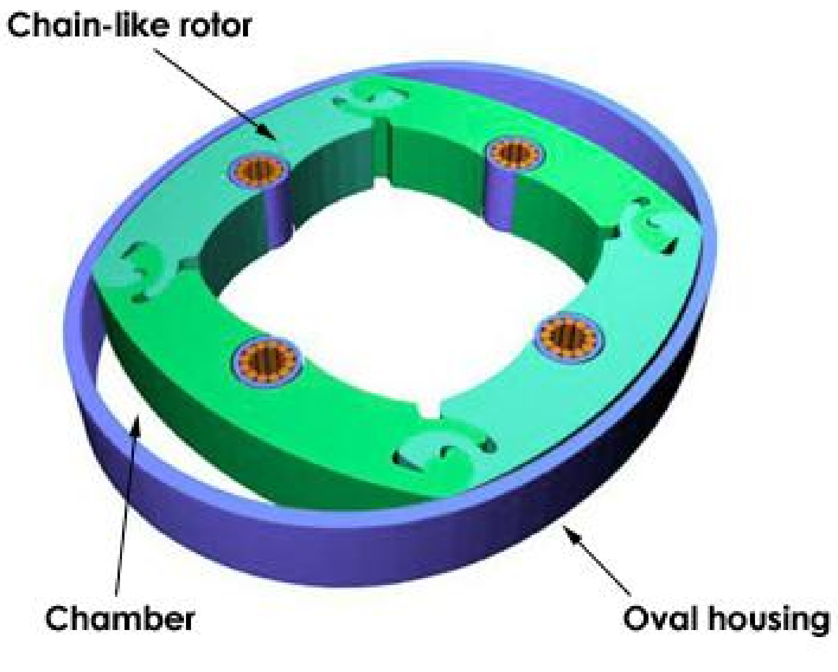
1. INTRODUCTION

The Saint - Hilaire family first patented the Quasiturbine combustion engine in 1996. The Quasiturbine concept resulted from research that began with an intense evaluation of all engine concepts to note advantageous, disadvantageous and opportunities for improvement. During this exploratory process, the Saint – Hilaire team came to realize that a unique engine solution would be one that made improvements to the standard Wankel or rotary engine.

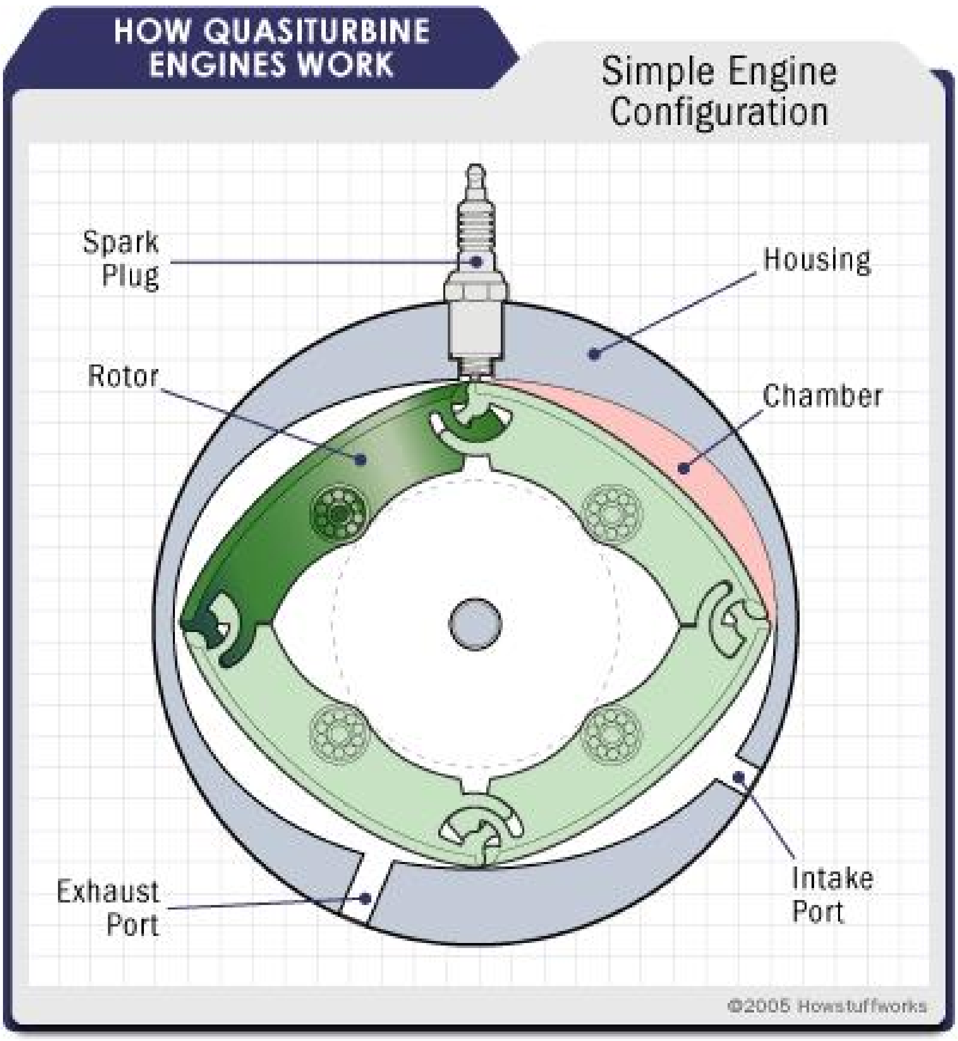
Like rotary engines, the Quasiturbine engine is based on a rotor-and-housing design. But instead of three blades, the Quasiturbine rotor has four elements chained together, with combustion chambers located between each element and the walls of the housing.



There are actually two different ways to configure this design -- one with carriages and one without carriages.

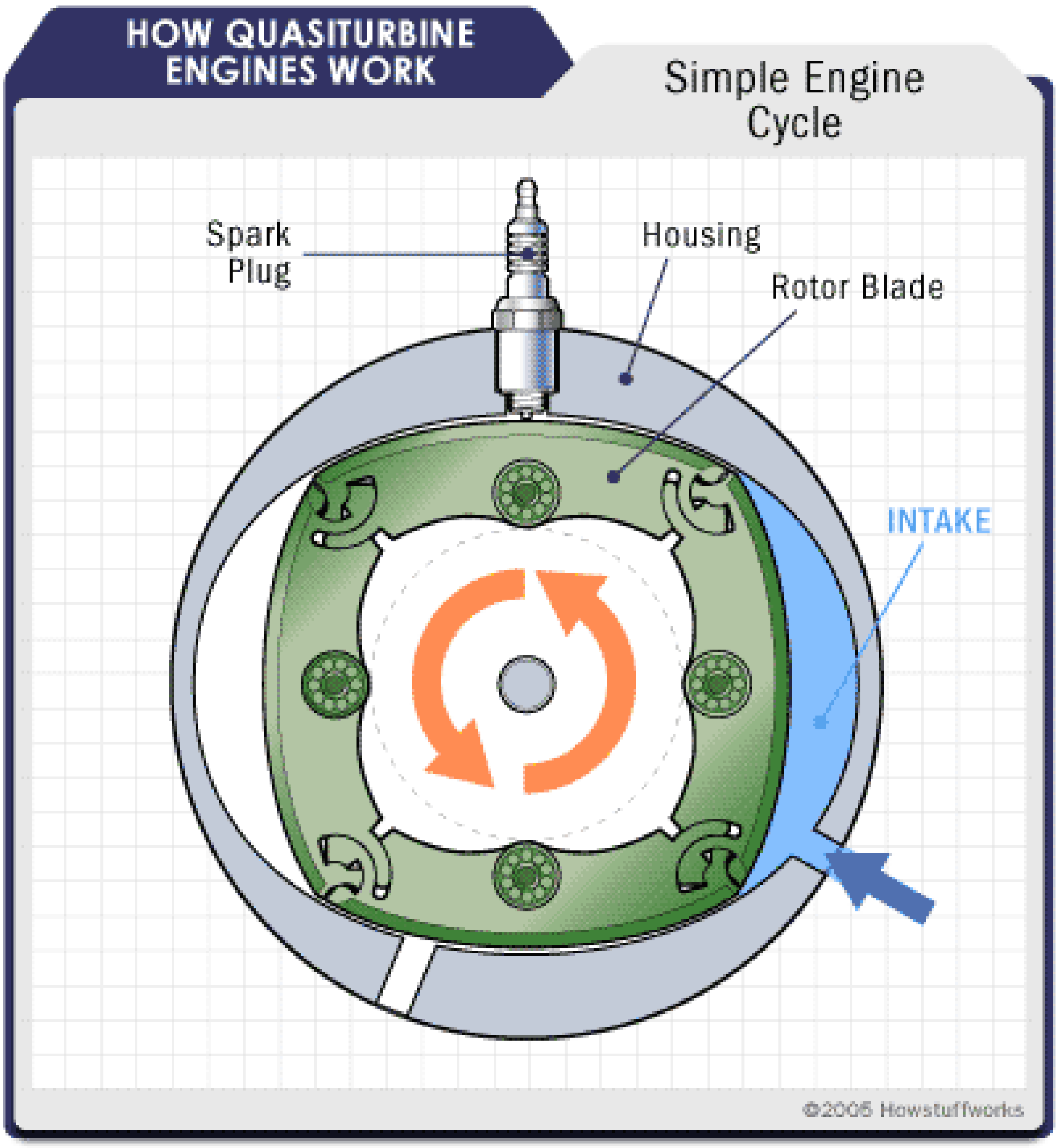
2. The Simple Quasiturbine Engine

The simpler Quasiturbine model looks very much like a traditional rotary engine: A rotor turns inside a nearly oval-shaped housing. Notice, however, that the Quasiturbine rotor has four elements instead of three. The sides of the rotor seal against the sides of the housing, and the corners of the rotor seal against the inner periphery, dividing it into four chambers.



In a piston engine, one complete four-stroke cycle produces two complete revolutions of the crankshaft that means the power output of a piston engine is half a power stroke per one piston revolution.

A Quasiturbine engine, on the other hand, doesn't need pistons. Instead, the four strokes of a typical piston engine are arranged sequentially around the oval housing. There's no need for the crankshaft to perform the rotary conversion.



Intake : which draws in a mixture of fuel and air

Compression :which squeezes the fuel-air mixture into a smaller volume

Combustion :which uses a spark from a spark plug to ignite the fuel

Exhaust :which expels waste gases (the byproducts of combustion) from the engine compartment

Quasiturbine engines with carriages work on the same basic idea as this simple design, with added design modifications that allow for photo-detonation.

Photo-detonation is a superior combustion mode that requires more compression and greater sturdiness than piston or rotary engines can provide.

3. Types of Internal Combustion Engines

Internal combustion engines fall into four categories based on how well air and fuel are mixed together in the combustion chamber and how the fuel is ignited.

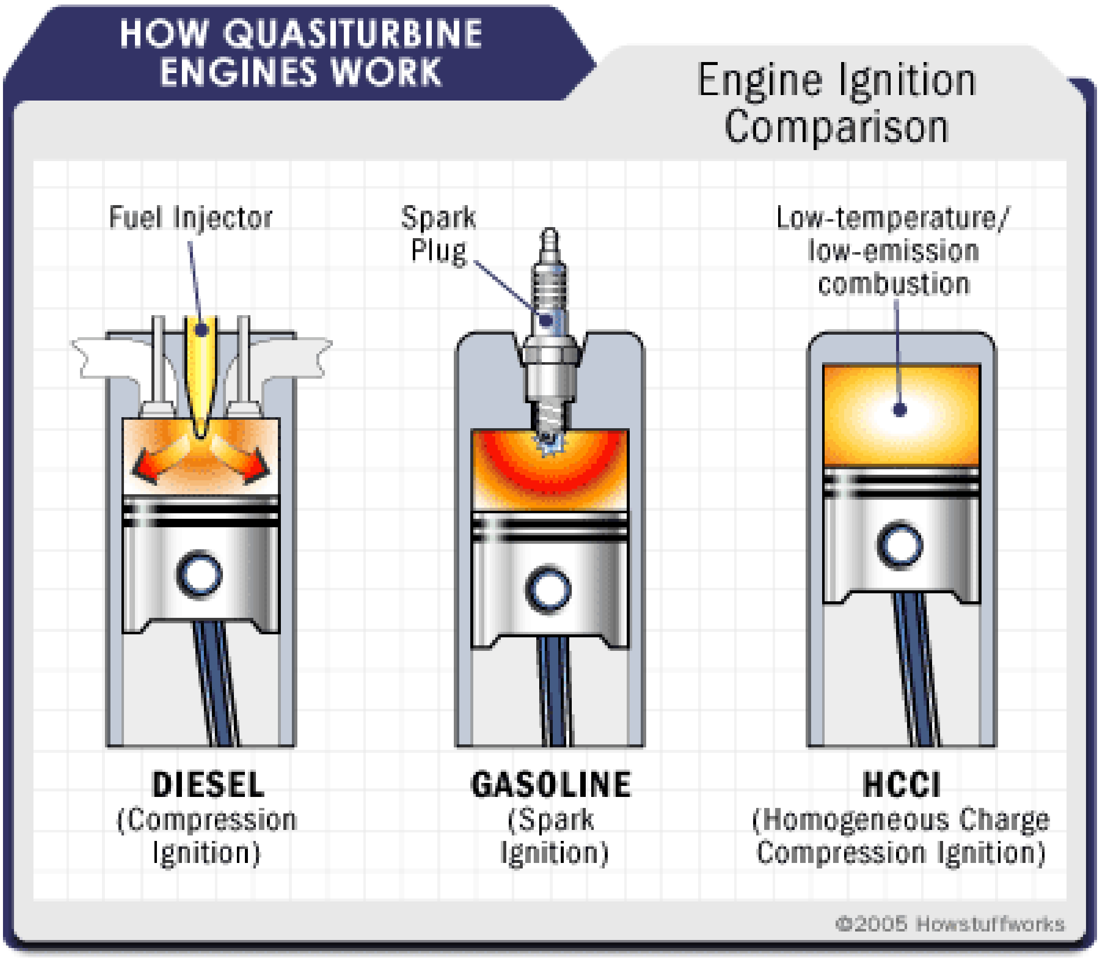
Four Types of Internal Combustion Engines		
	Homogenous Fuel-air Mixture	Heterogeneous Fuel-air Mixture
Spark-ignition	**Type I** Gasoline Engine	**Type II** Gasoline Direct-injection (GDI) Engine
Pressure-heated Self-ignition	**Type IV** Photo-detonation Engine	**Type III** Diesel Engine

Type I : Includes engines in which the air and fuel mix thoroughly to form what is called a homogenous mixture. When a spark ignites the fuel, a hot flame sweeps through the mixture, burning the fuel as it goes. This, of course, is the gasoline engine.

Type II : A gasoline-direct injection engine uses partially mixed fuel and air (i.e., a heterogeneous mixture) that is injected directly into the cylinder rather than into an intake port. A spark plug then ignites the mixture, burning more of the fuel and creating less waste.

Type III : Air and fuel are only partially mixed in the combustion chamber. This heterogeneous mixture is then compressed, which causes the temperature to rise until self-ignition takes place.

Type IV : The best attributes of gasoline and diesel engines are combined. 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 an HCCI engine. HCCI (Homogeneous Charge Compression Ignition) 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.



Of course, the high pressure required for photo-detonation puts a significant amount of stress on the engine itself. Piston engines can't withstand the violent force of the detonation. And traditional rotary engines such as the Wankel, which have longer combustion chambers that limit the amount of compression they can achieve, are incapable of producing the high-pressure environment necessary for photo-detonation to occur.

Enter the Quasiturbine with carriages. 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.

4. Quasiturbine with Carriages

The main Components of this engine is described below.

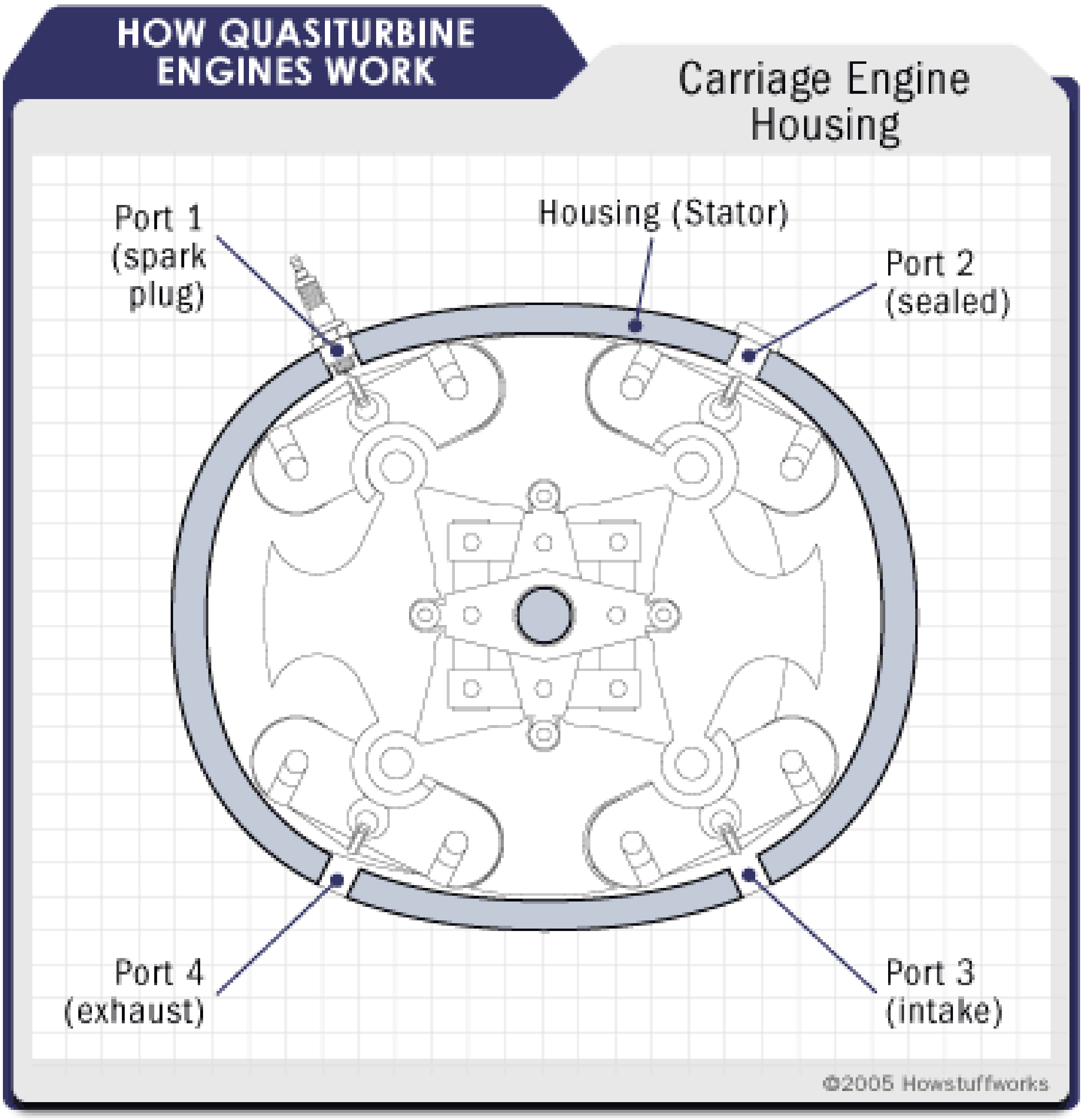
The housing (stator), which is a near oval known as the "Saint-Hilaire skating rink," forms the cavity in which the rotor rotates.

The housing contains four ports:

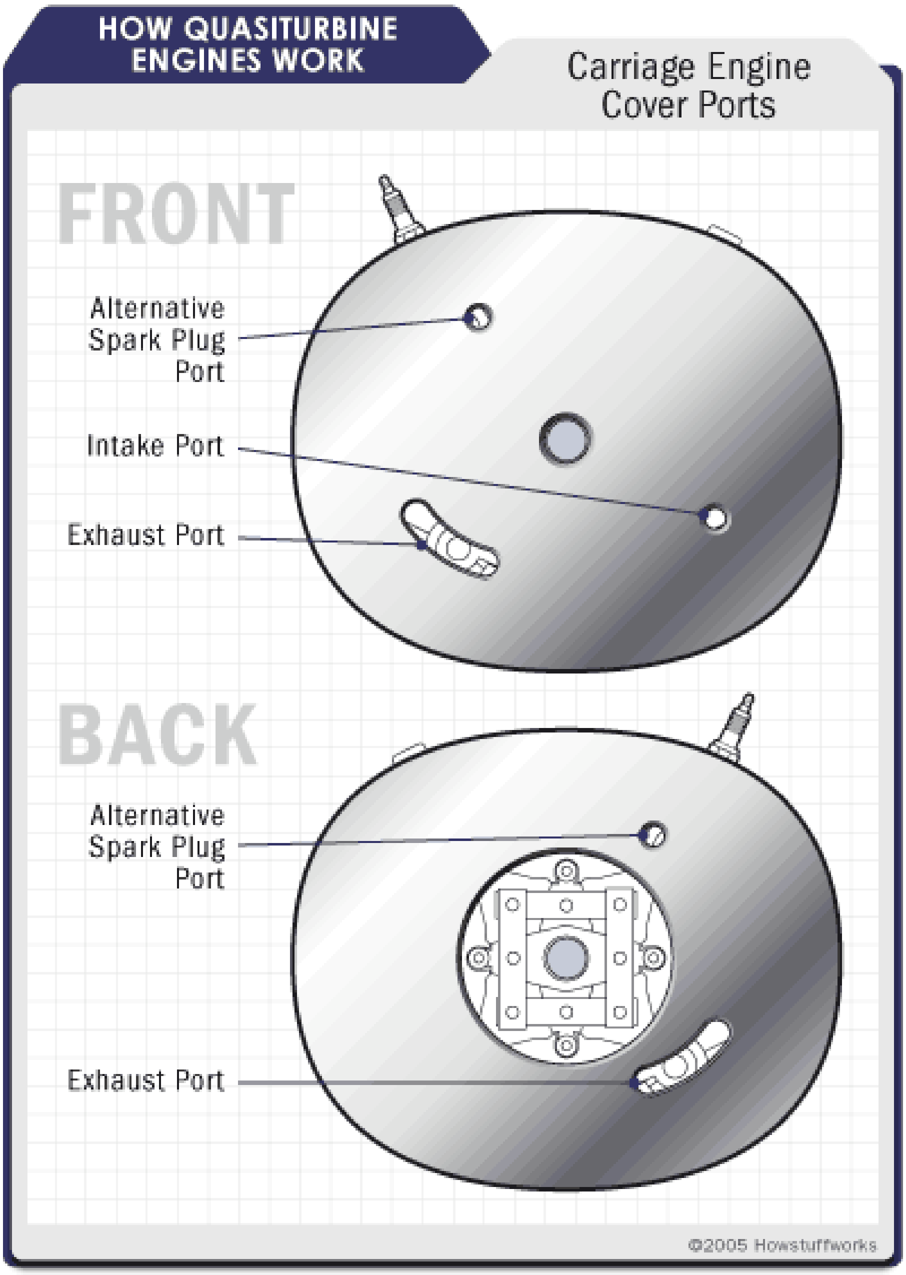
- A port where the spark plugs normally sits.
- A port that is closed with a removable plug.
- A port for the intake of air.
- An exhaust port used to release the waste gases of combustion.

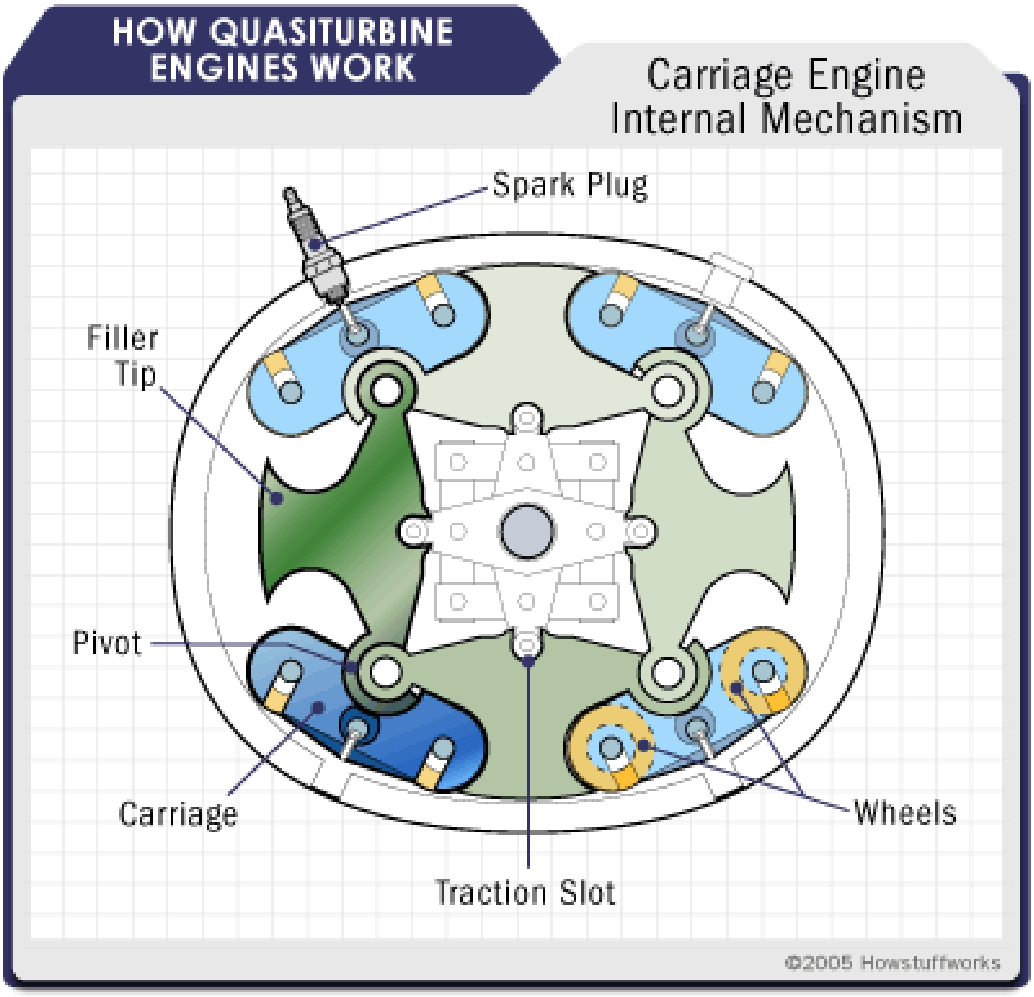
The housing is enclosed on each side by two covers. The covers

have three ports of their own, allowing for maximum flexibility in how the engine is configured. For example, one port can serve as an intake from a conventional carburetor or be fitted with a gas or diesel injector, while another can serve as an alternate location for a spark plug. One of the three ports is a large outlet for exhaust gasses.

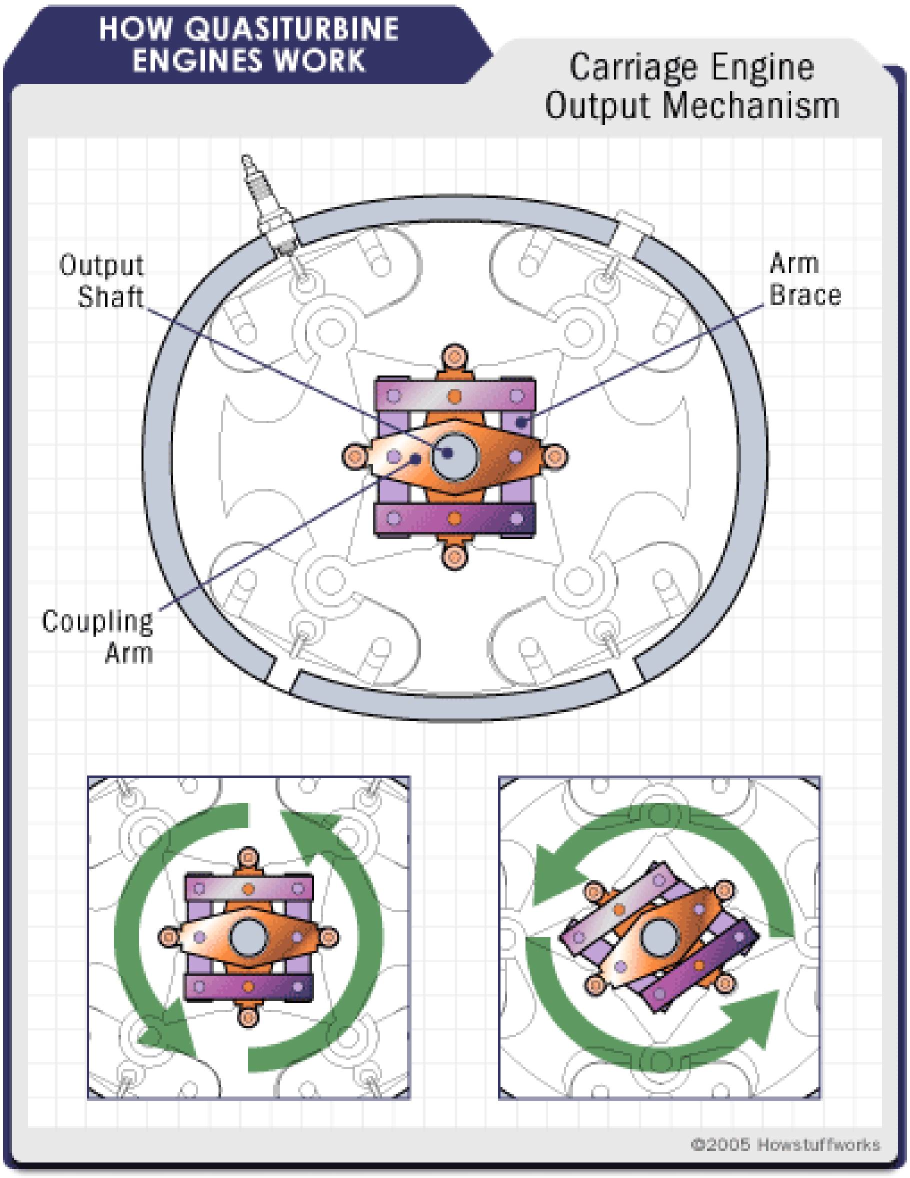


The rotor, made of four blades, replaces the pistons of a typical internal combustion engine. Each blade has a filler tip and traction slots to receive the coupling arms. A pivot forms the end of each blade. The job of the pivot is to join one blade to the next and to form a connection between the blade and the rocking carriages. There are four rocking carriages total, one for each blade. Each carriage is free to rotate around the same pivot so that it remains in contact with the inner wall of the housing at all times. Each carriage works closely with two wheels, which means there are eight wheels altogether. The wheels enable the rotor to roll smoothly on the contoured surface of the housing wall and are made wide to reduce pressure at the point of contact.



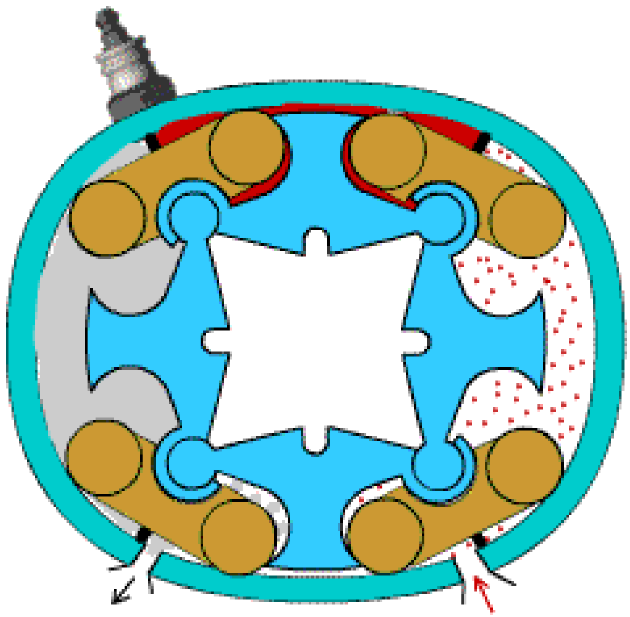


The Quasiturbine engine doesn't need a central shaft to operate; but of course, a car requires an output shaft to transfer power from the engine to the wheels. The output shaft is connected to the rotor by two coupling arms, which fit into traction slots, and four arm braces.



5. Operation of Quasiturbine with Carriages

In the Quasiturbine engine, the four strokes of a typical piston Engines are arranged sequentially around the oval housing. The housing surrounds a four-sided articulated rotor, which turns and moves with in the housing. The sides of the rotor seal against the sides of the housing and the corners of the rotor seal against the inner periphery, dividing it in to four chambers.



As the rotor blade turns, the volume of the chambers changes. First the volume increases, which allows the fuel – air mixture to expand. Then the volume decreases, which compresses the mixture in to a smaller space. Before the end of the compression the fuel – air mixture is burned by spark plug. Thus power is produced. One combustion stroke is ending right when the next combustion stroke is ready to fire. By making a small channel along the internal housing wall next to the spark plug, a small amount of hot gas is allowed to flow back to the next ready-to-fire combustion chamber when each of the carriage seals passes over the channel. The result is continuous combustion.

The four chambers produce two consecutive circuits. The first circuit is used to compress and expand during combustion. The second is used to expel exhaust and intake air. In one revolution of the rotor, four power strokes are created. That's eight times more than a typical piston engine.

6. Turbine Comparison

Hydraulic, pneumatic, steam, gas and fuel combustion produce primary energy in the form of expansion and pressure. Being a hydro – aero –static device, the Quasiturbine directly transforms this pressure energy in to mechanical rotation motion with optimum efficiency. Whatever low or high is the pressure. Conventional turbines are hydro – aero dynamic and efficiency of conventional turbine falls rapidly if the flow velocity moves away from the optimum. Because the Quasiturbine does not require the pressure energy to be converted in to the intermediary form of kinetic energy it has numerous advantageous over the conventional turbines, including on the efficiency at all regions.

7. Wankel Comparison

The Quasiturbine is superficially similar to the Wankel engine, but is quite distinct from it. The Wankel engine has a single rigid triangular rotor synchronized by gears with the housing, and driven by a crankshaft rotating at three times the rotor speed, which moves the rotor faces radically inward and outward. The Wankel attempt to realize the four strokes with a three-sided rotor, limits overlapping port optimization, and because of the crankshaft, the Wankel has near sinusoidal volume pulse characteristics like the piston. The Quasiturbine has a four-sided articulated rotor, rotating on a circular supporting track with a shaft rotating at the same speed as the rotor. It has no synchronization gears and no crankshaft, which allows carriage, types to shape “almost at will” the pressure pulse characteristics for specific needs, including achieving photo-detonation.

8. Efficiency at Low Power

The modern high – power piston engine in automobiles is generally used with only a 15% average load factor. The efficiency of a 200 KW gas piston engine falls dramatically when used at 20 KW because of high vacuum depressurization needed in the intake manifold, which vacuum become less as the power produced by the engine increases. Photo detonation engines do not need intake vacuum as they intake all the air available and mainly for this reason, efficiency stays high even at low engine power.

The development of a photo detonation engine may provide a means to avoid that low – power – efficiency penalty, may be more environment friendly as it will require low octane additive – free gasoline or diesel fuel. May be multifuel compatible, including direct hydrogen combustion and may offer reduction in the overall propulsion system weight, size, maintenance and cost.

9. Advantageous and Disadvantageous

Advantageous:

1. Simplicity and small size.
2. Zero vibration because the engine is perfectly balanced.
3. Faster acceleration without a flywheel.
4. Higher torque at lower rpm.
5. Nearly oil free operation.
6. Less Noise
7. Complete flexibility to operate completely submerged or in any orientation even upside down.
8. Fewer moving parts for less wear and tear.

9. It increases the fuel efficiency.
10. It can run on different kinds of fuel.

Disadvantageous

The design of Quasiturbine engine is typically built of aluminium and cast iron, which expand and contract by different degrees when exposed to heat leading to some incidence of leakage.

The Quasiturbine engine is still in its infancy. The engine is not used in any real world application. It is still in its prototype phase.

10. Conclusion

In the future, however, you will likely see the Quasiturbine used in more than just your car. Because the central engine area is voluminous and requires no central shaft, it can accommodate generators, propellers and other output devices, making it an ideal engine to power chain saws, powered parachutes, snowmobiles, air compressors, ship propulsion systems and electric power plants.

11. Reference

www.quasiturbine.com

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