A Review on Application of the Quasiturbine Engine as a Replacement for the Standard Piston Engine

Akash Ampat, Siddhant Gaidhani[2],Sachin Yevale[3], Prashant Kharche[4]
[1]Student,Department of Mechanical Engineering, Smt. Kashibai Navale College of Engineering, Pune;Akash.ampat96@gmail.com,
[2]Student,Department of Mechanical Engineering, Smt. Kashibai Navale College of Engineering, Pune; sid0gaidhani@gmail.com

ABSTRACT

This paper reviews the concept of a Quasiturbine (also known as Qurbine) Engine and its potential as a replacement for the standard Piston Engine. The Quasiturbine Rotary Air Engine is a low rpm engine, working on low pressure. For this purpose, a binary system of Quasiturbines is also used. It also discusses the multi-fuel capability of Quasiturbine and how it can be used in vehicle propulsion systems. This piston-less rotary machine is intended to be used where the existing technologies are centuries old and have numerous insurmountable problems. It has been consistently observed that this engine provides a better efficiency, much smaller ratio of unit displacement to engine volume, extremely high power per cycle and reduced emissions.

Key words: Quasiturbine, standard piston engine, piston-less rotary engine, deformable rotor.

I. INTRODUCTION

A. Need and Invention

Dr. Gilles Saint-Hilaire, a thermonuclear physicist, after thoroughly studying the limitations of conventional engines, designed the Quasiturbine Engine. The Quasiturbine is a continuous Torque, symmetrically deformable spinning wheel. The Saint-Hilaire family used a modern computer based approach to map the conventional engine characteristics with optimum physical-chemical graphs. They proved wrong the centuries old belief that the sinusoidal movement of the crankshaft is the best way to obtain rotary motion.In reality, it has been a major obstacle to develop modern optimized engines. In contrast, the Quasiturbine design allows to shape in time the volume pulse in the combustion chamber, which is something that a piston or Wankel engine simply can't do. This greatly optimizes the thermodynamic efficiency for the Quasiturbine combustion-cycle.

B. Comparison with conventional engines

The Quasiturbine engine has been developed from this optimum desirable characteristics table and has succeeded, at least theoretically, to optimize simultaneously most of the important engine parameters, including compatibility with the revolutionary photo-detonation mode, which the piston cannot effectively tolerate. These various improvements increase fuel efficiency and power output, while reducing exhaust emissions. In a traditional 4 stroke piston engine, power stroke would occupy 25% of the total cycle. But due to the limitations imposed on valve timing, the effective power stroke is reduced to only 17%. The small relative duration time of the power stroke causes the peak to average power ratio to be as high as about 7:1, also increasing frictional losses. In a Quasiturbine engine using fuels, the next combustion stroke is ready to fire right when the previous one is finished. This produces four Power strokes per rotation, eight times what the Piston can achieve. This ratio is further doubled in an air Quasiturbine. Also, the Quasiturbine average power is within 20% of its peak power.

C. Construction

The Quasiturbine can be considered to be an amalgam of three modern engines- inspired by the Turbine, it perfects the Piston and improves upon the Wankel. It is a rotary engine having a four faced articulated rotor with free and accessible center. Thus it does require a crankshaft. Itproduces high torque at low RPM, rotating without vibrations. The rotor as an assembly is deformable and the four faces are joined together by hinges at the vertices. The volume enclosed between the blades of the rotor and stator casing provides compression and expansion in a fashion similar to the Wankel engine.While most rotary engines use the principle of volume variation between a curve and a moving cord, this new engine concept makes use of a rotor with seven degrees of freedom (X, Y, q, ø1, ø2, ø3, ø4), trapped inside an internal housing contour, and does not require a central shaft or support.

ISSN: 2321-8169
1336 – 1341

1. Without carriages

The Quasiturbine engine allows for numerous configurations by using the seven parameters. One of the most common of these configurations is the one without carriages (Model QT-SC). This is the simplest of all models having no internal parts. As the center is accessible, all engine components have a face accessible externally, including through the center.

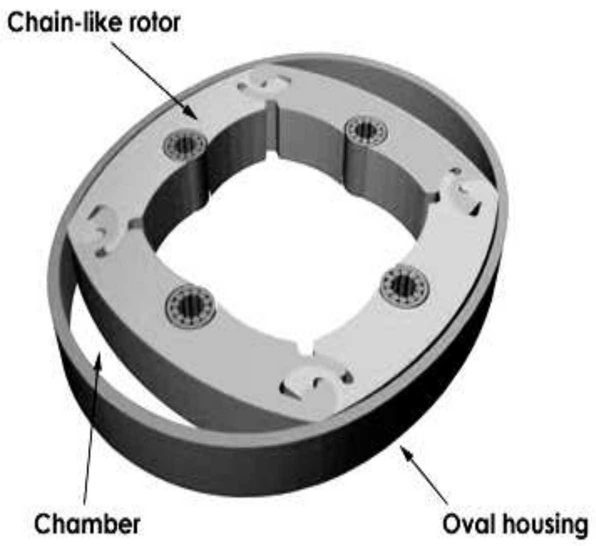

Fig. 1 Quasiturbine Engine without carriages

In an air Quasiturbine engine, there are two force vectors that are off center, creating a couple, that results into a rotary motion.

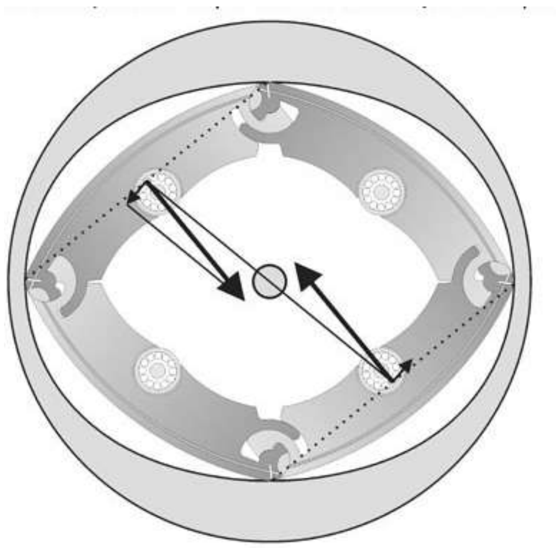

Fig. 2 Forces in an air Quasiturbine

A similar motion is achieved in a combustion type Quasiturbine by a single force.This causes a turning moment and maintains the rotation.

2. With Carriages

The more complex Quasiturbine designs can shape the volume pulse almost at will by varying the parameter sets. Such a configuration is the one with carriages (Model QT-AC).

Fig. 3 Quasiturbine with carriages

A QT-AC (with carriages) is intended for detonation mode, where high surface-to-volume ratiois a factor attenuating the violence of detonation.This model allows to shape the volume pressure pulse to have a tip 15 to 30 times shorter than the piston, which provide enhanced torque characteristics for pneumatic and steam Quasiturbine. Photo-detonation combines the best attributes of gasoline and diesel engines. A premixed fuel-air charge undergoes tremendous compression until the fuel self-ignites. This is what happens in a photo-detonation engine, and because it employs a homogenous charge and compression ignition, it is often described as anHCCI (Homogeneous Charge Compression Ignition) in the USA, CAI (Controlled Auto Ignition) in Europe and ATA (Active Thermo Atmosphere) in Japan. HCCI combustion results in virtually no emissions and superior fuel efficiency. This is because photo-detonation engines completely combust the fuel, leaving behind no hydrocarbons to be treated by a catalytic converter or simply expelled into the air.Only this design is strong enough and compact enough to withstand the force of photo-detonation and allow for the higher compression ratio necessary for pressure-heated self-ignition.

BACKGROUND

The first automobile using the Otto cycle was introduced in 1885. The Daimler Reitwagen used a hot-tube ignition system and the fuel known as Ligroin to become the world's first vehicle powered by an internal combustion engine. It has been more than a century since then, and yet, the design of the engine, in its core, has remained same. Although there have been numerous, closely spaced refinements in the design of the Crank-Piston engine, to optimize its performance, the basic concept of the engine’s mechanism has remained same. Even operating on a different cycle and fuel, the Diesel engine still retains the same mechanism.

The Quasiturbine mechanism eliminates all the limitations of the outdated piston engine, even when it is still in its infant stage. The Quasiturbine research team has initially established a list of 30 conceptual piston deficiencies and as many Wankel deficiencies. The Quasiturbine general concept is the result of an effort to improve both engines by suppressing the limiting sinusoidal crankshaft and offering up to 7 degrees of freedom at design. The inventors have made a systematic analysis of engine concepts, their value, their weaknesses, and their potential for improvement. All improvement ideas converged when they suggested to make a turbo-shaft turbine having only one turbine in one plane. In order to achieve that, the turbine blades had to be attached one to oneanother in a chain like configuration, where the rotor acts as compressor for a quarter of a turn, and as engine the next quarter of a turn. Furthermore, to be able to shape the pressure pulse at will in order to reach photo-detonation, extra degrees of freedom at design needed to be introduced by a set of peripheral carriages. Photo-detonation is an optimal combustion mode, where homogeneous fuel combusts automatically. The piston engine could never support this mode, leaving us wanting for a revolution in engine technology.

Hence, the Quasiturbine becomes an ideal replacement for the Piston engine, because of its ability to be scaled up or down to sizes the conventional engine could never achieve.

ISSN: 2321-8169
1336 – 1341

LITERATURE REVIEW

The Quasiturbine is indeed the most viable mechanism to replace the conventional combustion engines of today, but just like the early years of piston engine, the way in is through air (pneumatic) and steam powered engines, which is a huge industry in itself. This will be followed by combustion engines working on the Otto cycle, and then ultimately evolving into the ideal photo-detonation mode, which has never been practiced commercially.

In coherence with this, Mr. K.M Jagadale and fellowauthors explore the possibilities of using a Quasiturbine engine with air as the working fluid. This will be a pressure driven, continuous torque machine.

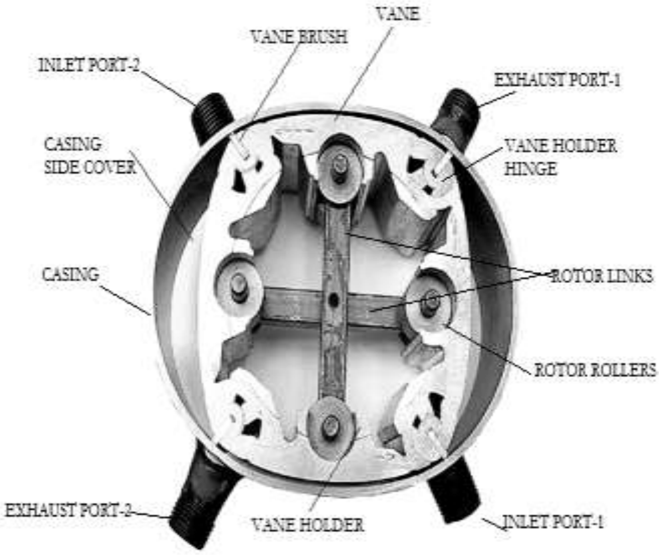

Fig. 4 Compressed air Quasiturbine engine

This model was designed for compressed air and steam applications, capable of handling large volumes of air or steam. The rotor consists of four identical blades. Each of the four blades produces two compression strokes per revolution which provides a total of eight compression strokes per revolution, when used as a compressor. When used as an air or steam engine, eight power strokes per revolution are provided. The model has four ports, two of which are used as inlet and the other two as exhaust. For one complete rotation of the rotor, the total displacement is eight times the displacement of one of the chambers.

In a conventional gas turbine, the combusted gases are directed through nozzles against the blade of the turbine rotor and are expanded to atmospheric pressure. This causes the desired rotary motion of the rotor. The amount of work derived from the gas turbine engine is equal to the difference between the work required to compress the air and the work obtained from the turbine. On the other hand, in the Quasiturbine, there are no turbine blades. Instead, the high pressure of the gases during the power stroke forces each rotor segment in the direction of rotation. By selectively admitting and discharging air, the four chambers of the rotor generate eight power strokes per rotor revolution which makes for a smooth operation.The Brayton cycle requires at least two Quasiturbines- one for the compressor and one for the prime mover, with different displacements. The two different Quasiturbines could be cascaded together, without much difficulty, on the same shaft to satisfy the requirement.

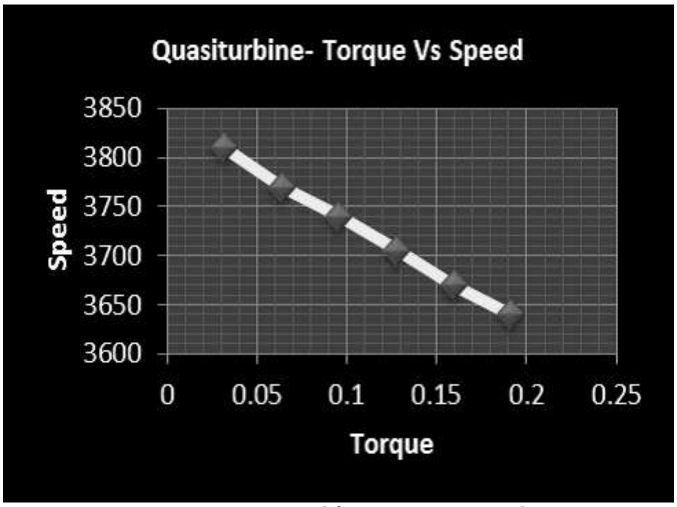

Fig. 5 Torque vs. Speed for rotary air Quasiturbine

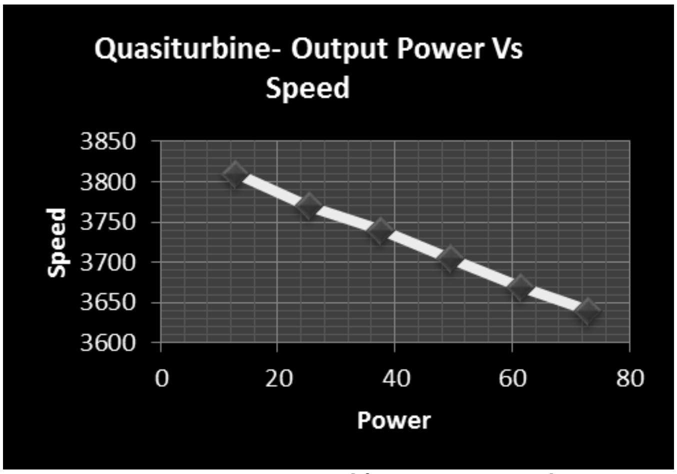

Fig. 6 Output Power vs. Speed for rotary air Quasiturbine

SUMMARY

The Quasiturbine is a revolutionary new engine design that appears to offer great improvements over the piston engines or other rotary engines. Several prototype engines have been constructed that demonstrate the basic concepts. It can be conclusively said that higher efficiency and power at lower weights (less than one quarter that of a piston engine) becomes the USP of this engine. The size and weight advantages provide opportunities for a tradeoff between engine sizes vs. efficiency, which is not practically possible with other types of engines. It also overcomes the dead-end of photo-detonation, faced by the piston engine.

That being said, the Quasi turbineis still not used in any real-world applications that would test its suitability as a replacement for the piston engine (or the rotary engine, for that matter). It is still in its prototype phase; the best look anyone has gotten so far is when it was demonstrated on a go-kart in 2004. The Quasiturbine may not be a competitive engine technology for decades.

There are two kinds of innovations: Those which improve the technologies in place and those which make them obsolete. The Quasiturbine belongs to the latter class, making its acceptance into the industry a bleak prospect. The impact it will have on the national energy infrastructure will be immediate. This inconvenience makes the shift to this technology a less obvious step.

ACKNOWLEDGEMENTS

The success and final outcome of this project required a lot of guidance and assistance from many people and I am extremely fortunate to have got this all along the completion of my project work. Whatever I have done is only due to such guidance and I would not forget to thank them.

I respect and thank Mr. H.A. Khande for giving me an opportunity to do the project work on “Application of the Quasiturbine Engine as a Replacement for the Standard Piston Engine”.

It was his support and guidance which made me complete the project on time. I am extremely grateful to him for providing his support and guidance in spite of his busy schedule. His extra effort in checking our research on a weekly basis helped to keep me on track and finish my work on time.

REFERENCES

[1] "A New Trend in Turbine Technology-Quasi Turbine Rotary Air Engine", Mr. K.M. Jagadale, International Journal for Technological Research in Engineering figures and tables, Volume 1, Issue 12, August-2014.
[2] "Quasiturbine Rotary Air Engine", Mr. Kadam A.N., Mr. Jadhav S.S., IOSR Journal of Mechanical and Civil Engineering, PP: 21-26.
[3] "Low Pressure High Torque Quasi Turbine Rotary Air Engine", Prof V.R. Gambhire, International Journal of Innovative Research in Science, Engineering and Technology, Vol. 3, Issue 8, August 2014.
[4] "Quantum Parallel: The Saint-Hilaire Quasiturbine as the Basis for a Simultaneous Paradigm Shift in Vehicle Propulsion Systems", Myron D. Stokes, December 15, 2003.
[5] "Quasiturbine: Technical Discussion- Comparing the Quasiturbine with Other Common Engines", Carol Crom