ISSN(Online) : 2319-8753
ISSN (Print) : 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 10, October 2016

Review of Quasi-Turbine Engine

Yogesh Khedkar[1], Prof.Sushant Pande[2]

P.G. Student, Department of Mechanical Engineering, D Y Patil College of Engineering, Akurdi, Pune, India[1]

Assistant Professor, Department of Mechanical Engineering, D Y Patil College of Engineering, Akurdi, Pune, India[2]

ABSTRACT: The Quasi turbine engine is a multi-fuel, continuous torque rotary engine.It a next step in the world of Engine research is to run engine on air or any other fuel. Turbine characteristics help achieving this goal. The quasi turbine turbo-machine is a pressure driven, continuous torque and symmetrically deformable spinning wheel. The Quasi turbine is a compact, low weight and high torque machine with top efficiency, especially in power modulation applications. One of the most important things is waste energy recovery in industrial field. As the natural resources are going to exhaust, energy recovery has great importance. A quasi turbine rotary air engine having low rpm and works on low pressure recovers waste energy may be in the form of any gas or steam. This paper discusses concept of quasi turbine air and combustion engines also the comparison between the quasi turbine engine and the other engines.

KEYWORDS: Quasi turbine (QT), Positive displacement rotor, piston less Rotary Machine.

I. INTRODUCTION

The Quasi-turbine is a new engine technology that was invented in 1990 and patented in 1996.The concept of quasi turbine rotary air engine was first introduced by Gilles Saint-Hilaire and etal. The first question can come in any every once mind is that, why the name Quasi-turbine? Because just like the conventional turbine, Quasi-turbine has a (quasi) continuous flow at intake and exhaust, propulsive dead time is zero. The Quasi-turbine is a pressure driven, continuous torque and symmetrically deformable spinning wheel. The Quasi-turbine is inspired by the turbine, perfects the piston and improves upon the Wankel. The Quasi turbine is a piston less Rotary Machine using a deformable rotor whose vanes are hinged at the vertices. The volume enclosed between the vanes of the rotor and the stator casing provides compression and expansion in a fashion similar to the familiar Wankel engine, but the hinging at the edges allows higher compression ratio. The Quasi turbine is a compact, low weight and high torque machine with top efficiency. Quasi turbine engine eliminates all energy wastes occurring in piston and Wankel engine. It requires less time to compression and expansion stroke. Quasi turbine engine is a multi-fuel engine that means we can use air or any other fuel like petrol or diesel. Quasi turbine air engine is an environmental free engine because we are using compressed as a fuel. Also we know that the world environment is more polluted because of gases that are emitted from the automobile exhaust and non-renewable resources such as petrol or diesel will be going to vanish within few years. So in such case quasi turbine air engine is the best alternative to present engine to save environment and the non-renewable resources.

(a) Quasi turbine Engine

ISSN(Online) : 2319-8753
ISSN (Print) : 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

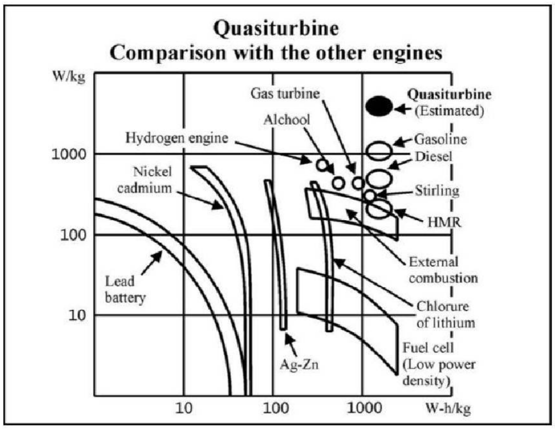
(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 10, October 2016

II. LITERATURE REVIEW

1) The concept of quasi turbine rotary air engine was first introduced by Gilles Saint-Hilaire and etal, [2]. He says that the quasi turbine turbo-machine is a pressuredriven, continuous torque and symmetrically deformable spinning wheel. He presentedthat with the help of Quasi turbine air engine even at low rpm high torque can beobtained.
2) Mr Myron D. Stokes [3] have presented the study of quasi turbine technology usedin a vehicle propulsion system, it can be used instead of IC engine.
3) Mr K.M Jagadale and Prof V.R.Gambhire in his paper on Low Pressure HighTorque Quasi Turbine Rotary Air Engine has given a concept of quasi-turbine.
4) Mr George Marchetti is vice-chairman of the Chicago Chapter of theElectrochemical Society, and he did quite an extensive analysis of the quasi turbinetechnology.

III. COMPARISON WITH CONVENTIONAL ENGINE



(b) Comparison of several engines.

A. COMPARISON WITH PISTON ENGINE

It is generally accepted historically that engine power goes up with displacement, but this is not quite true, and leads to substantial confusion in the world of engines. For all piston engines, the displacement is the maximum total cylinder volume, but the 4 stroke piston for example, intakes this volume of fuel mixture only once every 2 revolutions. In order to compare different types of engines, one has to get back to basics where the power of a theoretically good engine (which the piston and quasiturbine are, but not the Wankel because of the P-V diagram) is proportional to its fuel mixture intake capability per revolution, and not its displacement. Let's see what happens when comparing a 50cc four-stroke piston engine with a QT50cc quasiturbine at the same rpm. Both engines have 50 cc maximum chamber volumes. The piston engine will intake 50cc every 2 revolutions, while the quasi-turbine intakes 8 chambers x 50cc = 400cc in 2 revolutions. The quasi-turbine will intake 8 times more chambers and fuel-mixture, and produces something like 10 times more power.Also a4-stroke piston engine produces one combustion stroke per cylinder for every tworevolutions, the chambers of the quasi-turbine rotor generate 8 combustion strokes pertwo rotor revolutions; this is 8 times more. The 4-stroke piston has a long propulsivedead time; its average torque is about 1/7 of the peak torque. These peaks dictate theneed for extra robustness in piston engines. Sincethe quasi-turbine has no propulsivedead time (torque continuity), peak torque is within 20% of the average torque; for thisreason, the relative piston robustness needs to be 5 times (7 / 1.2) higher than thequasi-turbine.

ISSN(Online) : 2319-8753
ISSN (Print) : 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 10, October 2016

B. COMPARISON WITH WANKEL ENGINE

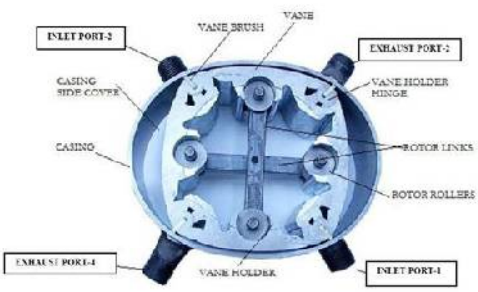
The Wankel engine has an eccentric crankshaft and its triangular rotor makes a pistonlike radial movement, the quasi-turbine is not in this category of rotary piston enginebecause it has no eccentric crankshaft and its pivoting blades are not moving radially.The eccentric crankshaft machines reach their maximum and minimum mechanicalextension in synchronization with the pressure strokes, while in the quasi-turbine, therotor reaches it maximum and minimum extension at half-stroke, producing a smoothkinetic transition near Top and Bottom pressure Dead Centre.Wankel of which themain shaft turns 3 times for every revolution of the rotor and fires once per shaftrevolution, the quasi-turbine shaft rotates at the same RPM as the rotor and fires 4times per shaft rotation, producing a quasi-continuous torque

C. COMPARISON WITH GAS TURBINE

Quasi-turbine does both in sequences, compressing 2 chambers during a quarter of aturn and relaxing them the next quarter of a turn. It is like two engines in one.Hydraulic, pneumatic, steam, gas and fuel combustion produce primary energy in theform of pressure. Being a hydro- aerostatic device, the quasi-turbine directlytransforms this pressure energy into mechanical rotation motion withoptimum efficiency, almost regardless of the pressure level Conventional turbines arehydro- aero- dynamic and they cannot handle directly the pressure energy that mustbe first converted into kinetic energy. For a given blade geometry, the efficiency ofconventional turbine falls rapidly if the flow condition and velocity moves away fromthe optimum design value.

IV. CONSTRUCTION OF QUASI TURBINE AIR ENGINE

A Quasi turbine is thus a non-crankshaft rotary engine having a fourfaced articulatedrotor with free and accessible centre, rotating without vibration and producing hightorque at lowRPM. The rotor as an assembly is deformable and the four faces arejoined together by hinges at the vertices.The rotor consists of four blades whichareidentical. Each of the four blades produces two compression strokes per revolutionwhich provides a total of eightcompression strokes per revolution when used as acompressor. When used as an air or steam, eight power strokes perrevolution areprovided. The model has four ports; starting with the upper right port we will numberthe ports. Clockwise1234. Ports 1 and 3 are intake ports and ports 2 and 4 are exhaustports. For one complete rotation of therotor, the total displacement is eight times thedisplacement of a one of the chambers.



(c) Construction of Quasi turbine Air Engine

ISSN(Online) : 2319-8753
ISSN (Print) : 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

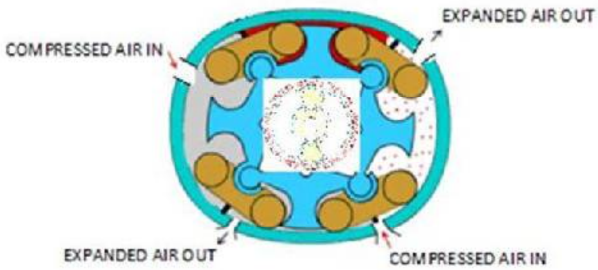
(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 10, October 2016

The main parts of the Quasi-turbine air engine are as follows:
1) Casing
2) Casing side plates
3) Vanes
4) Vane holders
5) The inlet and exhaust ports
6) Rotor links and Rotor roller
7) The power train

V. WORKING OF QUASI TURBINE AIR ENGINE

The simpler quasi-turbine model looks very much like a traditional rotary engine. Arotor turns inside a nearly oval-shaped housing. Notice, however, that the quasiturbinerotor has four elements instead of three. The side of the rotor seals against thesides of the housing and the corners of the rotor seals against the inner periphery dividing it into four chambers.In Quasi turbine air engine, an oval housing surrounds afour-sided articulated rotor which turns and moves within the housing, trapping theworking fluid (air) into four chambers. The two inlet pressure of compressed airrotates vanes in opposite direction this equal and oppositeforces forms a couple androtor rotates. As the rotor turns, its motion and the shape of the housingcause eachside of the housing to get closer and farther from the rotor, compressing andexpanding the chambers similarly to the strokes in a reciprocating engine. Byselectively admitting and discharging air, the four chambers of the rotor generateeight power strokes per rotor revolution which results in smooth operation at a largerange ofrotation. The Quasi turbine rotates from pressure as low as 1 bar. It hashigherpower to weight ratios and mechanical simplicity.



(d) Working of Quasi turbine Air Engine

VI. QUASI TURBINE COMBUSTION ENGINE

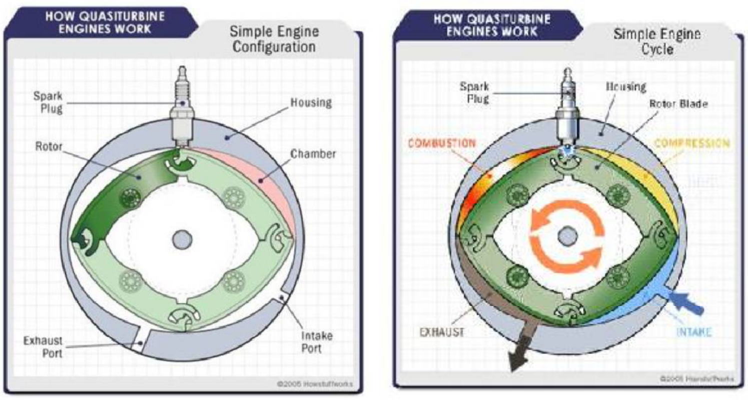
The construction of quasi turbine combustion engine is same as that of quasi turbineair engine only the difference is that it is having a spark plug and it requires a fuel forcombustion just like in piston engine. Figure (e) shows the quasi turbine combustionengine. The main parts of this engine are Rotor, Casing, Casing cover, power train,vane, vane holder, and the spark plug.The strokes of quasi turbine combustionengine are similar to that of piston engine. There are total four strokes i.e. intake,compression, combustion and exhaust stroke. A Quasiturbine enginedoesn't needpistons. The four strokes of a typical piston engine are arranged sequentially aroundthe oval housing. There's no need for the crankshaft to perform the rotary conversion.Figure (e) shows the four chambers of the engine. There are two ports intake andexhaust port. Figure (e) shows the working of quasi turbine combustion engine.

ISSN(Online) : 2319-8753
ISSN (Print) : 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 10, October 2016



(e)Working of Quasi turbine Combustion Engine

The four strokes are as fallows,
Intake stroke-It draws in a mixture of fuel and air through intake port.
Compression stroke-It squeezes the fuel-air mixture into a smallervolume.
Combustion stroke -It uses a spark from a spark plug to ignite the fuel
Exhaust stroke - It expels waste gasesfrom the engine compartment

VII. QUASITURBINE CHARACTERISTICS

A. MULTI MODES – MULTI FUELS

Not everyone in the world has easy access to qualityfossil fuels. Quasi-turbine can be made switchable to internalnatural gas, gasoline or diesel combustion, compressed airorsteam engine

B. LOW RPM

At comparable piston power, because there is no propulsive dead time and the propulsive force are positive at all time,there is no need for a high RPM flywheel to smooth the rotation.

C. HIGH TORQUE

Contrary to the Wankel engine of which the main shaftturns 3 times per revolution ofthe rotor and fires only onceper shaft revolution, the quasi-turbine shaft rotates atthesame RPM as the rotor, and fires 4 times per shaft rotation,producing a quasi-continuoustorque

D. LIGHT WEIGHT AND SMALL SIZE

At comparable piston power, the quasi-turbineis 4 to 5 times more compact and light. Since it has no oil pan requiring gravity drain, the quasi-turbine can beoperated in anyorientation.

E. ENVIRONMENTAL FREE

Better efficiency means saving the resources and protecting the environment. As we are using air as an intake fuel for quasi turbine air engine so there is no any harmful exhaust from theexhaust system. So the quasi turbine air engine is an environmental free engine.

F. LOW COST

Engine manufacturing cost is function of weight, material sophistication, availability, internal stress, robustness, centralized technology and manufacturing complexity. All these factors are favourable to a low cost quasi-turbine.

ISSN(Online) : 2319-8753
ISSN (Print) : 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 10, October 2016

VIII. Possible Applications

A. GAS PIPELINE PRESSURE ENERGY RECOVERY

Quasi-turbine is to recover the pipeline high pressure energy at local distributionstations. Instead of using a conventional pressure regulator, a pneumatic quasi-turbinewill rotate under the pressure differential and the flow will be controlled by the rpm,i.e. the torque applied on the quasi-turbine shaft. It does act as a dynamic active rotaryvalve. This way, the quasi-turbine can transform the pressure differential into useful mechanical work to run pump, compressor, ventilator, electricity generator.

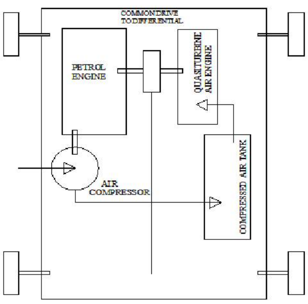
B. THE RETURN OF STEAM ENGINE

Conventional positive displacement steam engines are expensive, cumbersome andhave poor power to weight ratio. Solar, geothermal, biomass, cogeneration and heatrecovery are natural applications for the quasi-turbine steam engine due to itssimplicity, low price and low maintenance cost. While high pressure steam can bevery dangerous, pressure less than 60 psi is generally much less regulated and mostsuitable still for the quasi-turbines.

C. HYBRID AIR CARS

The future of energy strategies involves resources, efficiency,distribution andmobility. Hybrid technologies are viable approaches for the near term because theyare the best practical ways to avoid the low-power-efficiency-penalty of nowadayshigh power vehicle engine, used with only 15%average load factor. But getting extraefficiency this way requires additional power components and energy storage,withassociated counter-productive increases in weight, space, maintenance, cost andenvironmental recycling process. We can use the quasi turbine air engine as asecondary engine with another primary engine such as piston engine. Below figure illustrates the application of the quasi turbine air engine in hybridvehicles which is to be work as follows,

1) Initially the vehicle runs on petrol engine, during which the air compressor charges the compressed air tank with compressed air.
2) Once the air tank is fully charged the petrol engine is cut off from circuit and air engine runs on the compressed air from air tank.
3) After certain pressure drop, the petrol engine is switched on cycle continues.



(f) Hybrid car layout

D. WASTE AIR PRESSURE RECOVERY IN BLOW MOULDING PROCESS:-

Now days the blow moulding process is widely used because of universal use ofpackaged foods like mineral water, cold drinks beverages etc. At the time of blowmouldings the air issued at 30-40 bar pressure. After use of that air, it is escaped to atmosphere so the pressure energy with that air is wasted. That wasted energy is recovered by theuse of

ISSN(Online) : 2319-8753
ISSN (Print) : 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 10, October 2016

quasi turbine rotary air engine. Quasi turbine will work as a goodenergyrecovering instrument by recovering pressure energy wasted in the blowmoulding process.

E.OTHER APPLICATIONS

It can use for applications such as chain hacksaw, drills, dies grinders, dental drills andother pneumatic tools.

IX. CONCLUSION

The Quasiturbine is thus a pressure driven engine producing continuous torque with asymmetrically deformable spinning wheel. It is a new engine alternative with somecharacteristics simultaneously common to the turbine, Wankel and piston. A reviewof the technology and possible applications of steam engines to industrial power andwaste heat opportunities indicates that air engines are likely to be part of the energyengineer's portfolio as we move forward .The basic limitation of the quasi turbineengine at a present stage is that it is in its infancy stage. Though a lot of advancementhas been made since its invention has been marked quasi turbine is a new technologyprobably unwelcome in the world of engine establishment. In the future, however,you will likely see the Quasi-turbine use in more than just your car.

REFERENCES

Research Papers

[1] Saint-Hilaire et al., Proceeding of the Turbo Expo Conference, ―IGTI — International Gas Turbine Institute and ASME — American Society of Mechanical Engineers, page no. 7,.May 14-17, 2007
[2] Saint-Hilaire et al., Quasi turbine - Low RPM High Torque Pressure Driven Turbine For Top Efficiency Power Modulation‖, page no. 1,.May 2007.
[3] Stokes, M. D., ―Quantum Parallel: The Saint-Hilaire " Quasi turbine " As The Basis For A Simultaneous Paradigm Shift in Vehicle Propulsion Systems‖, White Paper published in eMOTIONREPORTS.com and presented at the 2004 Global Power train Conference (GPC) Advanced Power plants & Vehicles Session, Dearborn, Michigan, page no. 5, USA, 2004.
[4] K.M.Jagadale , Prof V.R.Gambhire, low pressure high torque quasi turbine rotary air engine,vol.3 ,Issue 8, ISSN 2319-8753, August 2014
[5] K.M.Jagadale , Prof V.R.Gambhire, A new trend in turbine technology- ― Quasi turbine rotary air engine‖, vol.1, Issue 12,ISSN (Online): 2347-4718, August 2014
[6] Saint-Hilaire et al.United States Patent –Patent No.US 6899075B2, Date of Patent- May 31,2005
[7] Crom, C., ―Technical Discussion Comparing the Quasi turbine with Other Common Engines‖, White Paper published in Energy Central, pageno. 12,2005.
[8] Eureka Innovative Engineering Magazine, October 1999. (Page No:29-30)
[9] Crom, C., 2007, ―Engine Exhaust Heat Recovery with Quasi turbines‖, White Paper published in Energy Central,
[10] Harry Valentine., ―Large -Scale Steam-powered Quasi turbine Engine Options‖, a white paper Mach 2010.
[11] Harry Valentine., ―Using the Quasi turbine to Regulate Natural Gas Pipeline Pressure and Flow-rate‖, a white paper August 2005.
[12] Joaquin G. Ruiz, February 2005 - Waste Heat Recovery in Automobile Engine Potential Solutions and Benefits, Massachusetts Institute of Technology, QT Stirling and Motion Reports White Paper cited .http://hdl.handle.net/1721.1/32832 https://dspace.mit.edu/bitstream/1721.1/32832/1/60689109.pdf .

Internet Resources

[13] http://quasiturbine.promci.qc.ca/ETheoryQTConcept.htm
[14] http://www.promci.qc.ca/pureinvention/apuq/APUQGoKartPneumatique.htm
[15] http://www.promci.qc.ca/pureinvention/apuq/APUQAutoPneumatique.htm
[16] http://quasiturbine.promci.qc.ca/QTPhotodetonation.html
[17] How Stuff Works, 2005, "Quasiturbine on the Web Encyclopedia", www.howstuffworks.com/quasiturbine.htm .