Cargine Engineering AB



Cargine Core Business:

To develop, document, patent and market combustion engine technology.

Pneumatic Valve Actuation

- Pneumatic, low pressure
- Cycle to cycle control of
 - Timing for open and close
 - Valve lift
- Passive hydraulics
 - Hydraulic latch
 - Soft valve seating
- Compact, low weight
- Low energy consumption
- High performance
- Suitable for low cost mass production



Valve Simulation Software 6000 rpm



Valve Simulation Software 3000 rpm

🛋 Valve	Sim 8.1 C	opyright	© 2008 C	argine En	gineerin	g AB									_ & ×
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Cylinder Head Package



Multi Cylinder Head



Running SAAB 9-5



Fuel Savings Miller Cycle

- 10-11% at part load
 - Less pumping work
 - Less compression work
 - Improved combustion

Miller Cycle vs Otto Cycle (Cargine Pneumatic Valve Actuators vs Standard Camshaft)



Fuel Savings "Skip-Cycles"

 ~ 20 % savings potential



Increased Compression Ratio

- Increased fixed compression ratio
 - Miller Cycle knock control and/or
 - Water injection knock control and/or
 - Direct fuel injection
- Or Variable Compression Ratio
 - Control Piston in cylinder head operated by Pneumatic Valve Actuator

Increased Compression Ratio

• In addition to savings from Miller Cycle and "Skip Cycles", fuel savings potential of 2-5 %

Performance improvement

- Optimal valve time at every rpm (impulse charging at low rpm)
 - + 20-30 % low rpm torque
 - + 20-30 % high rpm peak power
- 2-4 stroke mode switching
 - + 40 % low rpm torque

Ricardo 2/4 sight project, projected performance improvement



"Conventional Concepts" Improvements

- Otto engines with Lambda 1 combustion can obtain 20-30 % reduction in fuel consumption.
- **Diesel-like efficiency** with "better than" normal **3-way catalyst emissions** (especially cold-start)
- Increased Low-End **Torque**
- Increased Peak Power

"Conventional Concepts" Improvements

- **Diesel engines** gain up to 5 % fuel efficiency with Miller cycle
- Lower NOx and Soot **Emissions**
- Increased Low-End **Torque**
- Increased Peak Power

- Pneumatic Hybrid
 - Stores compressed air at deceleration (Compressor Mode)
 - Uses the compressed air to accelerate the vehicle (Air-motor Mode)
 - Supercharge in order to achieve higher loads (at low rpm engine torque could increase 400-500%)

- Pneumatic Hybrid
 - Slightly lower efficiency than Electric Brake Energy Regeneration
 - + Low weight (especially if tank is integrated in vehicle structure)
 - + Low cost
 - + High Torque (gearbox reduction possible)

- Pneumatic Hybrid
 - Project at Lund
 University since 2 years
 - Measured regenerative efficiency 40 48 %



- Steam Hybrid BMW style
 - Decicated Steam Expander
 - Closed Water/Steam Loop
 - Dedicated expander add weight and cost to vehicle
 - Save up to 15 % fuel



Source: www.gizmag.com

- Steam Hybrid, Cargine style:
 - Use the engine as steam expander
 - Alternate conventional combustion cycles with steam expansion cycles
 - No extra expander needed, only heat exchanger and valves to each cylinder
 - Condensation of water from exhaust, no need to refill. Not a closed loop system

- Steam Hybrid, Cargine style:
 - Low extra weight
 - Low extra cost
 - Exhaust scrubbing
 - Access to water for water injection into cylinder
 - Internal Cooling and Regeneration of Cooling Losses
 - Isothermal Compression
 - Thermal Control of Internal Exhaust gases

- Steam Hybrid, Cargine style:
 - PCT/SE02/01777
 - Research Partners Wanted!

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	(43) International Publication Date 10 April 2003 (10.04.2003)	РСТ	(10) International Publication Number WO 03/029627 A1
(51)	International Palent Classification ⁷ : F02B 7 4780	5/02. (72 (75) Luveators and) Turenter: Applicant (50–53) onlyst HEDMAN , Ma [ST2SP]: Beveravik, S-640-34 Storrenholm (SP).
(24) (22)	Incomptonal Application Number: PCT/ST009 Incomptional Filing Dates: 1 Section 2002/01/01	דדדו די) (ד4 אווניז	I Agents FRÖDERBERG, Öskar: Dr. Ledwig Bar Patentrypt AB, Bay 17 (2), S109 (0) Strattalin (SR)
(25)	Filing Language	(81 (2001)	Designated States (<i>isotoral</i>): Als AO, AL, AM, AL, A AZ, BA, DB, DG, DR, DY, BZ, CA, CH, CN, CO, CR, C CZ, DB, DB, DM, 'DZ, FC, FC, LS, H, GB, GD, GE, GF, G
261 301	Publication Language: La Priority Data:	ري. روزي	GM, UR, LU, ID, IL, IN, IS, JP, KIS, KG, KP, KR, KZ, L LK, LR, LS, LL, LL, YMA, MD, MG, MK, MN, MC, MX, MZ, NO, NZ, OM, PH, PL, PL, RO, RU, SD, SE, S SL, SK, SL, TL, TM, TN, TR, TT, TZ, UA, HG, US, IJ
71)	Applicant flor all designed States encour CARCINE TNOTNEERING AR [STATE]. Subminue (S) S 264 68 Unided and (STATE].	51' US): (84 Koin-	 VN, YE, ZA, ZM, ZW. Designated States (assignable ARIPO petiet (GH, G) KF, LA, MW, MZ, AD, SL, AZ, TZ, 133, ZM, ZW Lemma AMA XZ, XY, ZY, ZY, AD, SL, TZ ZD
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