An Evaluation on the Effectiveness of Rotary Engine Technology

M. Alexander Bates

Neumont College of Computer Science

ENG110 Intro to English Composition

Sarah Carter

2/1/2023

**An Evaluation on the Effectiveness of Rotary Engine Technology**

Rotary engine technology is a unique and fascinating variation of the internal combustion engine. The traditional internal combustion engine is a piston engine, it is made up of pistons that pump up and down their cylinders creating little explosions, that up and down motion is turned into the much more useful rotating motion by crankshaft to power your vehicle. The rotary engine on the other hand is comprised of one or more triangular rotors oscillating in an oval shaped chamber. This fundamentally different way to do fundamentally the same thing leads to interesting benefits and drawbacks. We will explore these benefits and drawbacks amongusthese criteria: maintenance, power, and fuel efficiency.

The rotary engine is a much simpler solution to internal combustion than the piston engine. The simplest rotary engine has 2 moving parts, the rotor that oscillates within its housing, and the eccentric shaft that it is rotating around. A piston engine has many moving parts to it: a crankshaft to convert the up and down energy of the pistons to rotational energy, a camshaft to move the valves, a timing chain to move the camshaft, and each cylinder has a piston, a valve for intake, and a valve for exhaust, and rocker arms or pushrods to move the valves. (Nortex Lube and Tune, 2018) Often rotary engines have 2 or 3 rotors (mine has 2) bringing up the total moving parts to 3 compared to the piston engines 18 or so parts (ibid.). This makes it seem like the rotary engine is the clear winner in ease of maintenance and repair, but this criterion is more complex than that. While the piston engine has many more possible points of failure, they are all easier to access when compared to what can go wrong with a rotary. The most common point of failure on the rotary has to do with the apex seals, they are placed at the 3 points of the triangular shaped rotor. These seals have a tendency to stop sealing very well and the only way to access them is to take apart the entire engine to replace them. Even though it’s easier to rebuild a rotary engine than it is a piston engine, due to the fact that you don’t usually have to rebuild a piston engine they win this criterion. Essentially piston engines have a big number of small problems, while rotary engines have a small number of big problems.

What the rotary engine lacks in ease of maintenance it makes up for with power. Diagram

Description automatically generatedAs you can see in this image the points of the rotor separate the combustion chamber into three sections, labeled 4 (Wikimedia Foundation, 2023). The blue region is air intake, the darker red region is the ignition zone, and the last region is the exhaust. Because of this unique shape the engine is intaking its air, fuel, and oil mixture at the same time as it is compressing and igniting, this means the rotary engine displaces twice as much fuel as a piston engine of the same size. This setup of intake and compression and ignition also means that it does what the standard 4-stroke piston engine does in half the rotations. A piston starting fully extended must sink down to intake the oxygen fuel mixture, then once it reaches the bottom of its range of motion it returns back upwards to compress the mixture, at the top of its reach the fuel mixture is ignited and the force of the explosion sends the piston downwards, at the end of this downwards trip it must return to the top to push the burnt exhaust out of the cylinder. Not only is this process slower and less efficient than the way the rotary engines, but it also introduces some major drawbacks that the rotary engine does not have. When the piston reaches the apex of its movement it must come to a complete stop and then start moving in the opposite direction, the rotor on the other hand smoothly rotates within its chamber without ever needing to do such a thing. This makes the rotary engine run much smoother, it also lets the rotary engine reach much higher RPMs. If you push a piston engine to those higher RPMs you risk the piston not being able to come to a stop due to inertia and it can break from all that force, a rotary engine can easily hit those higher RPMs and it is actually required for routine cleaning of the combustion chamber.

The combustion process in a rotary engine leads to a significant amount of unburnt fuel due to the chamber’s shape and motion. When the chamber is getting ignited at its most compressed the chamber is a very long and thin shape, this means the flame must essentially travel along a line, this fire spread process slower than in a piston engine due to this difference in shape. This long thin shape also means that there is much more exposed surface area, the engine loses a lot of heat energy due to this. My 1985 RX-7 on average gets 14 to 17 miles per gallon, a 1985 mk2 Toyota Supra gets about 18 to 19 miles per gallon. To get the 17 miles per gallon I had to do a lot of coasting and fuel-efficient driving. Overall, this leaves the rotary engine with a very poor fuel economy. Although this is something we have the technology to improve, we have the technology to recycle the unburnt fuel back into the system. The rotary engine is an underdeveloped and underused technology and with modern techniques and some much-needed attention and development I am confident that a rotary engine with comparable fuel economy is attainable. One of the possible solutions to this issue is laser ignition, in 2021 Mazda ran a study using lasers to ignite different fuel mixtures and found that it did indeed improve fuel efficiency.

If you were to specifically seek out a car with a rotary engine your only options would be retro cars or the newly released 2023 Mazda MX-30 R-EV. The rotary engine in the latter being an optional range extender for the electric vehicle, and the former being very rare and generally unreliable due to age. In the technologies current state, it wouldn’t be a stretch to say that the rotary engine is objectively worse than its piston brother. That being said, the future of the rotary engine looks bright, technology has come a long way and Mazda seems to be getting ready to give the technology another shot.

# References

Ferrara, M. (2021, March 3). Rotary vs Piston. DSPORT Magazine. Retrieved February 1, 2023, from https://dsportmag.com/the-tech/education/rotary-vs-piston/

Hege, J. B. (2007). *The wankel rotary engine: A history.* McFarland.

Holloway, H. (2013, July 15). Mazda's radical new Rotary Tech. Autocar. Retrieved February 8, 2023, from https://www.autocar.co.uk/car-news/motoring/mazdas-radical-new-rotary-tech

Mauck, S., & Haynes J. H. (1986). *Mazda RX-7 Owners Workshop Manual.* Haynes Pub. Group.

Nortex Lube and Tune. (2018, October 26). What parts make up a car's engine. Nortex Lube and Tune. Retrieved February 7, 2023, from https://nortexlubeandtune.com/blog/what-parts-make-up-a-car-s-engine

Ohkubo, M., Tashima, S., Shimizu, R., Fuse, S., Ebino, H. (2004). *Developed Technologies of the New Rotary Engine (RENESIS).* (No. 2004-01-1790). SAE Technical Paper. Retrieved from <https://www.rx8club.com/attachments/rx-8-media-news-11/198516d1380086553-wanted-original-rx8-press-kit-information-new-rotary-eng.pdf>

Rupp, S. (2022, January 21). Everything you need to know about LS, LSX, and Vortec engines: Specs, history, swaps, and more. MotorTrend. Retrieved February 7, 2023, from https://www.motortrend.com/how-to/chevy-ls-lsx-lsa-engine-history/

Solomon, O. (2022, September 6). Rotary vs. Piston Engine – Pros and Cons. Rx Mechanic. Retrieved February 1, 2023, from https://rxmechanic.com/rotary-vs-piston-engine/

Wikimedia Foundation. (2023, February 3). General Motors LS-based small-block engine. Wikipedia. Retrieved February 7, 2023, from https://en.wikipedia.org/wiki/General\_Motors\_LS-based\_small-block\_engine

Wikimedia Foundation. (2023, February 3). Wankel engine. Wikipedia. Retrieved February 8, 2023, from <https://en.wikipedia.org/wiki/Wankel_engine>