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HOW TO MODIFY YOUR MAZDA RX-7

High-performance mods to 12A & 13B rotary engines. Clutch, transmission & rear-axle recommendations. Suspension & brake preparation & tuning. Air dams, spoilers, fender flares & more. Complete parts list.

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with Jim Downing

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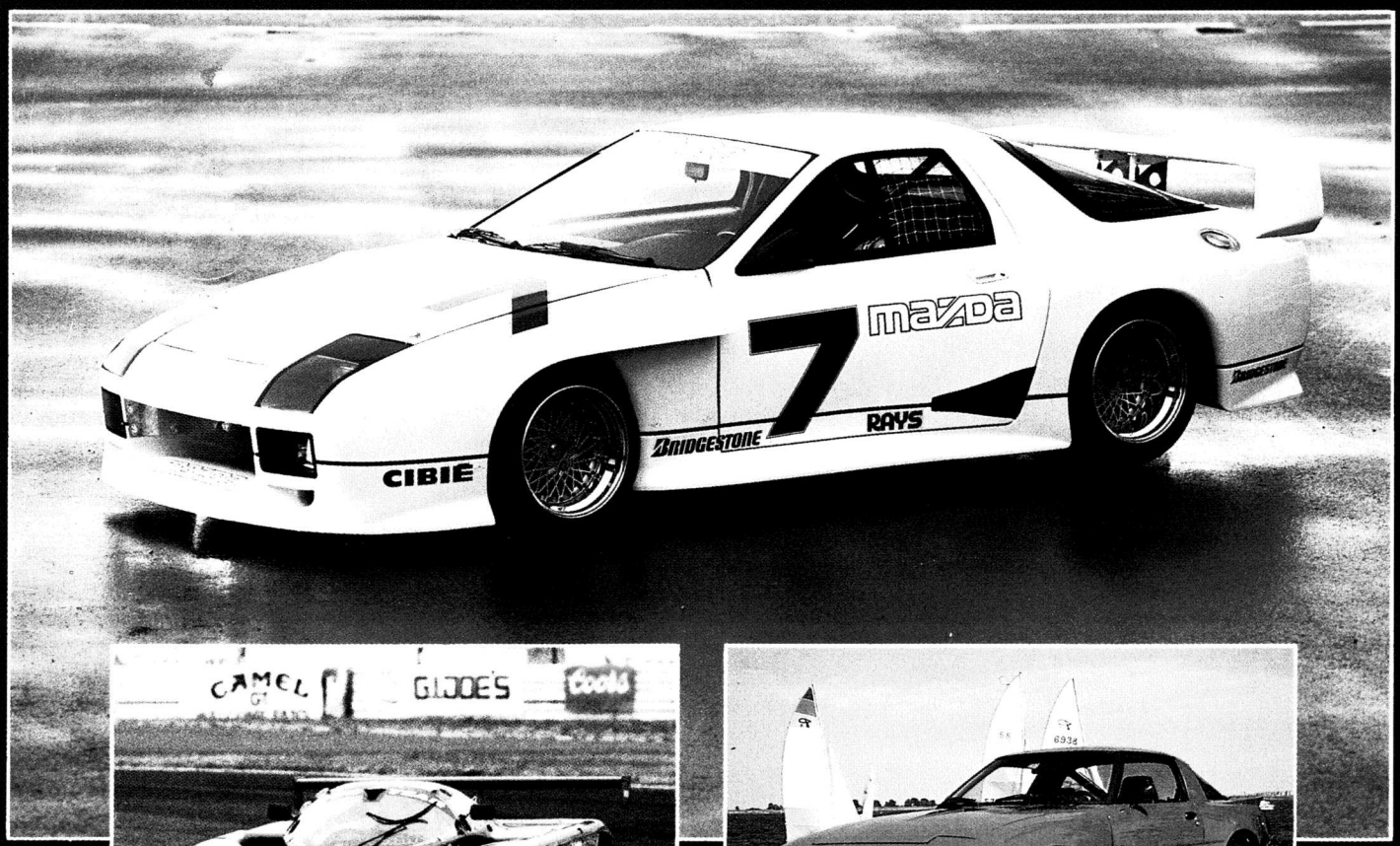

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HOW TO MODIFY YOUR

MAZDA

RX-7

by Dave Emanuel with Jim Downing

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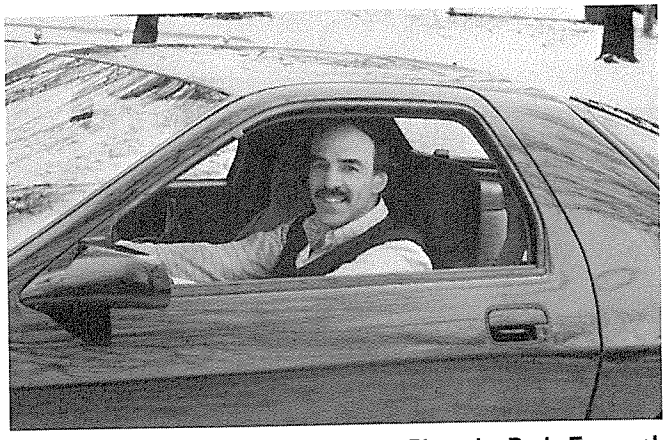


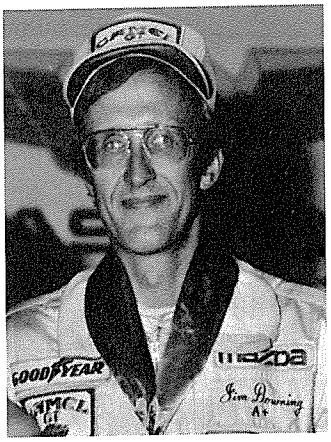
Photo by Doris Emanuel.

Dave Emanuel began his career in journalism in 1970 when *Car Craft* magazine published his first article. Since then, his byline has appeared on over 750 feature articles in magazines such as *Road & Track, Motor Trend, Circle Track, Popular Science, Home Mechanix, GEO, Sports Car Illustrated, Automobile Quarterly, InnAmerica* and *Regency*. He has also written three books.

A thorough knowledge of a subject is required before someone can write authoritatively about it and Dave gained his knowledge about automobiles the old fashioned way—he broke them. Even before he was of legal driving age, he had a shattered transmission behind him. After learning how to repair his own damage, he routinely helped his friends who were equally adept at finding the stress limits of various kinds of steel alloys.

Actually, most of the repair work that Dave had to do was caused by a physical problem—an extreme amount of force applied by the right foot. With such an affliction, it was only natural that Dave would wind up on a race track. Over the years, he has been involved in drag racing, autocrossing and road racing and his experiences have added to his knowledge of cars and the techniques that improve performance and handling.

The marriage of journalism and automobiles came about when Dave set a track record with a 428 Mustang and decided to chronicle his efforts. He was then working as a systems analyst for a computer company, but he continued writing about high-performance cars and modifications. After dabbling in journalism on a part-time basis for several years, Dave left the computer field to devote full time to writing. In a relatively few years, he has established himself as one of the country's leading independent automotive journalists.



Jim Downing began racing in 1963, behind the wheel of an Elva Courier. For several years, his participation was limited to SCCA club events primarily in the Atlanta, Georgia area. In his second year of competition, Jim drove a Formula Vee machine and did well enough to be invited to the first SCCA Runoffs, then held in Riverside, California. From the outset of his racing career, Jim never intended to become more than a hobby racer competing in the amateur ranks. But in 1974, after growing dissatisfied with club racing, he made the jump to professional road racing when he competed in IMSA's (International Motor Sports Association) Champion Spark Plug Series. And since 1979, he has been a full-time road racer. A consistent front-runner, Jim placed second in the Champion Spark Plug Series in 1980, and won the championship in 1981. In 1982, he moved on to the GTU category and promptly won that series championship.

1983 was a year of transition for Jim, co-driver John Maffucci and the entire Downing/Atlanta team. While concentrating on development of a totally new car for IMSA's Prototype (GTP) class, Jim continued to race his GTU car and just missed winning a second championship. With the new car—built in accordance with the rules for the World Endurance Championship 700 kilogram class—completed, Jim campaigned in GTP during 1984. In essence, he had a Camel Lights car, even though the class did not yet exist. However, when Camel Lights was introduced in 1985, the Downing/Atlanta team was ready. Jim won the championship in both 1985 and 1986.

Jim's automotive background began when he was a youngster; his father owned several auto-import dealerships in Atlanta. During college, Jim ran a repair shop specializing in English cars. Following graduation from Georgia Institute of Technology, he followed in his father's footsteps by opening an imported car dealership. He has also been involved in auto-parts retailing, but racing has been and is, his prime interest.

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INTRODUCTION

Mazda's RX-7, introduced in 1978, was the car that put the rotary engine on the map. Sports-car aficionados have found the car to offer exciting performance, economical operation and excellent reliability. What else could you ask for?

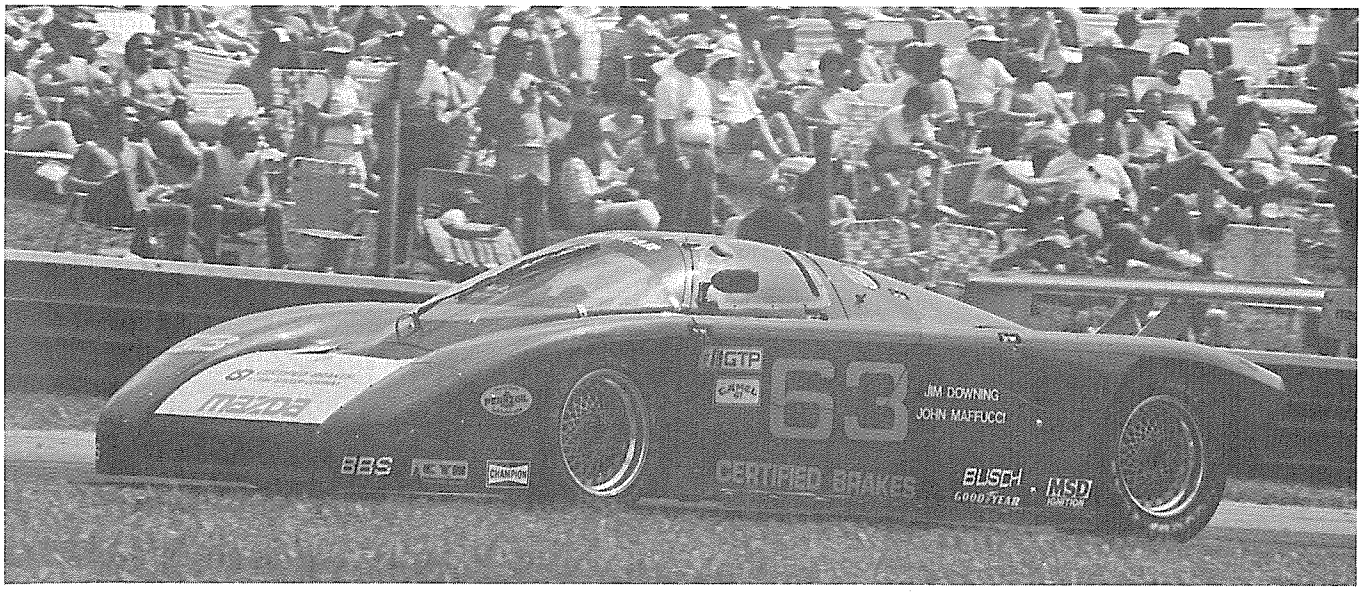
As the automobile foundered in its embryonic state, inventors and designers experimented with various types of power-producing devices. Piston engines, steam engines and electric motors all served in man's quest to perfect a self-propelled vehicle. Although the piston or reciprocating engine was crude and not terribly efficient, it quickly became the dominant automotive powerplant. For in spite of its shortcomings, the reciprocating engine is comparatively easy to build and service, does not rely on batteries that require periodic recharging, and does not require that the driver wait for water to boil before he or she can drive off.

THE BEGINNING OF ROTARY POWER

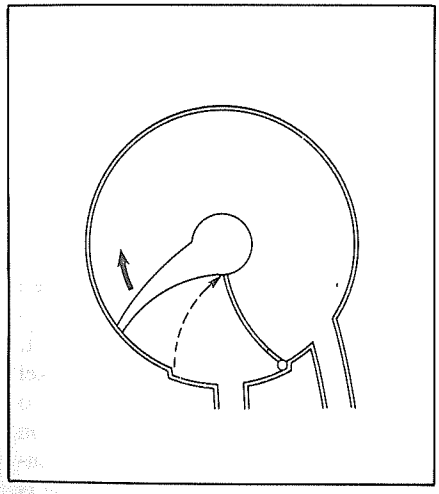
Although reciprocating-type internal-combustion automobile engines date back to 1876, when Nikolaus Otto of Germany perfected his design, development of the rotary engine actually predates Otto. However, the earliest efforts to develop practical rotary mechanisms were centered around pumps and compressors rather than engines. (In 1588, Agostino Ramelli designed a rotary piston water pump.) James Watt, whose name is associated with development of the piston-type steam engine, also took out several patents covering rotary steam engines. Between 1772 and 1782, Watt designed a number of rotary steam engines. However, insufficient rotor-to-housing sealing prevented these engines from being put to practical use.

Development of rotary steam engines continued and they became a viable source of power by the mid-19th century. But, it wasn't until 1908 that the first internal-combustion rotary engine was designed. The brain child of a British engineer named *Umpleby,* it was essentially a conversion of the rotary steam engine patented by John F. Cooley in 1903. Although his intentions were undoubtedly in earnest, Umpleby never fully developed his idea.

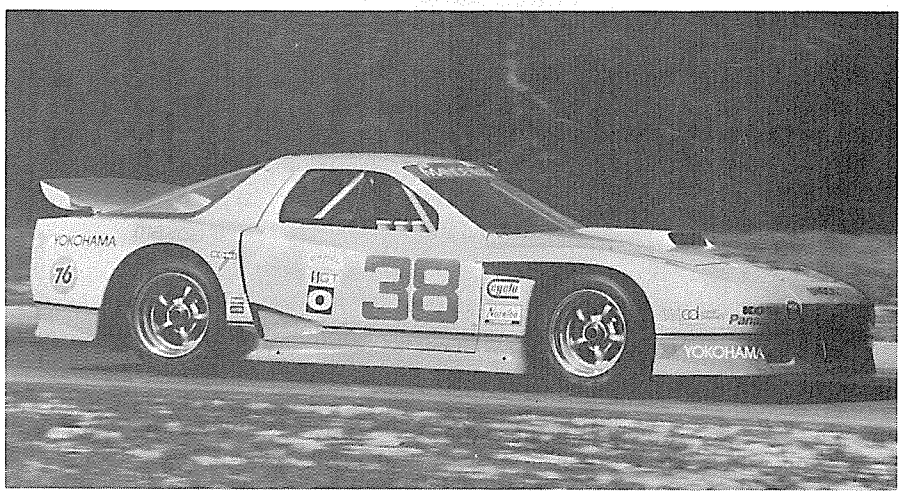
Enter Felix Wankel—Even in the 1938



The Camel Lights GTP race car, campaigned by Jim Downing and co-driver John Maffucci, represents the epitome in naturally aspirated rotary-engine development. The Downing/Atlanta team won the IMSA Camel Lights championship in both 1985 and '86.



James Watt of steam-engine fame was one of the early experimenters who dabbled with rotary power. He invented a rotary steam engine in 1759. Drawing courtesy Mazda.

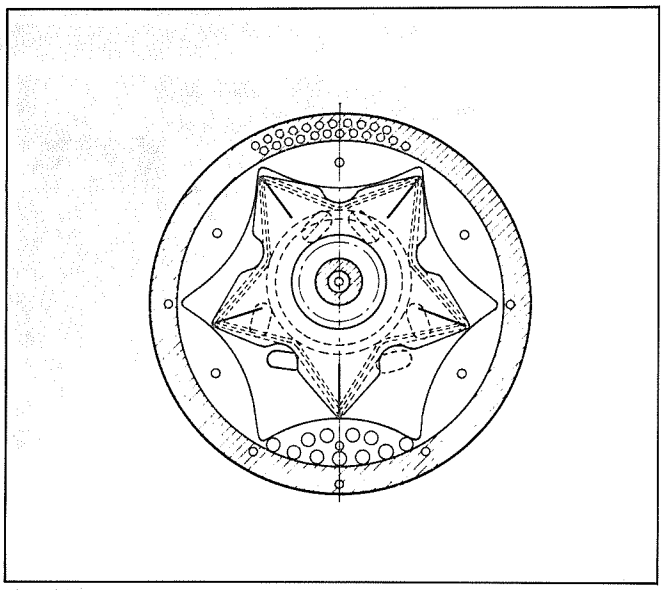


Roger Mandeville introduced his 1986 IMSA GTO RX-7 at the season finale at Daytona. The engine, a three-rotor model that produced over 450 HP, featured an electronic management system. Obviously, rotary engines have come a long way since the RX-7 was introduced.

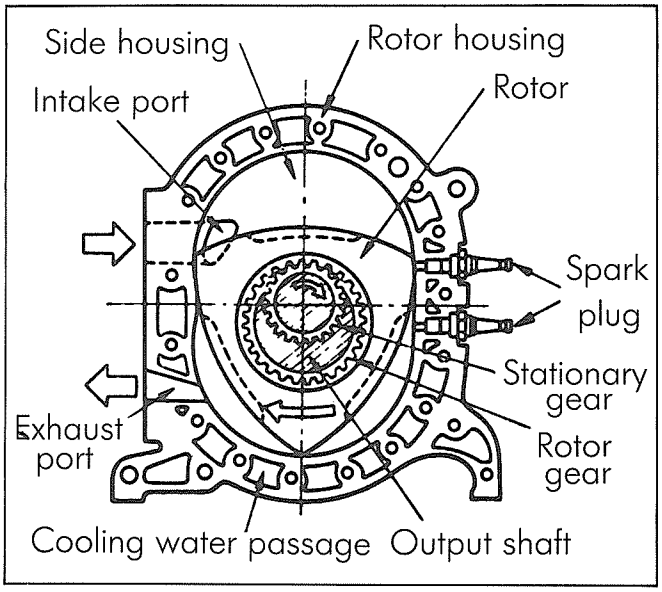
design of Dimitri Sensaud de Lavou, sealing was terribly ineffective. In spite of these problems there never seemed to be a lack of inventors willing to carry the torch for rotary power. And when Dr. Felix Wankel of West Germany picked up the torch, he carried it to new heights.

In 1951, Wankel devised a rotary compressor that was used as a supercharger on an NSU motorcycle, built specifically to set speed records. The rotary compressor served as a springboard for development of a truly viable rotary internal-combustion engine.

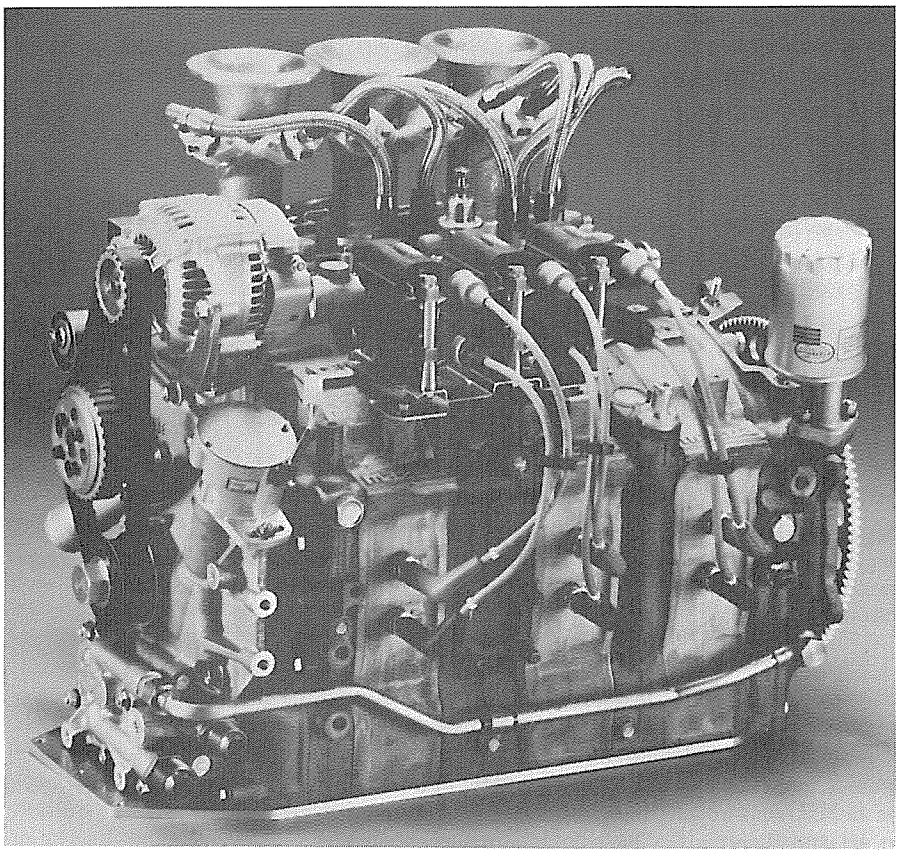
Were it not for madman Hitler's rise to power, Wankel's development of the rotary engine might have come to fruition considerably sooner. Wankel had been involved in the uncovering of an embezzlement scheme by the Socialist party. When Hitler became State Chan-



Rotary engine according to Sensaud de Lavou: 1938 design had some merit, but couldn't be put into production because of sealing and lubrication problems. Drawing courtesy Mazda.



Basic construction of a rotary engine with key components identified. Drawing courtesy Mazda.



The 13G three-rotor engine was installed in the Mazda 757 GTP race cars that competed at LeMans. Displacing 1962cc's, by virtue of three 654cc chambers, this is the largest rotary engine to be installed in a race car.

cellor, Wankel was labeled a traitor to the party. But he was lucky. Wankel was only imprisoned for several months, not sent to the gas chamber.

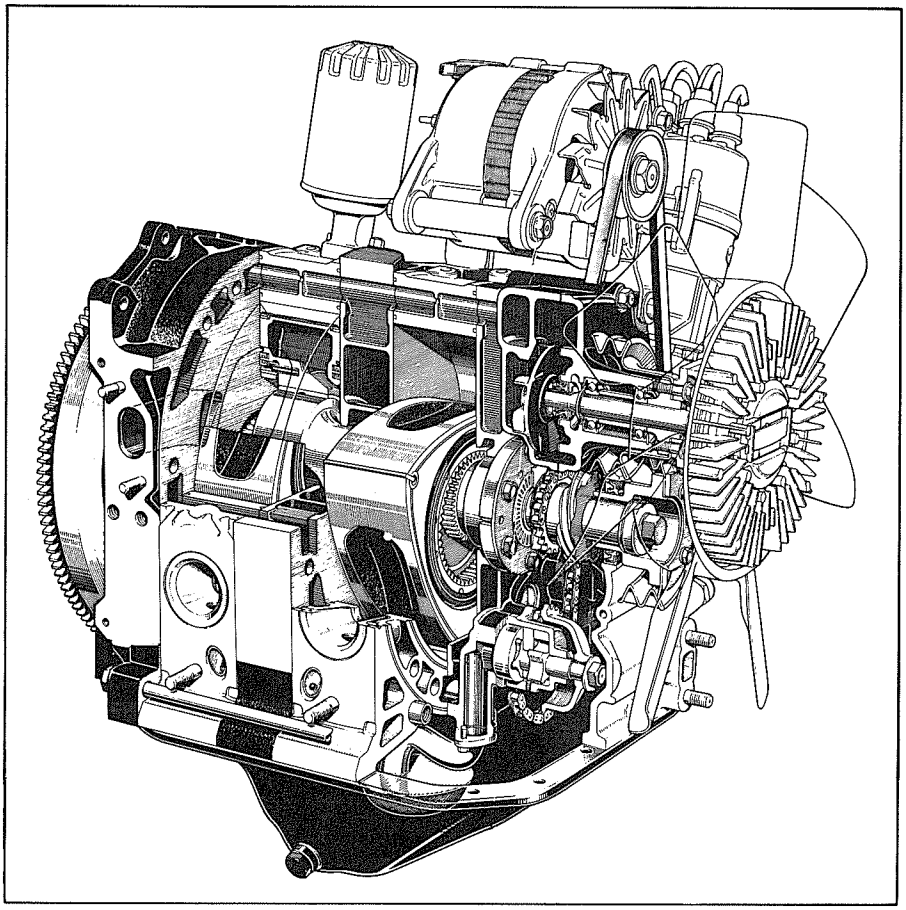
Wankel had applied for a patent on a two-rotor rotary engine on September 24, 1934. But after being released from prison, he became involved in various government-sponsored projects aimed at improving the performance of piston aircraft engines. It wasn't until 1951, when Wankel teamed with NSU, that rotary-engine development got rolling again. With NSU resources at his avail, Wankel began converting his rotary air pump to an internal-combustion engine. And on February 1, 1957, his DKM-54 test engine ran under its own power. (DKM is an abbreviation of *Drehkolbenmotor,* the German word for *rotary-piston engine.*)

As originally developed, Wankel's rotary included both an inner and outer rotor inside an external case. This arrangement added both cost and weight, so Dr. W. G. Froede and the engineering staff at NSU redesigned the DKM engine. They replaced the outer rotor with a stationary rotor housing. This design was known as the Kreiskolbenmotor (KKM).

The first KKM engine, a 125cc single-rotor model was first tested in 1957. It weighed only 37 pounds with a cast-iron

housing and 23 pounds with an aluminum housing. More importantly, it greatly simplified the intake and ignition systems. The KKM-125 was the precursor of today's rotary engine as produced by Mazda. In Wankel's DKM engine, the sparkplugs were in the rotor faces and the intake mixture was brought in through the eccentric shaft.

Following the KKM-125, Froede build a 250cc version for further development. The first endurance testing took place in 1959 and in 1960, the engine passed its first 1,000-hour durability test. It also registered a maximum of 44 HP at 9,000 rpm. The KKM-250 ultimately led to development of the KKM-612 two-rotor engine that is widely known as the NSU Ro-80.



With only 60—70% of the parts found in a piston engine, a rotary is simpler, more durable and more reliable. Drawing courtesy Rotary Rocket.