The Wankel Renesis Rotary Engine

A rotary engine is an internal combustion engine that employs a rotating triangular shaped rotor to make power. This is in contrast to a reciprocating engine which utilizes pistons instead of a rotor. In a reciprocating engine, the pressure that is created when air and fuel is burnt is enclosed in cylinders and forces pistons to move up and down. In a rotary engine, that same expanding air-fuel mixture is contained in a chamber that is formed by the outside rotor housing, one face of the triangular-shaped rotor, and the side housing. The burning mixture expands and causes the rotor to revolve around a central point, which in turn provides rotational power.

Rotor

Similar to a triangle, the rotor has three convex faces. Each face/side of the rotor has a “pocket” in it, called a rotor depression, which creates a combustion chamber. The shape of the rotor depression has a major influence on the compression ratio of the engine and determines the power and efficiency of the engine. The exact shape of the rotor depression becomes very important at high rotor speeds. The burning and expanding air-fuel mixture must squeeze between the rotor housing and the depression, which is usually 0.01 – 0.015 inches. If the depression is too small, pressure can build up on the trailing (bottom) edge and can cause the rotor to slow down. This can lead to increased heat and reduced power. If it is too big, not enough pressure will build up during combustion. Therefore, the shape of the rotor depression is a cut-and-try balancing act to find the best fit.

The fact that the combustion chamber is very long and very shallow requires that all rotary engines have two spark plugs per rotor. Most normal reciprocating engines only have one spark plug per cylinder. The two spark plugs are placed in the rotor housing and separated from each other at opposing ends of the combustion chamber. The leading
(top) spark plug fires before the trailing spark plug (usually a difference of nanoseconds) in an effort to increase rotor speeds and eliminate any build up of pressure around the trailing edge of the rotor.

A metal or ceramic blade is placed at the point where two faces meet on the rotor. This blade is called the apex seal. The apex seal divides the rotor into three separate spaces, one for each face of the rotor. The rotor also has a set of internal gear teeth cut into the center of one side. These teeth then mate with a fixed gear connected to the side housing. These two gears establish the path that the rotor takes while revolving inside the housing.

**Rotor and Side Housing**

The rotor housing is oval in shape and contains the rotor and all of the other moving parts of the engine. The shape of the rotor and rotor housing is designed so that the three apex seals of the rotor will constantly touch the wall of the chamber, forming three sealed volumes of air-fuel mixture. The side housing is the end plate that closes in the combustion chambers and acts as a wall. The housings are machined very smooth to reduce friction with the rotor and to increase power potential.

Intake and exhaust ports are located on the side housing which allows the air-fuel mixture to enter and exit the engine. As the rotor passes the intake port, the available combustion space increases and draws in fresh air-fuel mixture from the intake. At the end of the combustion cycle, the rotor passes the exhaust port as the combustion space decreases forcing out the spent air-fuel mixture. There are no valves in the intake and exhaust ports to block the passage of the air-fuel mixture. The intake port connects directly to the throttle and the exhaust port connects directly to the exhaust. This is in contrast to a reciprocating engine that requires valves, valve springs, and camshafts to allow the entrance and exit of the air-fuel mixture. The lack of these moving parts results in increased reliability, mechanical smoothness, and power potential.
The side port configuration allows newer Renesis rotary engines to achieve zero overlap. In older rotary engines, the exhaust port was located on the rotor housing itself. Air-fuel mixture could enter through the intake port and leave directly through the exhaust port without being combusted. This resulted in poor emissions and bad fuel economy. Placing the intake and exhaust ports on the side housing allows newer rotary engines to pass strict emissions testing and increases fuel economy at the same time. This also allows higher rotor speeds because the apex seals don’t have to slide over the exhaust port which can lead to breakage.

**Eccentric Shaft**

A rotary engine uses an eccentric shaft to transfer the rotation of the rotor to the transmission. The eccentric shaft is analogous to a crankshaft in a reciprocating engine. The eccentric shaft has round lobes that are offset from the centerline of the shaft. This is where the term “eccentric shaft” is derived. As the rotor revolves inside the rotor and side housings, it pushes on the lobes of the eccentric shaft. Since the lobes are offset from the centerline of the shaft, this creates torque and causes the eccentric shaft to spin.

**Real World Results**

There are multiple configurations of the rotary engine ranging from one to four rotors, diesel to hydrogen powered, and two and four stroke combinations. The Mazda 787B even took the checkered flag at one of the most prestigious races in the world, The 24 Hours of LeMans, while utilizing a four-rotor engine in 1991. The Renesis Rotary Engine went on to win the International Engine of the Year award in 2004. These engines can be found in all fresh-from-the-factory RX-8s. With thousands of examples to be had that provide a power potential, smoothness, and an intoxicating sound surpassing all reciprocating engines, the Wankel Renesis Rotary Engine will be powering some of the fastest cars in the world for a long time to come.