RVCR Engine Description

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RVCR Engine technology, represent a Game-Changer innovation in propulsion/drive system applicable to Transport and Power sectors.

We are developing I.C. Engine based on RVCR (a breakthrough innovation in Mechanism of Energy Conversion). This document provides an overview of the RVCR Engine for those skilled in the art. For Further detailed explanation and descriptive explanation please send your request to contact id.

1. Background: -

Today engines are based on either 'Reciprocating-Piston-Crank' or 'Turbo-Jet' mechanism. They differ in Hardware configurations, where former uses a cylindrical oscillating 'Piston' connected to a 'Connecting Rod' to rotate a crank, the latter has radial blades fitted on a central shaft mounted on bearing. These configurations were invented a century ago. There also exists another rotary system applied in 'Wankel' engines which is rarely used. we have developed a new mechanism called RVCR.

2. RVCR Basics:

The reciprocating piston engine has Pistons that slide up and down in a straight Cylinder called Liner. This piston here is extended downwards (out of the liner) using a oscillating connecting Rod. In RVCR the cylinder is bent and takes the shape of a hollow doughnut and has two bent Piston inside it. The 2 bent pistons are extruded out of the bent liner sideways using a sleeve (one on each side) that can be turned to slide the bent piston inside the hollow toroidal liner. (like key twisted from outside).

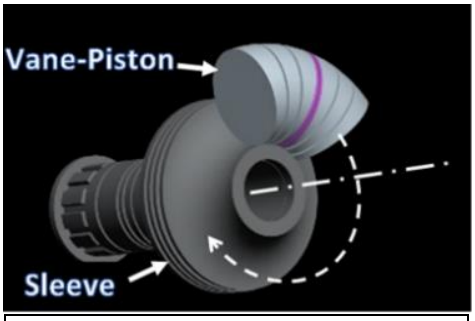


Fig 1 - Vane Piston and Sleeve

kinematic Mechanism Description: -

Conventional mechanism configuration comprises of components *(links)*, connected *(Paired)* to other links forming a chain, where one link in the chain remains 'grounded' or stationary while others work as 'moving links'. Engines have 3 moving links (Sliding Piston, Oscillating Connecting Rod, and Turning Crank) Constrained within a 4th stationary/Grounded block (Liner and main bearings are part of block). RVCR allows dynamic reorienting of moving link (bent piston) to be a grounded link (Cylinder Head).

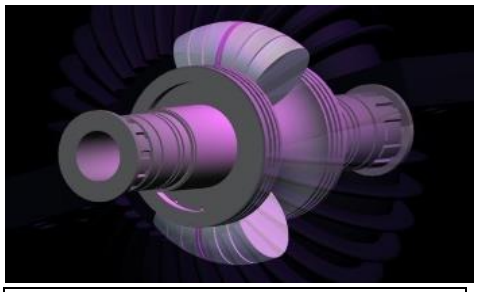


Fig 2, 'Vane Piston' & 'Sleeve' Set

RVCR assembly: -

RVCR constitutes of a pair of 'vane-piston' sets mounted on a central shaft and each couple and decouple with it individually. When coupled the 'vane piston' rotates along with the shaft and when decoupled it is grounded.

The sequence: -

1st one 'vane-piston' rotates along the central shaft axis hence the angle between the two 'Vane Pistons' increases on one side and reduces on the other. The rotating vane reaches the proximity of the 2nd 'vane-piston' that is held stationary from the back side. At a pre-set point of the rotating 'vane-piston' actuates the coupling between stationary 'Vane-Piston' ahead of and the central shaft (Like the actuating of a shuttle Valve in steam engine) and both 'Vane Piston' made to rotate synchronously with. Here the rotating Piston transfers its inertia to the 2nd 'vane-Piston'. Subsequently when the 1st 'vane-piston' reaches the point where the 2nd 'vane-piston' was held stationary, it is decoupled from the central shaft, and held stationary. The 2nd 'vane-piston' now continues to rotate till it reaches the proximity of the current stationary 1st 'vane-piston'. This pattern is repeated cyclically.

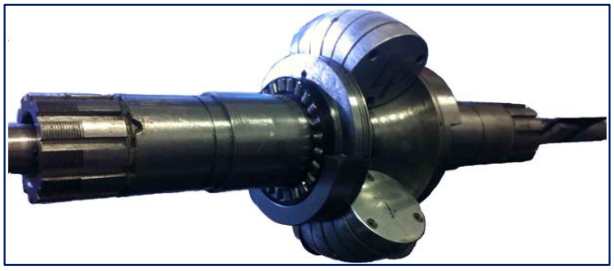


Fig 3- Vane-Pistons on sleeves on central shaft

3. Precedence:

RVCR uses 'Rotary-Vane' concept with two or multiple 'Vane-Pistons' sets, mounted on a shaft, inside a hollow torus chamber. The flaws of the predecessor 'Rotary Vane' system like 'Swing-Piston', 'Toroidal', 'Wankel', 'MYT', 'ORE' Engines) are resolved by Innovative design solutions, in the areas of: -

1. Sealing
2. Rotary Inertias
3. Thermal imbalances.
4. Packaging of Valves.
5. Lubricant Recovery.
6. Manufacturing & Commercial Viability.

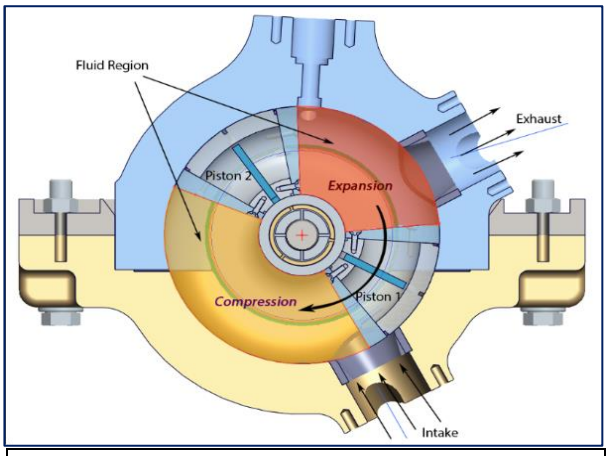


Fig 4 - Graphic Depiction RVCR Gas Process

4. RVCR & compression Ratio: -

The two 'vane-piston' rotate alternately with its counterpart being stationary and the role reversal happens after a short period when both Vane Piston rotate synchronously. This 'Short Period' of synchronous Rotation defines the 'Compression Ratio'. The shorter the Period higher the 'Compression Ratio' and Vice Versa. The time-Period is controlled and altered analogously to achieve a smooth wide-ranging VCR.

5. Technical attributes for skilled in art.

1. A simplified 'Rotary Positive Displacement Mechanism' delivering 'Variable Compression Ratio'(VCR).
2. Achieves controlled/analogous Variation in Compression/Expansion Ratios.
3. Enables 'Constant Volume Heat Addition' (CVHA) and Rejection (CVHR) processes.
4. Delivers High Torque @ Low RPM's (Very High Expansion Ratio per crank angle)
5. Deploys 'Opposed Piston' Principle and with equal 'Across Piston Sectional areas'.
6. Packages two independent chains of links acting as 'Multiple Opposed Piston' within one enclosed Chamber.
7. Two Rotors, alternating as 'Moving' and 'Grounded' Link for Independent Transmission of Forces by Rotors

6. Why RVCR?

The automotive and non-automotive industry are driven towards clean, sustainable and lower carbon print solutions. Efficiency and free emissions are the core goals to be achieved by the industry as demanded by both policy makers and consumers. RVCR is a superior technological alternative for dealing with the environmental challenges from the indiscriminate use of fossil fuels, that incremental innovations in existing technologies like batteries, electric drives; alternative-fuels, fuel cell and improved combustion technologies, are unable to solve. RVCR engines deliver a level playing platform for green fuels to compete with fossil fuels without additional investment needs creating a sustainable system that empowers end users, industry players and policy makers alike.

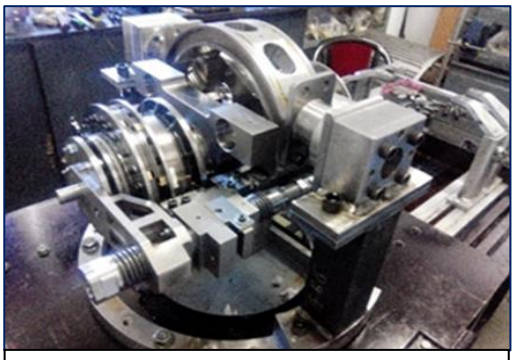


Fig 5 Proto on Test Rig

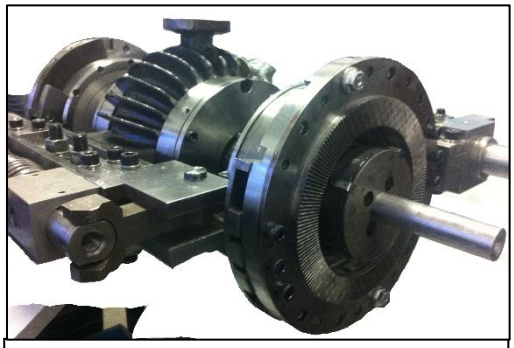
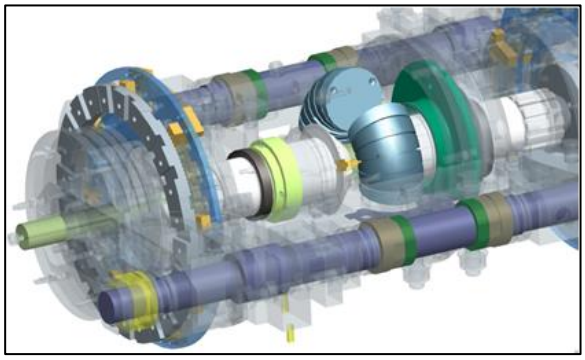


Fig 6 Prototype Assembly

7. RVCR Characteristics and Advantages:

RVCR Mechanism Based Engine design warps a 'Positive displacement' system of rotating pistons in a toroidal liner to deliver a compact high performance Prime-Mover. The Various Characteristics advantages of the RVCR System as compared to conventional existing I.C. Engine under various heads listed below.

1.1. Quantum Leap in Energy efficiency.
1.2. Specific Power (High performance)
1.3. Capital Reduced Cost
1.4. Operational Cost reduction.
1.5. Degree of compactness (Downsizing)
1.6. Savings and Operational Gains
1.7. Strategic Gains.



8. Hike Energy Efficiency

RVCR engine adds a new dimension in combustion process by allowing 'Dynamic Compression Ratio Variation' (VCR) combined with 'Constant Volume Heat Addition' (CVHA) that opens doors to new possibilities in combustion process and Load dependent peak pressure control. The area of VCR is much researched and published results known to deliver a 27 to 30% leap in fuel efficiency by ensuring peak efficiency and any load condition across the Load Range. This load range is further enhanced by wide rage VCR that allows Smooth fuel change over from lighter to denser fuels.

Criteria 7.1	Particulars	% Gains **
Fuel Efficiency	VCR Induced Gains	+27%
	Constant Vol Heat Addition	+5.5 %
	Combustion Control	%

Mechanical Efficiency	100 % Mechanical Leverage	*
	Pumping Loss Reduction	
	Reduced FHP from Reduced Strokes	
	Reduced FHP by eliminating of **Piston slapping** and X-Head	
	Reduced FHP By elimination of windage Losses.	

9. Operational Cost reduction.

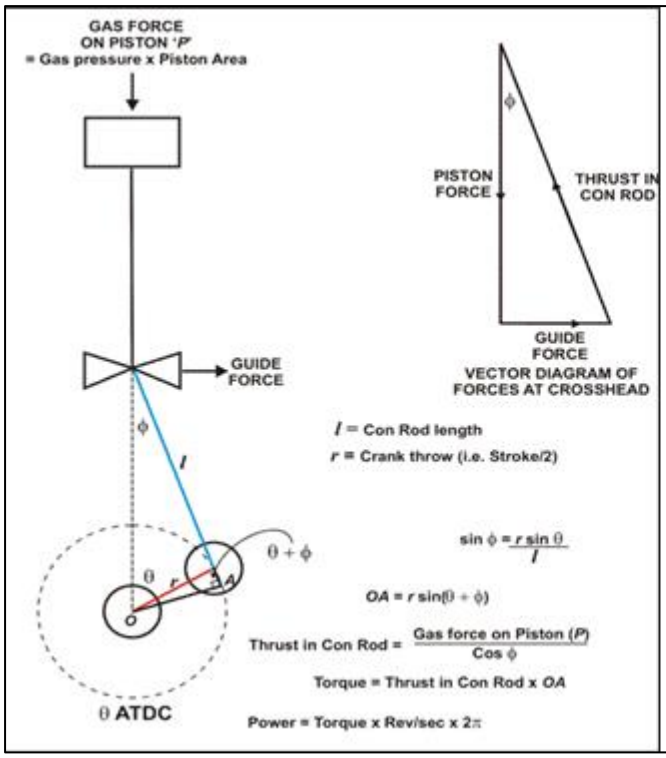
Reduced BSFC	Ref *Fuel & Mechanical Efficiency gains above.	
Reduced Maintenance	Lower Vibration & Wear- No Reversal of Inertia force	
	Lower Vibration & Wear- **No 2nd Order Vibrations**	
	Even Torsional Balance **Dynamically Balanced Rotors**	
	Hydro Dynamic lubrication at every link.	
	No Piston chattering/**Reduced Valve Gear** & Windage Losses.	

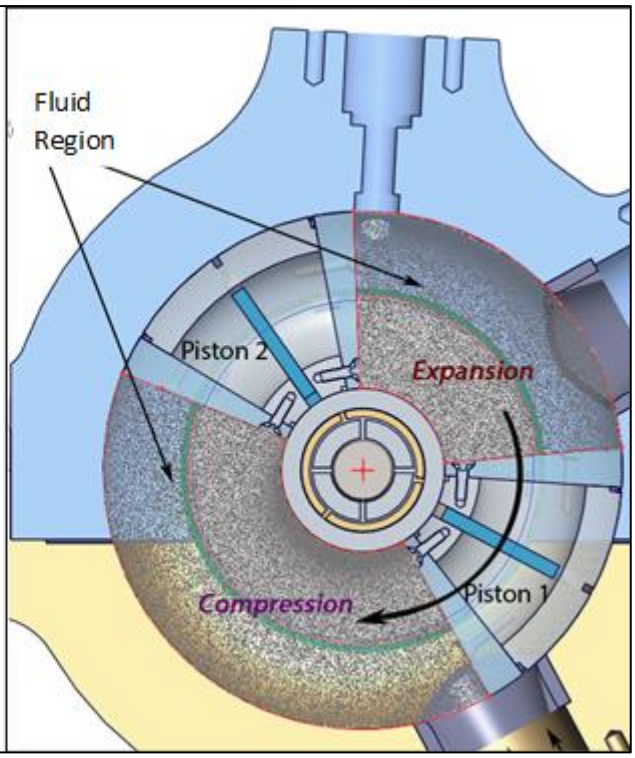
* check Energy conversion factor Pg-4

10. Power/Torque/ Downsizing: - Factors

Specific Power: -RVCR breaks-open the ceiling limits of thermodynamic efficiencies possible with existing conventional system which cannot attain 'Constant Volume Process' both during Heat Addition and Rejection. Double acting piston stroke engines

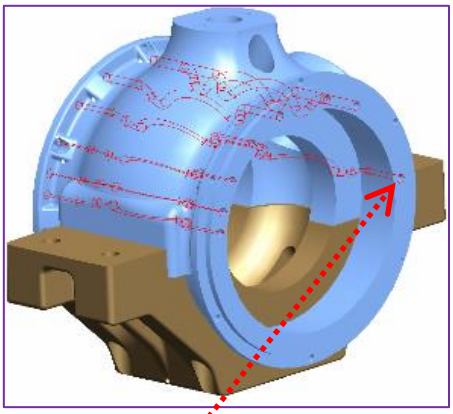
Energy Conversion Factor, of RVCR is a key aspect in the overall superiority and Performance characteristic. In conventional Reciprocating Piston the gas forces act downward and the forces torsion is created by F/CosΦ due to angularity of the Con-Rod. IN RVCR the Gas Forces act's perpendicular to the to the turning arm through the entire cycle. Mechanical Leverage is always maximum for RVCR as Φ = 0 and the gas forces always produce maximum torque

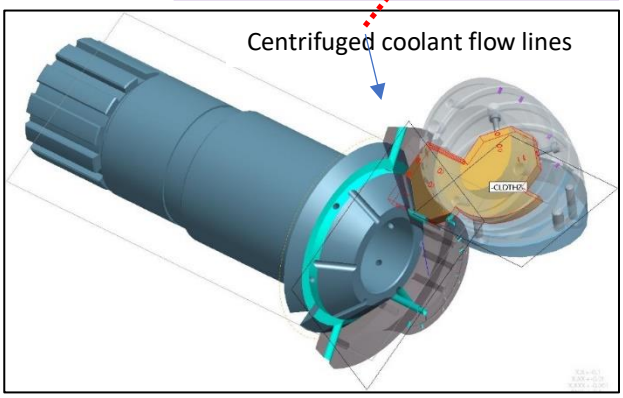




Torque Characteristic: - RVCR design eliminates the bore -stroke constraint as piston vanes are rigidly fixed to Rotary sleeves (Not floating over gudgeon). The need for extra-long strokes for high Torque @ low RPM's is circumvented high expansion rates from large bores. The other features are: -

- Displacement Scavenging
- Centrifugal Coolant flow
- External open VCR controls
- Easy external main bearings access





Degree of compactness: - VCR deploys Double acting pistons warped around a central axis and multiple Sets arranged for Multiple units makes it Highly compact. The compactness factor increases with increase in output rating hence Larger the engine higher the shrinkage.

Capital Cost Reduction: -

RVCR ENGINE cost reduction factor is evaluated by comparison drawn with conventional engine parts

eliminated and hence the reduction in weight and material.

Components comparison

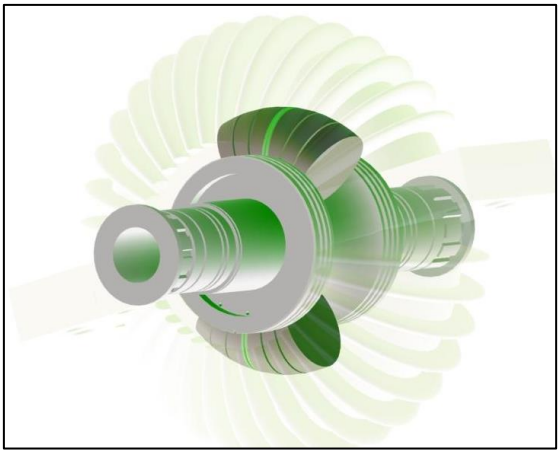
	Conventional Reciprocating Piston Crank Engine	RVCR Engines		Savings
1	A frame/Entablature	Eliminated	+	Material Cost & Weight
2	C Case/Sump	Eliminated	+	Material Cost & Weight
3	Fly wheel	multiple purpose	++	Material Cost & Weight
4	Piston rod	Eliminated	+	Material Cost & Weight
5	Piston Bush	Eliminated	+	Material Cost & Weight
6	Gudgeon	Eliminated	+	Material Cost & Weight
7	Top end Bearing	Semi Eliminated	+	Cost and life
8	Con Rod	Eliminated	+	Material Cost & Weight
9	Bottom End Bearing	Semi Eliminated	+	Cost and life
10	Main Bearing	Semi Strenuous,	++	Cost and life
11	Thrust Bearing	Semi Strenuous,	+	Cost and life.
12	Crank throw	Eliminated	+	Material Cost & Weight
13	Crank Counter Weight	Eliminated	+	Material Cost & Weight
14	Valves & Gear	Reduced Gear	+	Material Cost & Weight
15	Dedicated Cylinder Head	Eliminated	+	Material Cost & Weight

Manufacture Cost Reduction: -The Manufacturing cost of the various subassemblies and system of RVCR when compared with Conventional engines on parameters listed below.

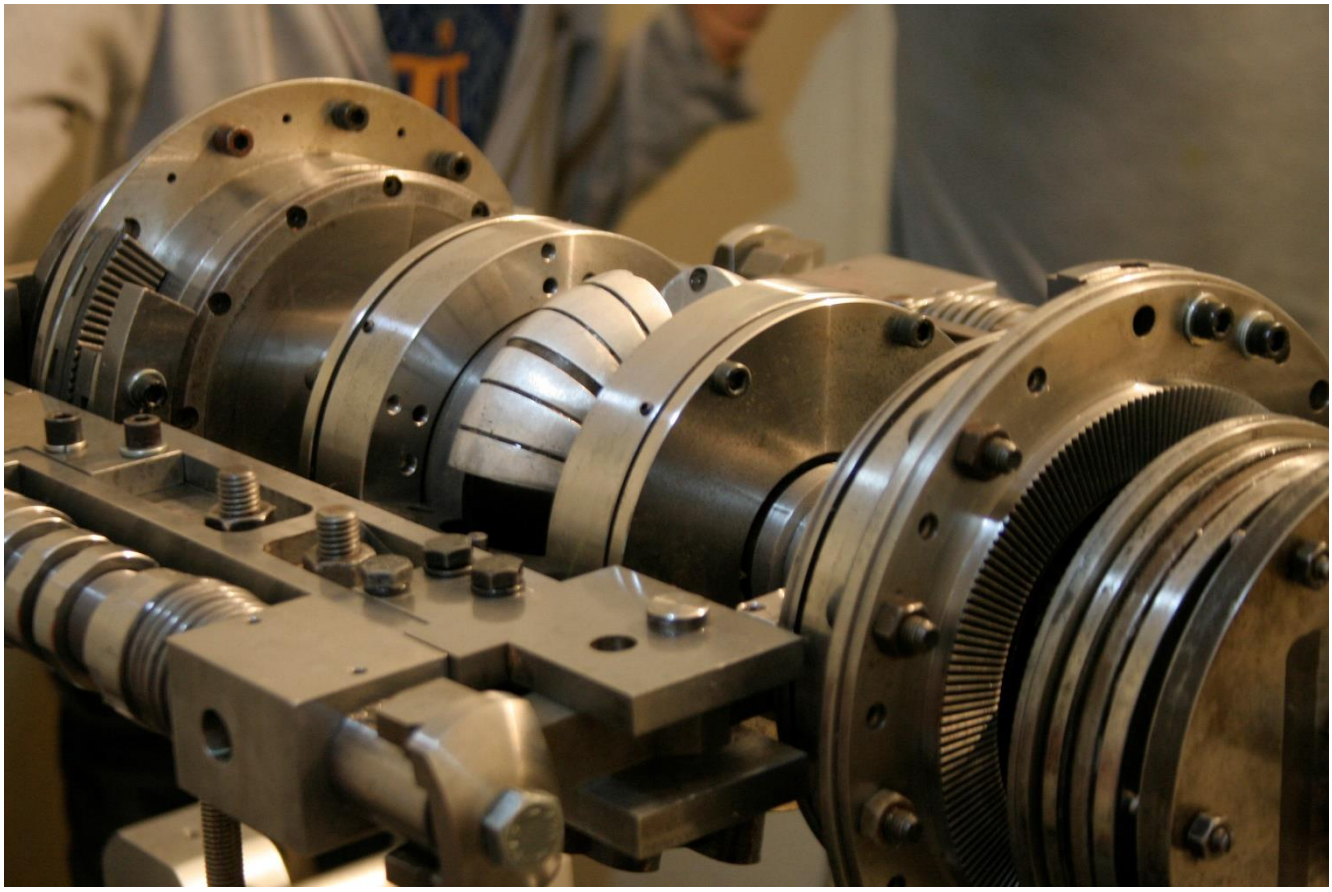
RVCR Particulars	Conventional engine Components Equivalent.	Parameter
Casting	Cyl-Cover, Jacket, A-Frame, Bed-Plate	Simplified into Single
Tolerance	Journal: Crank Pin: top end pin: liner centre-line)	Simplified
Valve Drive Chain	Valve /Linkages/ Cam Shaft	Reduced & Simplified
Load Pattern	No angularity, Torque & Thermal imbalance	Eased

11. Business Process Value Gains.

RVCR Engine for main Propulsion and Auxiliary drives in transport benefits from the reduction in "Weight to Power" Ratio however the "Volume to Power" Ratio is kernel to revenues in most transport sector operational value. The warping of the entire Prime-Mover influences the dimension reduction through a cubic function, resulting in availability of volume for revenue Generation.



Criteria	Particulars
Volume	Non-Linear Downsizing
	Volume Customisation
	Support Accessories
Environment & Carbon Foot Print	Emission Control
	Fuel Flexibility
	Green fuel Adaptability



RVCR Prototype Engine @ TRL -5

Thank you

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