WANKEL (ROTARY) ENGINE: OTTO CYCLE

WHAT IS IT?

The Wankel engine is an internal combustion engine that uses the four strokes of a typical Otto cycle (intake, compression, combustion, exhaust) to create kinetic energy. This kinetic energy is converted into rotational energy used to spin the cars transmission and ultimately propel the car. Unlike it's piston-driven counter-part, the Wankel engine directly converts pressure into rotating motion.

HISTORY

The Wankel engine was designed in 1951 by German engineer Felix Wankel for NSU Motorenwerke AG (NSU), a German automobile manufacturer. The initial design had the housing and the rotor of the engine move on independent axes. This was later changed so that the housing remained fixed (This is the version covered in this article).

The engine saw its first commercial use in Norton Motorcycles, a British motorcycle company. It then moved on to cars in 1961 when Mazda partnered with NSU to make rotary engines a standard in commercially available vehicles.

Currently, the engine sees use in motorcycles, racecars, airplanes, and even go-carts.

PARTS

Knowing the basic components in the engine is vital to knowing how the engine functions. The diagram below labels the important parts of the engine that are mentioned later.

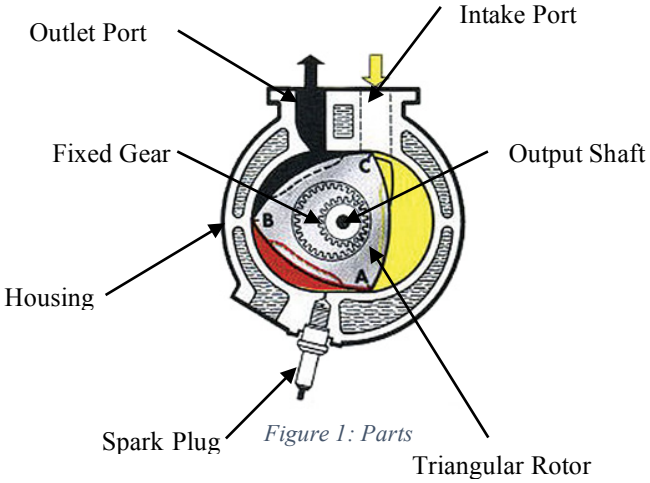

Figure 1: Parts

- INTAKE PORT: The entry point for the gas into the engine.
- OUTPUT SHAFT: Moves the rotational kinetic energy from the rotor to the rest of the car.
- TRIANGULAR ROTOR: Divides the chamber into intake, compression, and combustion areas and supports the energy of the system and the engines gear set.
- SPARK PLUG: Provides the electric energy used to combust the compressed fuel.
- HOUSING: Contains the combustion reaction and guides the motion of the triangular rotor.
- FIXED GEAR: Gear attached to the housing to ensure the correct movement of the rotor within the housing.
- OUTLET PORT: Exit area for ignited gasoline.

HOW DOES IT WORK?

The engine functions in a four step process: INTAKE, COMPRESSION, IGNITION, EXHAUST. During these four stages, the engine converts gasoline into energy that the car uses to move. These stages are known as strokes, making the Wankel engine a 4-stroke engine, similar to the conventional piston engine.

A Wankel engine differs from a traditional piston engine because of the unique design of the housing and rotor. As opposed to the single piston-head surface which typical engines have, the Wankel engine's rotors have three sides. This allows three actions to take place during one rotation of the rotor.

PROCESS

The following process tracks the flow of gasoline as it enters the engine until it is combusted and exits it. It is important to note however that these stages, as was mentioned before, happen simultaneously.

INTAKE

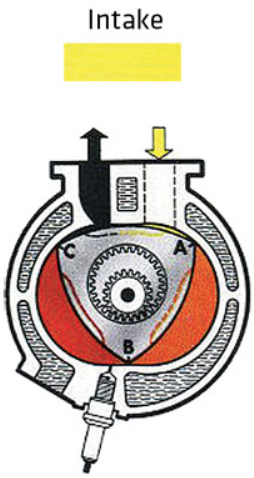

Figure 2: Intake

The first stroke in the cycle. During this phase, a drop in pressure caused by the rotor's motion draws in an air/fuel mixture (Figure 2).

This mixture is drawn around the rotor and forced into the second stroke of the cycle.

In order to ensure that none of the exhaust from the previous cycle re-enters during intake, the housing is extended to touch the edge of the rotor.

Unlike traditional engines where the amount of fuel entering the engine is controlled by a camshaft (valve-operating component on piston engines) synced with the rest of the engines motion, fuel enters into a Wankel engine based on the rotation of its rotor.

COMPRESSION

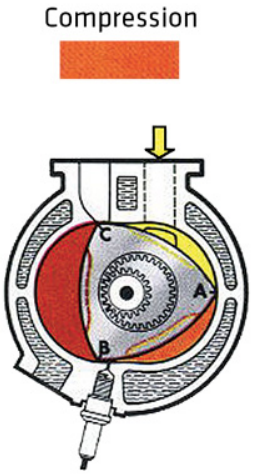

Figure 3: Compression

Compression is the second stroke in the cycle. In this phase, the rotor forces the mixture into a tighter area of the housing, creating a pressurized air/fuel mixture (Figure 3).

It is important that the fuel be compacted at this stage, because it will not ignite if it isn't at the correct pressure.

IGNITION

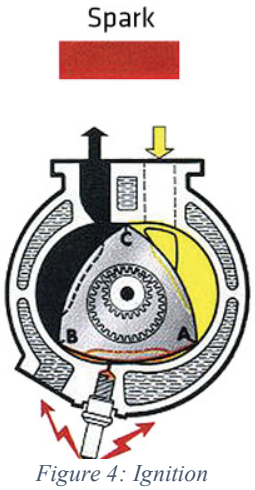

Figure 4: Ignition

Taking the compressed mixture from the previous stroke, the third stroke, ignition, ignites the mixture (Figure 4) creating the exhaust and the energy used to move the rotor.

To compensate for the odd area needed

to contour to the shape and position of the rotor at this point, the spark plug(s) need to be positioned in a way to ensure the mixture burns evenly.

This is the most important stage in the cycle because it determines the speed and power outputted by the engine.

EXHAUST

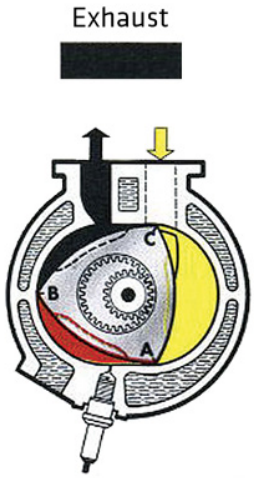

Figure 5: Exhaust

The fourth and final stroke of the Wankel engine process is the expulsion of the exhaust through the outlet port (Seen on Figure 5 in black). The sudden expansion of the now gaseous **fuel mixture** forces the rotor back around to its initial position. The exhaust is drawn from the engine to the exhaust system of the car.

Wankel vs. Piston Engine

While both engines serve the same purpose, there are a number of key design differences between them. For one, the Wankel engine converts pressure directly into the rotation of the output shaft, while a piston engine uses the vertical motion of its pistons to do this. This difference leads to Wankel engines being typically lighter than their piston counter-parts, leading to machines needing light, compact engines (motorcycles, chainsaws) using rotary engines.

Additionally, Wankel engines can withstand higher engine revolutions due to the inherent motion of the rotor to the output shaft and the engines absence of highly stressed components such as camshafts or crankshafts.

The problems with the Wankel engine come from the seals at the edges of the triangular rotor. These edges, by design, are in constant contact with the housing of the engine. The material therefore has to allow the rotor to move without restricting movement and prevent any leaks between the three sides of the rotor. This is especially hard to maintain as the seals experience wear due to engine use.

Refrences

Singh, Rachender. "The Wankel Rotary Combustion Engine: Construction & Working." Automobile Infotech. 18 Apr. 2014. Web. 23 Mar. 2016.

"Wankel Engine." Wikipedia. Wikimedia Foundation, 14 Mar. 2016. Web. 20 Mar. 2016.