter	~35–40 kW/liter	~76.6 kW/liter
Cylinder Volume	~2000 liters	~570 liters	~261 liters
Engine Weight (est.)	~120 tons	~50 tons	~25 tons
Annual Diesel Consumption	~17,520 tons	~14,330 tons	~12,115 tons
Annual Fuel Savings	–	~35 MNOK	~59.5 MNOK
CO_2 Capture Potential	Low (70–80%)	High via condensation (99%)	High via condensation (99%)
Annual OPEX (Optimistic)	~15 MNOK	~3.24 MNOK	~3.24 MNOK
Annual OPEX (Max Conservative)	~15 MNOK	~15 MNOK	~15 MNOK
10-Year Net Profit (Optimistic)	–	**+178 MNOK**	**+425 MNOK**
10-Year Net Profit (Max Conservative)	–	**+40 MNOK**	**+255 MNOK**

QUALIFICATION OF THE TECHNOLOGY: EASY AND LOW COST

Technology Readiness Levels

TRL 1 – Basic principles observed and reported, done before patent description

TRL 2 – Technology concept or application formulated, patent application description

TRL 3 - Analytical proof of concept

TRL 4 – Technology basic validation in a laboratory environment

TRL 5 – Prototype basic validation in a relevant environment

TRL 6 – Prototype demonstration in a relevant environment

TRL 7 – Prototype demonstration in an operational environment

TRL 8 – Technology completed and qualified through test and demonstration

TRL 9 – Technology qualified through successful operations

GETTING TO TRL 6

- Test arrangement:

LOX

LOX PUMP

EVAPORATOR

DIESEL MOTOR

EXHAUST

CO2 FOR FLAME DILUTION

Water and LCO2