RVCR Technology
Competitive & Alternative Technology Comparison

Criteria	RVCR Tech	Alternative VCR Tech 1	Alternative VCR Tech 2
Technology	Roto Dynamic VCR	Variable Crank Position Method	Variable stroke Length Method
Performance			
Specific Output	Very High Performance out put. High Expansion Rates at slow speed using Very large Bore compared to stroke.	Not Possible	Not Possible
	Multiple Power stroke per Unit per RPM	Once in 4 strokes	Once in 4 strokes
	1 or More pair of 'Double acting pistons' Packaged in 1 liner	4 pistons need 4 Liners (units)	4 pistons need 4 liners (units)
FHP reduction factors	¼ the number of strokes	4 strokes /Power stroke	4 stroke/Power stroke
	No piston Chattering and Piston Slapping	Piston Chattering inherent	Cantilever piston friction inherent
	VCR drive friction simpler (point contact)	Comparatively tedious friction	Comparatively tedious friction(gears)
Thermal Efficiency	Constant Vol Heat addition and Rejection	Not Possible	Not Possible
	VCR efficiency increment	VCR efficiency increment	VCR efficiency increment
	Diesel Injection reaction force capture	Not possible	Not Possible
	TDC advance & retard (Floating TDC)	Not Possible	Not Possible
Downsizing	2 Double acting Piston in one liner	Single acting 1piston 1 unit	Single acting 1piston 1 unit
	VCR induced high loads capability	VCR induced high loads capability	VCR induced high loads capability
	Fuel switch over to high calorific value fuel	Only limited range Possible	Only limited range Possible.
Thermal Load & Heat Balance	Centered air inlet to combustion chamber	Offset air inlet to Combustion	Offset air inlet to Combustion
	Reduced radiation area and time	Larger radiation surface area and time	Larger radiation surface area and time
	Radially Self-Centrifuged Cooling	External cooling	External cooling
Vibration & Maintenance	No reversal of inertia forces	Reciprocating Piston	Reciprocating Piston
	No 2nd order vibrations	2nd order vibrations present	2nd order vibrations present
	External open VCR controls	VCR control in heat zone vicinity	VCR control in heat zone vicinity

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	External VCR control components	VCR control at blow by vicinity	VCR control in blow by vicinity
	Dynamically Balanced Rotor	Varying Out of balance forces	Out of balance forces exist
	Piston ring blow by tell-tale hole	No Real time blow by measure	No Real time blow by measure
	Cylinder L.O. tell-tale hole	No Real time Cyl L.O measure	No Real time Cyl L.O measure
	Easy external main bearings access	Internal Main Bearings	Internal Mail bearings
	No displacement of rotor axis	Shifting in Crank center line	Offset in gear link loading
VCR & application	Easy CR range altering (VCR Plate change)	Not possible	Not possible
	Change from VCR, for load Range to fuel	CR range/sensitivity alteration Not	CR range/sensitivity alteration Not
	Displacement Scv'g	2 stroke Scavenging efficiency low	2 stroke Scavenging efficiency low
Exhaust Smoke and Emissions	VCR controlled peak temperature	VCR controlled peak temperature	VCR controlled peak temperature
	VCR & CVHA based combustion control	VCR based combustion control	VCR based Combustion control
Physical Characteristics			
Weight	No entablature	Engine Entablature must	Heavy Entablature Must
	No Con rod + Piston rod	Gudgeon, Con rod + Crank Essential	Con rod essential
	No dedicated Fly weight required	Large Dedicated flywheel	Large dedicated flywheel
	No Gudgeon, Top / Bottom End Bearings	Gudgeon, End Bearings required	Gudgeon, End Bearings essential
	Crank /Counter Not	Crank /Counter weight required	Crank /Counter weight required
	Flywheel weight reduction	Flywheel Weight essential	Flywheel weight reduction
	Piston weight reduction (Double acting)	Piston skirt required	Piston single acting
	Reduced Valve Gear (1 cam for units)	Increased Valve gear and individual push rod Length high	Increased Valve gear and individual push rod Length high
Size & Volume	No Reciprocating links,	Reciprocating mechanism	Reciprocating mechanism
	No Entablature	Entablature essential	Entablature essential
	No Crank Case (integrated into clutch)	Crank Case essential	Crank Case essential
	No dedicated Flywheel required	Dedicated Flywheel essential	Dedicated Flywheel essential
	C-case relief Valve not required	C-Case relief valve required in bigger	C-Case relief valve required in bigger

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Seals	Specialized Seal required for Gas Seal	No specialized seal required	No specialized seal required
Infrastructure			
Implementation speed, resources	Technology NOT Implementation ready, Resource intensive, Easier to implement as simpler engines can be implemented first and later add-on features integrated)	Technology Better implementation ready than RVCR, Resource intensive but industry better streamlined (most tools and equipment available), Cannot be implemented in parts. Complete package implementation required	Technology Better implementation ready than RVCR, Resource intensive, industry better streamlined (most tools and equipment available), Cannot be implemented in parts. Complete package implementation required
Maintenance requirements	Custom Maintenance requirements, Maintenance equipment's & structure standardization to start from scratch, Lesser long-term maintenance Easier maintenance	Customized maintenance requirement, Maintenance equipment's and structure standardization partially available, More long-term maintenance, Higher degree of Maintenance	Customized maintenance requirement, Maintenance equipment's and structure standardization partially available, More long-term maintenance, Higher degree of Maintenance
Spare parts requirements	Less number for power range.	Custom Spares inventory buildup required, higher number for power range.	Custom Spares inventory buildup required, higher number for power range.
Service & Support requirements	Custom inventory / training buildup required, Can utilize existing service structure	Custom inventory / training buildup required, Can utilize existing service structure	Custom inventory / training buildup required. Can utilize existing service structure
Learning curve	Technology Fast/ easy to learn. General eagerness to learn among technical professional observed.	Much of learning already exist, (incremental technology)	Much of learning already exist, (incremental technology)
Fit with existing infrastructure and processes	Can be integrated into existing products but need customization,	Can be integrated into existing products but need customization	Can be integrated into existing products but need customization
Ease of manufacture	Existing Manufacturing facilities can be used but need customization, Easy to streamline manufacturing	Existing Manufacturing facilities can be used but need higher degree of customization,	Existing Manufacturing facilities can be used but need higher degree customization,
Scalability	Highly scalable, Scalability by Parametric design	Limited scalability, difficult Parametric design scalability	limited scalability, difficult Parametric design scalability

Less resource intensive	Less Material requirement per unit power	More material requirement, per unit power	More material requirement, per unit power
Flexibility to operate in various environments	Yes, is flexible to operate in varied environment	Yes	yes
Ease/ability to integrate / adapt to various infrastructure and resources worldwide (electrical system, transportation, fuels, language	Can easily integrate	Can integrate	Can integrate
Defensibility / Difficulty of duplication.	Not easy enough for general mass duplication. Powerful exclusive licensee strategy adopted.	Not easy for general mass duplication, Infringement strategy not known.	Not easy for general mass duplication Infringement strategy not known
Intellectual property			
Patents granted	Granted Patent world wide	Status not known to me	Status not known to me
Uniqueness	Technology is unique and Path Breaking	Technology is incremental and known	Technology is incremental and known
How “wide a fence” has IP protection measures placed around the technology	Continuation applications and other support patenting strategy adopted. IP ownership available	Not known	Not known
Cost			
Cost reduction	Not quantified in absolute terms Computational analysis used to quantify cost shows high cost reduction	Not available in absolute terms Computational analysis used to quantify cost shows increase in cost	Not available in absolute terms Computational analysis used to quantify cost shows increase in cost
Reduction in production cost	Least cost per unit Power, Non-linear reduction with power increase, Analysis based on reduced material cost	More cost per unit Power than RVCR based on the extra material requirement	More cost per unit Power than RVCR, based on the extra material requirement
Reduction in raw materials cost	Least cost per unit Power, based on number of reduced components and Mass	More cost per unit Power than RVCR, based on number of extra components and Mass	More cost per unit Power than RVCR, based on number of extra components and Mass

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Reduction in capital cost	Less capital cost than all existing Products	Increased capital cost than existing Products	Increased capital cost than existing Products
Reduction in operating cost	Reduced operating cost, based on fuel efficiency, reduced wear	The cost is reduced by improved fuel efficiency, however higher components wear.	The cost is reduced by improved fuel efficiency, however higher components wear.
Reduction in maintenance cost	less maintenance, simpler components, lesser stress levels on Components	number of stressed components are more	number of stressed components are more
Cost to commercialize	Similar funding requirement as other technologies. RVCR is relatively newer than competitors technology		
Time to commercialize	2.5 Years to licensing	Not know	Not known
Markets			
Geographic area knowledge and strengths	New Market Creation capability.	Need to be fitted in Existing market space	Need to be fitted in Existing market space
Sales Channels	To be developed	To be developed	To be developed
Recognition	RVCR awareness is Minimal in industry	The technology is known to industry	The technology is known to industry
Miscellaneous			
Market readiness	Early stage (1st Licensing done)	Medium stage (Not known)	Pilot product ready for 5 Years (No takers)
Degree of innovation	Breakthrough Technology	Incremental Technology	Incremental technology
Number of applications	All engine applications & fluid Handling	I C Engines	I.C. Engines
Funding	Self-funding by inventor/Gyatk Grants under DSIR (Govt of India) Angel funding by KSIDC (Govt of Kerala) Funded by partial License Sale.	Partial US government funding	Pilot product funded completely (Source not known)