RVCR: Rotary Variable Compression Ratio (VCR) engine

Contents

1. Executive Summary

This document provides an overview of the RVCR wind motor application for those skilled in the art.

Today when all Power sector players are pursuing incremental innovations to improve efficiency in Renewable Energy power generators, RVCR is the only mature Game-changer Class technology that would help you Leap frog existing market leaders and Lay foundations to new generation of Wind power Generators.

The overview covers the concept explained in broad terms wherein it is expected that the reader has enough technical understanding in principles in Fluid Mechanics and Kinematic mechanism. For detailed explanation and elaborate description please send your request to contact id on the website. (Please note appropriate confidentialities non-disclosure commitments would be involved)

2. Back Ground

Conventional 3 blade Turbines is a vital and almost universal component of Renewable Energy Power Generator used to tap into wind energy. The turbine blade design Principles was Invented about a century ago and after decades of incremental improvements are now saturated at peak Efficiencies. Today the focus is towards extending the length of the Blade and maximize the blade sweep area. This again has its draw back as the cantilever effect increases with Length and the blade root area is highly stressed.

There are other alternative methods but none of these use wind motors with Positive displacement principal. This is because the Positive displacement motors increases complexity and frictional resistance.
RVCR is a new principal based on a breakthrough concept in 'Mechanism for Energy Conversion', invented and patented by Engineer Ajee Kamath, (Founder of KGYAT). The Superior Physics of RVCR mechanism maximizes 'Energy Conversion Factor'; 'Enhances Efficiency' and results in extremely simple Rotary Positive displacement Prime-Mover. We have formulated know-how for designing RVCR Wind motors. This document provides a technical overview of the technology applied in wind power generator application and its benefits.

3. The overview:

RVCR mechanism-based wind motors differ from conventional axial flow wind turbines which are rotary machines converting the Kinetic Energy of Wind into Power. This is achieved by lift gained when wind flows over the aerofoil profile of turbine blades. RVCR on the other hand is based on a rotary positive displacement mechanism. RVCR Wind motor is driven by pressure differential between the intake and exhaust of the Motor. The differential is created between high wind velocity at elevated levels from earth surface and ground level stagnant air conditions by placing convergent divergent nozzle in the path of high velocity wind.
The pressure differential can be used as a drive force with RVCR wind Motors as the RVCR technique uses a very simplified highly efficient Energy Conversion mechanism compared to any other positive displacement motors or rotary turbines.

This root principal differentiator when evaluated in terms of its implication on increment in efficiency of Power take-off, indicates towards the gain in Value. The simplified geometry of the technology component systems when compared to conventional turbines complements further gain in value in terms various attributes listed below

1. Power take-off (higher energy capture efficiency)
2. Power to weight ratio,
3. Capacity factor,
4. Ease of installation and operation and time saving
5. Portability by reduction in weight & Volume and time saving in logistics
6. Ease of manufacture, lowered cost of Manufacture,
7. Ease of conveyor belt manufacture and standardisation
8. Time value of money by increased productivity and in tapping wind power,
9. reduced Cost of power
10. Ease of Scalability and hence covering across the spectrum market segments.
11. increased share of renewable energy
12. over all carbon foot print
13. Environmental friendliness non-interference to airborne life forms

4. Wind Energy availability:

At higher altitudes, wind flow velocities are higher. This wind flow is usually considered as laminar flow. At near earth surface, wind speed is lower because of the occurrence of no-slip condition and by obstacles like buildings, trees etc. As the distance from earth surface increases in the upward direction, resistance to air flow decreases and it results in higher wind speeds. The ground creates friction and turbulence which gradually tapers off at greater heights. Placing a Convergent divergent nozzle in the good enough air flow creates low pressure at throat of the Nozzle. An air stack connecting the low pressure at nozzle throat to lower altitude areas of high-pressure region will channels air high pressure to low pressure areas. Air flow velocity from the high-pressure areas to nozzle throat and into the air stream is a function of pressure differential between the same which is a further function of wind velocity.

5. The Comparison

Sr. No.	***RVCR TECHNOLOGY REPG***	***CONVENTIONAL 3-BLADE WIND TURBINE***
Principal	High Efficiency Positive Displacement Mechanism	Less efficient Rotary axial flow mechanism
Specific output	Higher Energy Capture efficiency from wind flow by positive displacement.	Lower Energy Capture Efficiency caused due to air stream slip.
	Energy tapping surface area warped to 1/3rd. Allows energy capture area increase multifold	Wing surface extends over large area and cannot accommodate any extra surface.
	Improved stream lining of air stream for increasing stream velocity -	air stream flow does-not stream line and disperse in multiple directions
Installation	Wind motor Installation at ground level & No high elevation placement required	Required to be placed at higher wind velocity levels at high elevations from ground level
	Embedded Installation possible within city and within populated areas.	Standalone installation required
	Easier foundations & Layout	Heavy foundation required
	Easy transportation & logistics	Difficult Transportation
	Can be installed at the location of power demand avoiding Transmission losses	Results in greater transmission losses by longer transmission structures
	Quick installation & dismantling	Elongated installation time
Capital Cost Of unit	No Yaw gearbox (Position independent of wind direction)	Complicated & Costly Yaw gearbox required
	No Synchronous gearbox required	Costly & Complicated Synchronous gearbox required
	Smaller diameter Vanes	Large turbine blade span required
	Lesser Stress Level on components	High Stress levels on turbine blade roots
	Easy Roto-dynamic Variable Expansion	Complicated Variable pitch mechanism
	Simplified Metallurgy & lower material costs	Costly Material of turbine blades
Operational Cost & Ease Of Operation	Easy and low-cost maintenance	High maintenance costs
	Lesser no. of rotating components hence lesser frictional loss.	Large no. of moving parts due to special mechanisms hence high Frictional loss.
	No Large Centrifugal forces	Large Centrifugal forces
	Simplified feedback system	Complicated feedback system required
	Gyroscopic effect eliminated	Complicated Gyroscopic effect
	Devise Airflow throughput easily controlled	Wind Airflow Control not possible
Environment and Safety	Animal hazards are prevented	Hazard to birds
	Quieter operation	Noisy Operation
	No lock-down required in storm condition	Complicated lock-down in storm conditions
Downsizing	Customized sizing advantage	Uni-directional sizing

6. RVCR Component's structure, their arrangement and vane sequence

The RVCR Kinematic mechanism comprises two identical vanes (V1 and V2 in the figure No.4) enclosed in toroidal (hollow doughnut shaped) casing and the vane edge geometry is the same as the cross-section of the casing hollow space.

The vanes are rigidly connected to the ends of two intermittently rotating rotors facing each other and mounted on a central shaft. The vanes are angularly displaced within the chamber and the cycle begins with the vanes are positioned initially adjacent to each other and near inlet and outlet port respectively while maintaining a defined minimal angle between them.

The vane V2 (Shown in Figure No. 4) is held stationary with the action of vane motion control elements while V1 is coupled to the central shaft and rotates. After rotating through a definite angular distance, where in the moving vane V1 approaches the stationary vane V2 and it has an inclusive angle same as it had at the initial position with V2 behind it, both vanes are coupled to the central shaft and rotate simultaneously and acquire interchange initial positions where in the moving vane is at the position where V2 was kept stationary. Now the V1 is stationary and V2 moves and cycle continuous. The vane position inside the chamber is read at space outside of the casing and motion control mechanism controls the intermittent rotary motion or each vane and converts it into continuous motion on output shaft.
The high-pressure atmospheric air is driven through inlet port by pressure difference created at venturi throat, drives the vanes and is then discharged by the divergent section through piping. The directing fin allows free rotation of convergent divergent nozzle as per the direction of wind flow. The structure is mounted on base through supporting column.

7. Drawing with component name description

1. Fig 1 shows the sectional view of RVCR wind motor power generator concept
2. Fig 2 shows the sectional view of the RVCR wind motor unit
3. Fig 3 shows the isometric view of
    a) Self-aligning and elevation adjustable convergent divergent nozzle,
    b) RVCR wind motor
4. Fig 4 shows the schematic view of vane

8. Wind Power Generators Applications

1. City Based Wind Power Embedded Generators
2. Outdoor high capacity Wind Power Generators
3. Portable Wind Power Generators
4. Off-Shore Wind Power Generators

RVCR Technology

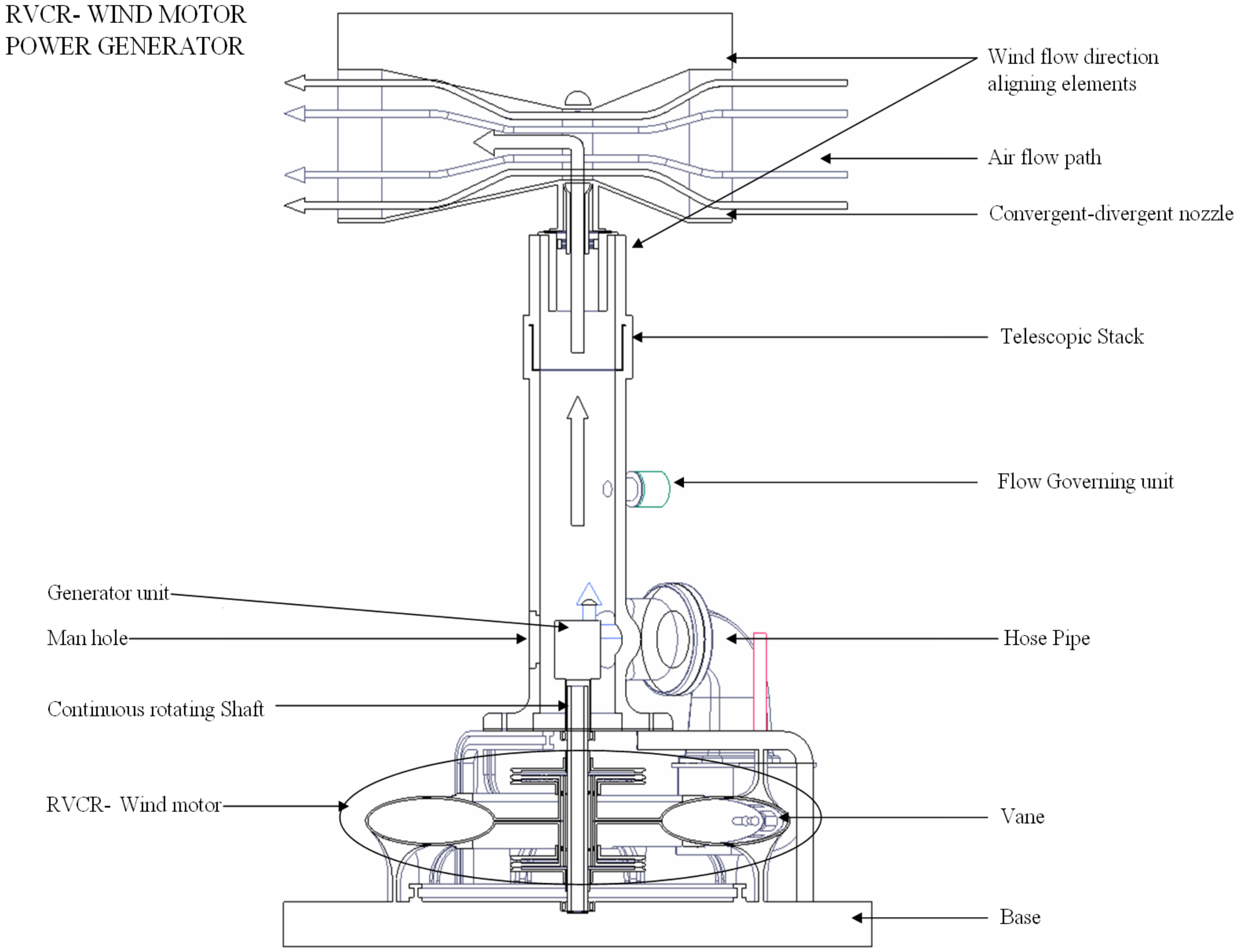

Fig 1

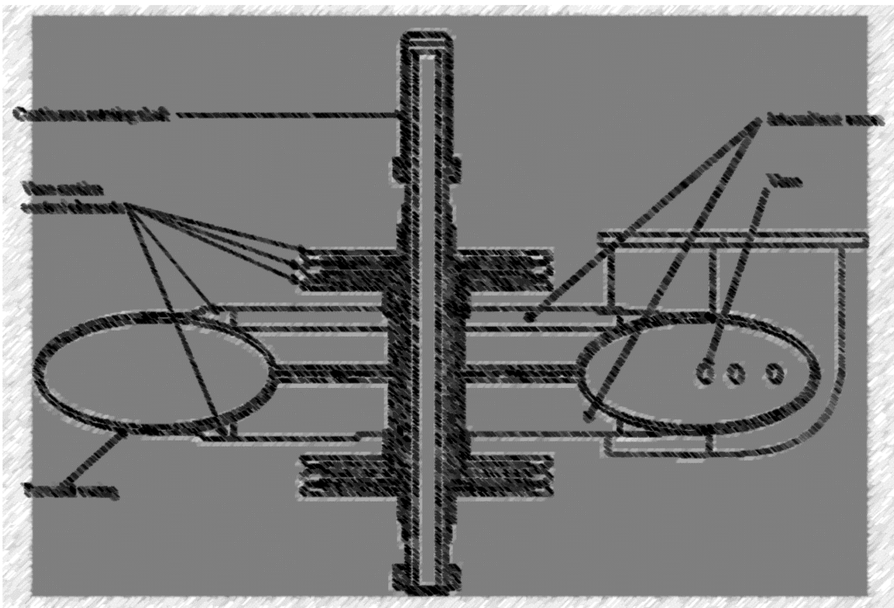

Fig 2

**** Confidential**

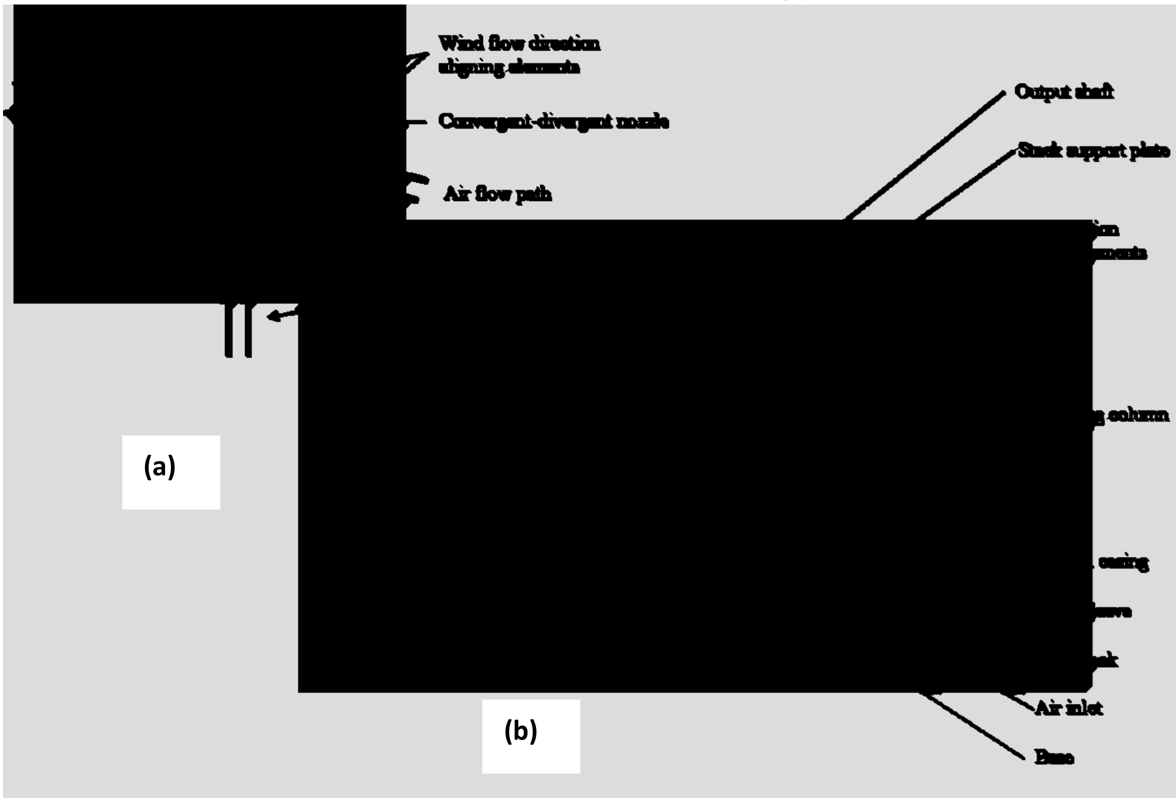

Fig 3

Fig 4

**** Subject of Confidentiality**

9. Advantages and benefits

9.1. PTO (High Efficiency Positive Displacement Mechanism):

- In Comparison with a 3-bladed conventional wind turbine, energy capture ratio of RVCR-WM is higher as it is a positive displacement unit, as the entire flow channel force acts on the vanes, unlike in conventional turbines where a large portion of the air flow through the effective flow channel area (blade tip circle) bypasses the unit without working on the aero-foil blades. The RVCR-WM configuration has a convergent-divergent nozzle induced pressure differential across the vanes that transfer the air energy much more effectively than in conventional turbines, hence increases the efficiency of the system.
- RVCR-WM being a compact lightweight unit allows easy and rapid alignment of convergent-divergent nozzle with the air stream flow direction. The vertical position adjustment flexibility helps alignment with maximum throughput height that enables maximum energy capture of air stream flow.

9.2. PWR (Power to Weight Ratio):

- No Yaw gearbox is required: The mass of the convergent-divergent nozzle is fractional Compared to turbine and is static hence no gyroscopic forces are to be dealt with. That the RVCR-WM Power generator alignment to the flow is performed with the help of directional fin, whereas in conventional Air turbines, the positioning of turbine with air flow requires complicated, costly & bulk of the Yaw gear.
- No Synchronous gear requirement: The Vane RPM control by simplified quantitative air flow governing by short-circuiting the air flow past the RVCR-WM by means of flow control valves placed at air outflow stack. This is not possible in 3 Blade wind turbines where wind flow through put cannot be manipulated.
- No Cantilever effect & simply supported Vanes: Conventional turbine blades are huge cantilevers with very high stress levels hence require specialized metallurgy and very robust design leading to excessive mass of the blades, whereas RVCR vanes are not cantilevers but are simply supported beams, hence requires simplified design, metallurgy & lightweight hollow structure, considerably increasing the Power to Weight Ratio.

9.3. Weight reduction by Vane geometry Optimization:

- The increment in rated power is proportioned to unidirectional increase in blade length; whereas RVCR-WM scaling up is achieved by optimizing the casing chamber cross-sectional area wherein the minor & major axis provide for bidirectional degree of design freedom for scale-up making RVCR-WM size adaptable to custom space demands.

9.4. Transportation &Installation Advantage:

- RVCR-WM Power generator is compact, and the ease of design enables easy sealing of the entire unit into a air-tight entity, thence designed buoyant to be towed by conventional tug boats for offshore installations and do not require specialized transportation means as in case of 3-blade air turbines.

9.5. Lower Cost of Maintenance & Increased operations time (Capacity Factor):

- Lower Stress Level on components compared to conventional Air turbines, lighter vanes in the RVCR-WM unit have lesser chances of failure and hence lesser downtime.
- Ease of maintenance facilitated by telescopic air stack for lowering of nozzle and seals and ground level dismantling and maintenance provisions.
- No lockdown for avoiding excessive overloading of components during dangerous air flow conditions, as the flow throughput is controlled by means of easily achievable qualitative flow governing, largely improving the capacity factor.
- Lesser functional variables in RVCR-WM unit hence easy control, lesser maintenance & higher efficiency.

9.6. Environmental Impact:

- Air flow through nozzles means no exposed rotating parts prevents airborne life form injury and noise generation in RVCR-WM unit.
- Compact & lightweight RVCR-WM unit has a lower Carbon footprint than conventional 3-blade turbine.