Tom Kimmel

4671 E. Hillcrest Dr.
Berrien Springs, MI 49103
(269) 473-6221
georgethomaskimmel@gmail.com

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Website

Michel Opposed Piston …

This is a cam engine. There are a great many ways of turning reciprocating motion into rotary motion. This is far too much of a temptation for steam engine designers, or at least new steam engine designers, to pass up. We have "Z" cranks, swash plates, flexible shafts, and cam engines—in fact everything except the Lanchester Crank which is, of course, a good idea.

The purpose of this little note is to show the geometry of a good cam engine design. As you can see the lobes are not spherical or arcs of a circle but an odd shape that takes into account the radius of the roller on the end of the connecting rod. A cam engine is not a new invention. It works self-starting if there are odd and even numbered cams and pistons. It also has an effective gear down built into the design and that number is arrived at by counting the lobes and that number is the gear down ratio. The numbers of cylinders do not matter for the gear down ratio, only for the torque generated.

The basic problem with a cam engine is the great stresses on the parts. There is a lot of side-loading on the piston or cross-head along with great stress on the roller bearing. These stresses are already taken care of in the standard IC engine design using crank throws and connecting rods and wrist pins making a cam engine design unnecessary. A steam engine only needs to get the piston to go back and forth in a cylinder and all of the fancy machinery does not make the steam any more or any less efficient as a pressure gas.

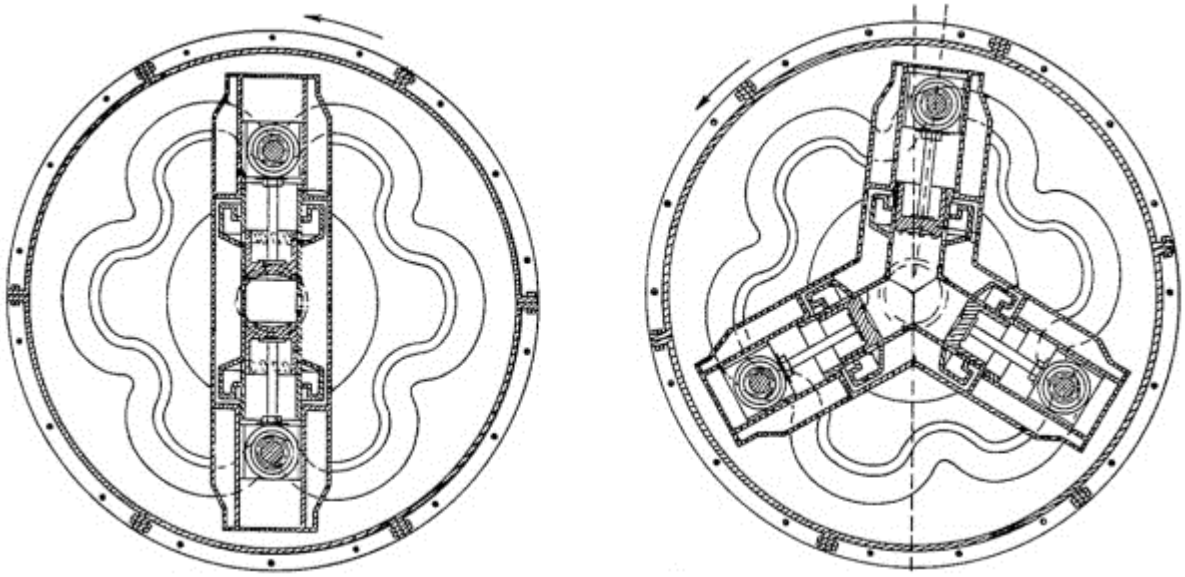
I almost forgot the famous Bourke engine, "probably the most often suppressed of all the suppressed inventions". It is a Scotch Yoke design. The Scotch Yoke works very well as a pump and much less well as an engine and the reason is because of the angle of the sliding surfaces. It is like a wedge that works really good for tipping over trees but it is very difficult for a heavy tree to make it move the other way.

And so and in conclusion, much of what we are dealing with is geometry. We have angles, levers, logarithmic progressions, and the square-cube rule. A basic understanding of these things is a great help before starting to invent more things.

Michel Opposed Piston Diesel Engines

By William Pearce

Hermann Michel of Voorde, Germany was a foreman at the Krupp Germania shipyard in Kiel, Germany. Through his work, he experienced the common problems of two-stroke submarine engines. Seeking to avoid the disadvantages of conventional engines, Michel designed a unique, new engine. He believed his engine would be particularly well suited for marine use. His design was for an opposed piston, two-stroke, diesel engine. Beyond the use of opposed pistons, the Michel engine was unique in that it was a crank less cam engine. With minor changes in the basic engine design, the cylinder group could either be stationary or rotate like a rotary engine. Michel filed a patent application for his engine configuration in Germany on 20 July 1920 and in the United States on 23 August 1921.



Drawings from Hermann Michel's original patent show two- and three-cylinder cam engines. In the drawings, the cylinder group was stationary and the cam ring rotated. The upper cylinder in the three-cylinder engine drawing had the exhaust ports. Note that it was angled slightly different than the other cylinders to facilitate scavenging.

Michel's engine design was for either two pistons in a common cylinder or three pistons in three cylinders. Regardless of the number of pistons used, the cylinder group possessed a common combustion chamber in which the pistons moved toward each other on the compression stroke. The movement of opposite pistons covered or uncovered intake and exhaust ports that were in the cylinder walls. This configuration eliminated the use of valves and a head gasket. The intake and exhaust port locations allowed scavenging air to flow through the cylinder and completely evacuate any exhaust gases when the ports were open.

The engine did not have a crankshaft. The pistons' movement was controlled by a comparatively large cam ring that surrounded the cylinder group. The rod for each piston had rollers in an annular cam track that formed an undulating path. This path determined the pistons' movement in the cylinder and facilitated the compression stroke. When configured with stationary cylinders, the cam ring rotated around the cylinder group. For a rotary configuration, the cylinder group rotated inside the stationary cam ring.

Unlike a crankshaft that is directly tied to the cycle of the engine, the cam ring could be made with several compression and power cycles for each revolution. For example, if the cam ring had six cycles, the cylinder group would go through six compression and six power strokes for each revolution of the cam ring. Likewise on a rotary configuration, the cylinder group would go through six compression and six power strokes each revolution.

Note: Added below are excel file pages listing rotary engine patents.

2011-0000460	2011	Guenther	Eggert	Control of a Rotary Engine	Katrix rotary expander cavity shaped like Pascals limacon, uses football shaped rotor, eccentric and slide.	engine		
7971436	2011	Yamamoto	Yasushi	Rotary Steam Engine	Interesting concept. Low quality heat vaporizes working fluid, creating steam bubbles. Bubbles displace water inside "paddle wheel" immersed in water, uneven bouyancy causing wheel to rotate.	power plant	engine	Isuzu
7713042	2010	Rodgers	John	Rotary Engine	Sliding vane engine with internal rotary valve	rotary engine		
2010-0126173	2010	Rosh	Melvin S	Rotary Propane Steam Engine Road Vehicle	See Title	power plant		
2009-0142211	2009	Holden	John	Rotary Steam Engine	w/ R Rehlander.	engine		Torque Applications, Inc
7331324	2008	James	Jerome M	Crankshaft Rotary Valve	Crankshaft functions as rotary valve.	engine		
7178502	2007	Okulov	Paul D	Balanced Rotary Internal Combustion Engine or Cycling Volume Machine	Includes steam variant. Four pistons and associated linkages form rotor apexes in rotary engine.	engine		
7073477	2006	Gorski	Raymond W	Rotary Engine	Vane motor	engine		
WO-2006-016019	2006	Pham	Pascal	Six Stroke Rotary Engine Comprising a Three-Part Piston	IC engine patent but fascinating design. Three lobed tubular piston rotates around two centers inside 6 arced chamber. Full cycle takes place over 2/6 rotation.	engine		
6945050	2005	Kimura	Yasunari	Rotary Fluid Machinery	Multiple inventors. Vanes and pistons in bottom cycle engine extract energy from steam and water.	engine	combined cycle	Honda
6918336	2005	Makino	Hiroyuki	Rotary Hydraulic Machine	Multiple inventors. Swash plate motor applicable for steam use.	engine		Honda
6732525	2004	Endoh	Tsuneo	Rotary Type Fluid Machine, Vane Type Fluid Machine, & Waste Heat Recovering Device for ICE	Multiple inventors. Rotary vane type motor used in automotive ICE waste heat recovery.	bottom cycling		Honda
6681738	2004	Endoh	Tsuneo	Rotary Type Fluid Machine, Vane Type Fluid Machine, & Waste Heat Recovering Device for ICE	Multiple inventors. Rotary vane type motor used in automotive ICE waste heat recovery.	bottom cycling		Honda
6565310	2003	Davidow	Robert	Steam Powered Rotary Engine	Simple two element counter rotating impulse and reaction turbine assy.	engine		
6513482	2003	Endoh	Tsuneo	Rotary Type Fluid Machine, Vane Type Fluid Machine, & Waste Heat Recovering Device for ICE	Multiple inventors. Rotary vane type motor used in automotive ICE waste heat recovery.	bottom cycle		Honda
6503072	2003	Nardi	Anthony P	Pressure Articulated Positive Displacement, Single Expansion Rotary Engine	Rotary Engine	engine		
5839270	1998	Jirnov	Olga	Sliding-Blade Rotary Air-Heat Engine with Isothermal Compression of Air	Engine compresses air/water mixture, separates, combusts, expands both.	combined cycle		
5501586	1996	Edwards	Thomas C	Non Contact Rotary Vane Gas Expanding Apparatus	Vane motor uses air cushioning to seal yet keep vanes from wearing against housing.	engine		
5535715	1996	Mouton	William J	Geared Reciprocating Piston Engine with Spherical Rotary Valve	Opposed internal combustion engine, 'unique' valve and drive configurations.	engine		
5032068	1991	Kurherr	Waldemar H	Displacement Type Rotary System Steam Turbine Engine	Toothed rotary engine.	engine	engine	
4836761	1989	Edling	Jack V	Rotary Engine with a Pair of Piston Assemblies and Shuttle Valves	See title.	engine	engine	
4437308	1984	Fischer	Victor H	Rotary Heat Engine	Power plant with vane rotor, injects pressurized heated water some of which flashes.	powerplant		Thermal Systems Ltd
4451219	1984	Kurherr	Waldemar H	Valveless Bi-Chamber Rotary Steam Engine with Turbine Effect	Two chambered vane motor on two opposed crankpins.	engine		
4470779	1984	Whitehouse	Ronald CN	Rotary Piston Machine withMating Frustroconical Sealing Surface	Rotary engine.	engine		
4462775	1984	Whitehouse	Ronald CN	Rotary Fluid Machine with Expandable Rotary Oburator	Rotary engine.	engine		
4297090	1981	Hoffmann	Ralph M	Rotary Expansion Power Unit with Valve Disc Connected to Crankshaft	Wankel style housing and rotor.	engine		Trochoid Power Corp.
4177771	1979	Nutku	Ata	Rotary Engines with Free Reciprocating-Rotating Pistons and Jet Thrust Drive	Rotating block with outward facing radial pistons spins in ring, cylinder exhaust acts as Hero turbine.	engine		
4070862	1978	Doerner	William A	Cascaded Two-Fluid Rotary Closed Rankine Cycle Engine	Co-invented with Buskirk. Closed rotary Rankine cycle engine, first stage exhaust heats second fluid.	powerplant	engine	DuPont

4009576	1977	Doerner	William A	Regenerator for Rotary Rankine Cycle Engines	See title.	powerplant	engine	DuPont
4047856	1977	Hoffman	Ralph M	Rotary Steam Engine	Steam Wankel.	engine	valve gear	
3941527	1976	Allington	Jackson H	Rotary Engine	See title.	engine		
3994640	1976	Cohen	William	Spherical Rotary Steam Engine	Nutating element engine.	engine	engine	
3962874	1976	Doerner	William A	Rotary Heat Engine Powered Single Fluid Cooling and Heating Apparatus	Hermetically sealed Rankine cycle powered cooling unit.	powerplant	engine	DuPont
3950950	1976	Doerner	William	Rotary Rankine Engine Powered Electric Generating Apparatus	Co-invented with Van Buskirk. Integrated Rankine power plant with rotary expander and boiler.	powerplant		DuPont
3970055	1976	Long	Otto V	Uniflow Type External Combustion Engine Featuring Double Expansion and Rotary Drive	Double acting uniflow wobbler.	engine		
3988082	1976	Rogers	Paul	Rotary Steam Engine	Pivoting vane/piston arrangement.	engine	engine	
3938918	1976	Snygg	John	Rotary Vane Device	Co-invented with Ebrok. Vanes guided by rollers create pump or expander.	engine		
3914075	1975	Brulfert	Andre'	Sliding Partition Rotary Engine with Rectilinear Seals	Rotary steam engine seals. Coinvented with AG Hoss.	engine		
3863454	1975	Doerner	William A	Rotary Heat Engine Powered Two Fluid Cooling and Heating Apparatus	Hermetically sealed Rankine cycle powered cooling unit.	powerplant	engine	DuPont
3860357	1975	Grainger	Lewis MD	Rotary Steam Engine	Reversible bucket turbine.	engine	turbine	
3867075	1975	Horst	Tallmon E	Rotary Engine with Rotatable Thrust Heads In A Toroidal Chamber	Two opposite turning rotors in toroidal chamber act as pistons.	engine		Horst Power Systems
3865522	1975	Nardi	Anthony	Rotary Steam Engine	Rotary engine, piston attached to rotating cylinder slides along walls of stationary cylinder.	engine	rotary	
3890071	1975	O'Brien	William J	Rotary Steam Engine	Improved rotary vane engine with cylinderindrical rotor and cam shaped inner and outer housings.	engine		
3851630	1974	Forster	Merrill J	Rotary Piston Engine	Unitized rotary radial block IC engine with vapor cycle heat recovery.	bottom cycle	engine	Marine Industries Inc
3806286	1974	Granberg	Albert J	Rotary Steam Engine	Vane type engine.	engine		
3737248	1973	Abraham	Erich E	Rotary Engine	See title.	engine		
3769796	1973	Bechtold	Max F	Rotary Heat Engines	Rotary engine and boiler integrated Rankine powertrain.	powerplant		DuPont
3744246	1973	Doerner	William A	Rotary Closed Rankine Cycle with Internal Lubricating System	Integral power plant with turbine, rotary boilers and condenser, lubrication means.	powerplant		DuPont
33744245	1973	Kelly	Donald A	Closed Cycle Rotary Engine System	Organic working fluid system uses vane expander and compressor stages.	engine		
3762840	1973	Merz	Josef	Rotary Piston Engine of Trochoidal Construction	Steam Wankel.	engine	Daimler-Benz	
3744940	1973	Pierce	Erold F	Rotary Expansion Engine of the Wankel Type	Multiple inventors. Wankel expander.	engine		Curtiss Wright
3613368	1971	Doerner	William A	Rotary Heat Engine	Rotary boiler and condenser mounted on turbine shaft.	powerplant	turbine	DuPont
3628899	1971	George	Leslie C	Expansible Fluid Rotary Engine	Wankel with four rotary valves.	engine	valve gear	
3578890	1971	Jensen	Oluf F	Rotary Steam Engine	Multiple cylinder vane rotary engine.	engine		
3521979	1970	Horst	Tallmon E	Dual-Drive Rotary Engine	Rotors spinning in toroidal chamber.	engine		Horst Power Systems
3452643	1969	Pratt	Harold A	Rotary Steam Engine	Steam Wankel.	engine		
3370510	1968	Bunyan	Thomas W	Barrel Engine Reciprocating to Rotary Movement Mechanism	See title.	engine	rotary	P & O Research
3310043	1967	Gamage	Russell W	Rotary External Combustion Engines	see title	engine		
3116666	1964	Scott	Dewey L	Rotary Engine	See title.	engine		
3084677	1963	Mitchell	Samuel S	Sliding Vane Type Rotary Steam Engine	Rotary steam engine.	engine		
2988065	1961	Wankel	Felix	Rotary Internal Combustion Engine	w/ E. Hoeppner. Wankel engine.	engine		NSU
2680430	1954	Mallinckrodt	George E	Rotary Expansion Engine	Counter rotating annular cylinders and pistons.	engine		
2690164	1954	Skok	Alois	Rotary Engine	See title.	engine		
2620864	1952	Ray	William A	Rotary Oil Burner	Spinning cup burner.	burner		

2525804	1950	Kellogg	Robert B	Aircraft Rotary Boiler Turbine Air Condenser Power Plant	Turbine plant with rotary boiler and condenser.	powerplant		USN
2448824	1948	Price	Nathan C	Rotary Turbine-Type Hydraulic Coupling	High altitude internal combustion engine aircraft turbocharger uses bottom cycle steam engine to power system.	powerplant		Lockheed
GB-583035	1946	Maillard	Bernard	A Rotary Machine Generating Variable Volumes	Wankel comparable expander with design mathematic formulas.	engine		
2352544	1944	Iskols	Anatol D	Rotary Steam Engine	For ship propulsion.	engine		
2253005	1941	Wittich	William F	Rotary Fluid Pressure Engine	Appears to be a radial flow turbine.	engine		
2055137	1936	Sherman	Elmer W	Rotary Engine	See title.	engine		
1981615	1934	Enderlin	Joseph	Rotary Motor	Rotary engine, enough said.	engine		
1968537	1934	Plato	Gerhardt	Rotary Motor	Rotating eccentric with curved sliding wiper and rotary valve.	engine	rotary	
1856542	1932	Duer	Edward C	Rotary Steam Engine	Rotary engine, enough said.	engine		
1880131	1932	Gray	David A	Rotary Engine	See title.	engine		
1888693	1932	Powers	Milton A	Rotary Oil Burner	Spinning cup burner.	burner		Timken
1888476	1932	Scott	Lewis L	Rotary Oil Burner	Spinning cup burner.	burner		Standard Engineering
1861168	1932	Warren	Edward C	Rotary Engine	Co-invented with JHA Warren and W Warren.	engine		Warren Engine Co
1818430	1931	Ricardo	Harry R	Rotary Blower, Pump or Fluid Pressure Engine	Eccentrically mounted rotor carries movable sealing vanes.	engine		
1715490	1929	Ballerstedt	William D	Rotary Steam Engine		engine		
1655738	1928	Rasck	George R	Rotary Engine	Revolving elliptical drum with two stationary wipers and rotary valve admission.	engine	rotary	
1542614	1925	Ellis	Lewis M	Rotary Engine	Meshed herringbone geared expander.	engine		Winslow Safety HP Boiler Co.
1536737	1925	Williams	Arthur J	Rotary Engine for Vehicle Wheels	Wheel spokes are steam engine cylinders.	engine	vehicle	
1481865	1924	Haeseler	Charles H	Rotary Engine	Revolving eccentric with wiper in housing that doubles as admission valve.	engine	rotary	
RE15756	1924	Mitchell	Anthony GM	Mechanism for the Interconversion of Reciprocating and Rotary Motion	Swash plate motor.	engine		Crankless Engines
1484960	1924	Peck	Caid H	Rotary Cylinder Motor	See title.	engine		Ingersoll-Rand
1475509	1923	Raqot	CL and LF	Rotary Engine	Rollers on pistons run in cam to turn shaft.	engine		Ragot Motor Corp
1456222	1922	Charlton	Thomas	Rotary Engine	Rotary piston chambers.	engine		Studebaker?
1409057	1922	Mitchell	Anthony GM	Mechanism for the Interconversion of Reciprocating and Rotary Motion	Double acting swash plate engine.	engine		
1277964	1918	Lovelace	Thomas T	Rotary Motor	Aviation IC barrel motor.	engine		
1247552	1917	Lindenberg	Frank H	Rotary Engine	Staggered gear rotary engine.	engine	engine	
1225844	1917	Mueller	August E	Rotary Engine	Bucket type turbine.	engine		
1210046	1916	Cathey	George A	Rotary Engine	Co-invented with ED Johnson. Rotary piston engine either IC or IC/steam.	engine	combined cycle	
1158554	1915	Pratt	Charles R	Rotary Piston Engine	Barrel type engine, disc valves motor driven to change cutoff.	engine		
1054612	1913	Prosseda	John	Rotary Steam Engine	Turbine.	engine		
1043945	1912	Lentz	Hugo	Rotary Engine	New style vanes for vane motor with cam followers on outer edges.	engine		
1026474	1912	Stone	Alonzo	Rotary Engine	Radial engine, block rotates, uses either steam or IC.	engine		
1026887	1912	Van Deventer	John H	Rotary Engine	Helical gear engine.	engine	rotary	
891839	1908	Killam	George T	Rotary Engine	Co-invented with M O'Neil. Sliding vane rotary valve engine.	engine		
893181	1908	Macomber	Walter G	Rotary Engine	DA swashplate type barrel engine.	engine		
876396	1908	Reuter	John C	Rotary Motor	Sliding vane derivative.	engine		Reuter Manufacturing

882360	1908	Vincent	Stanford W	Rotary Engine	See title.	engine		
855028	1907	Walker	James C	Rotary Engine	See title.	engine		
833676	1906	Cooley	John F	Rotary Engine	Roller piston engine.	engine		
812527	1906	Reeves	Frederick W	Reciprocating Rotary Engine	Radial engine employing ratcheting motion instead of crank.	engine		
GB-1906-07888	1906	Reid	Daniel M	Improved Noiseless Rotary Engine	Sector shaped piston elements.	engine		
835741	1906	Williams	Win D	Rotary Oscillating Reciprocating Engine	Oscillating cylinder drives gear which revolves unit in ring gear.	engine		Williams Engine Co
788390	1905	Bardenwerper	Charles H	Rotary Motor	Rotary engine, radial pistons and cylinders, sliding ports.	engine		American Steam Motor
799596	1905	Elliott	Seth N	Rotary Engine	Rotary engine, enough said.	engine		
791695	1905	Hudson	Clifford C	Rotary Engine	Co-invented with CW Daniell.	engine		
799677	1905	Schulter	William	Rotary Engine	Rotary engine, enough said.	engine		
800330	1905	Shepard	James A	Rotary Motor	See patents of Caid Peck. Obviously enhancements of Peck patents, company name changed.	engine		General Pnuematic Tool Co.
798848	1905	Warren	Edward C	Rotary Engine	Complex booger.	engine		Rotary Engine Company
776376	1904	Becker	John AS	Rotary Engine	Four cylinder rotating block rotary radial engine.	engine		
759419	1904	Chapman	Albert B	Rotary Engine	Impulse turbine.	engine		
751842	1904	Ericson	Victor	Rotary Engine	See title.	engine		
756904	1904	Stephan	Ferdinand	Rotary Engine	See title.	engine		
763336	1904	Swanson	John W	Rotary Engine	Rotary engine, enough said.	engine		
762016	1904	Wyand	William	Rotary Engine	Rotary engine, enough said.	engine		Wyand-Somers-Moore Patent Developing Co.
741574	1903	Barrett	William F	Rotary Engine	Vane type engine.	engine		
723436	1903	Bayley	Thomas	Rotary Steam Engine	See title.	engine		
724994	1903	Cooley	John F	Rotary Fluid Engine	Epicyclical Engine. Interesting rotary design based on two rotating elements spinning at different rates.	engine		Epicycloidal Engine Dev. Co.
724665	1903	Cooley	John F	Rotary Fluid Motor	Mentioned in Horseless Age. Two lobe three cavity gerotor.	engine		Cooley Epicyclodial Engine Development Co.
729849	1903	Diebold	Theodore A	Rotary Engine	Four cylinder rotary radial engine.	engine		
731104	1903	Fuqua	David P	Rotary Steam Explosive Engine	Rotary engine runs on either internal combustion or steam.	engine		
730543	1903	Knight	Margaret B	Rotary Engine	See title.	engine		
733052	1903	Knowles	John	Rotary Engine	Geared discs with periphery arm comprise piston.	engine		
717897	1903	McCulloch	James McG.	Rotary Engine	Rotary engine with radial cylinders in rotating block and connecting rods with rollers on ends rotating in eccentric drum.	engine		
720845	1903	Reeves	Frederick W	Reciprocating Rotary Engine	Cylinder rotates around midpoint driven by reciprocating piston.	engine		
GB-1903-25832	1903	Schmucker	Alfred P	Rotary Steam Engine	Four cylinder radial layout block and pistons rotate on crank.	engine		
737876	1903	Smallbone	Harry E	Rotary Engine	Wobbler engine with rotating disc valve.	engine		
733777	1903	Waters	Frank J	Rotary Steam Engine	Vane in eccentrically mounted housing.	engine		

739567	1903	White	George	Rotary Engine	Rotary piston and swing gate valve.	engine		Bush Engine Co
715977	1902	Carothers	Samuel E	Rotary Engine	Rotary engine, enough said.	engine		
717190	1902	Gouger	Frank	Rotary Engine	Rotary engine, enough said.	engine		
715788	1902	Grove	John A	Rotary Engine	Rotary engine, enough said.	engine		
716903	1902	Knight	Margaret	Compound Rotary Engine	Rotary engine, enough said.	engine		
716642	1902	Mackle	William J	Rotary Engine	Rotary engine, enough said.	engine		
717244	1902	Morgan	William A	Rotary Engine or Pump	Rotary engine, enough said.	engine		
716470	1902	Pickel	John W	Rotary Engine	Rotary engine, enough said.	engine		
717023	1902	Putman	John	Rotary Engine	Rotary engine, enough said.	engine		
715152	1902	Roeske	Henry	Rotary Steam Motor	Rotary engine, enough said.	engine		
717461	1902	Soule'	George W	Rotary Engine	Rotary engine, enough said.	engine		
716589	1902	Springer	John	Rotary Engine	Co-invented with W Robbins. Rotary engine, enough said.	engine		
715904	1902	Troutman	Wilkes E	Rotary Engine	Rotary engine, enough said.	engine		
716791	1902	Upson	Delevan P	Rotary Motor	Rotary engine, enough said.	engine		
715221	1902	Warren	Edward C	Rotary Engine	"Annular-expansion-chamber rotary-abutment type".	engine		Rotary Engine Co.
716503	1902	Whitaker	Simon S	Rotary Engine	Rotary engine, enough said.	engine		
714425	1902	Williams	James F	Rotary Engine	See title.	engine		
715722	1902	Womer	Frank E	Rotary Engine	Rotary engine, enough said.	engine		
679937	1901	Benson	Hezekiah	Rotary Engine	Rotary engine, enough said.	engine		
679936	1901	Benson	Hezekiah	Rotary Engine	Rotary engine, enough said.	engine		
680635	1901	Bootes	John T	Rotary Engine	Rotary engine, enough said.	engine		
680479	1901	English	Peter	Rotary Engine	Co-invented with L Cooney. Rotary engine, enough said.	engine		
680478	1901	English	Peter	Rotary Engine	Co-invented with L Cooney. Rotary engine, enough said.	engine		
681537	1901	Fuchs	Fredrich	Rotary Engine	Rotary engine, enough said.	engine		
688518	1901	Herr	Harry C	Rotary Engine	Pistons operate in circular 'cylinder'.	engine		
680259	1901	Long	Elmer C	Rotary Engine	Rotary engine, enough said.	engine		
680068	1901	Pickering	Frederick S	Rotary Engine	Rotary engine, enough said.	engine		
684471	1901	Stevens	Lucious O	Rotary Engine	See title.	engine		
680747	1901	Walker	Joseph L	Rotary Engine	Rotary engine, enough said.	engine		
680510	1901	Warren	Edward C	Rotary Engine	Reversible compound double expansion rotary engine.	engine		
680509	1901	Warren	Edward C	Rotary Engine	See title.	engine		
667414	1901	Whipple	William N	Rotary Engine	See title.	engine		
666630	1901	Williams	Win D	Rotary Reciprocating Engine	Ring supports inwards facing pistons on connecting rods that ride in rotating piston block that is located off center of ring.	engine		Williams Engine Co
660017	1900	Lambert	William	Rotary Engine	See title.	engine		
625731	1899	Ames	Hannibal H	Rotary Engine	See title.	engine		
RE11743	1899	Parsons	John H	Rotary Engine	See title.	engine		Parson's Rotary Engine Co

601158	1898	Murphy	Benjamin F	Rotary Steam Engine	Vane motor.	engine		
605906	1898	Parsons	John H	Rotary Engine	See title.	engine		Gooding, CW and Warner, AD each one half
597793	1898	Taylor	Perry B	Rotary Engine	See title.	engine		
579851	1897	Verret	Nicholas J	Rotary Engine	Co-invented with TH Mooney.	engine		
598906	1896	Carnahan	LK&CS	Rotary Steam Engine	Piston operates in ring shaped cylinder.	engine		
GB-1895-09151	1895	Chaboche	Marie DP	Improvements in or relating to Rotary Engines	See title.	engine		
GB-1895-19700	1895	Gautier	Charles	Improvements in Rotary Engines and pumps	Co-invented with X Wehrle. Steam car developers.	engine		
532065	1895	House	Henry A	Rotary Engine	Simple impulse turbine, buckets cut into disc.	engine		
532476	1895	Moses	Alfred H	Rotary Engine	Missing drawing.	engine		
GB-1894-14940	1894	Chaboche	Marie DP	Improvements in or relating to Rotary Engines	See title.	engine		
507738	1893	Kettrom	Charles	Rotary Steam Engine	See title.	engine	engine	
456351	1891	Adams	Willard G	Rotary Engine	Vane type engine.	engine		
453935	1891	Meissner	C, A & W	Rotary Engine	See title.	engine		
465907	1891	Whipple	William N	Rotary Steam Engine	Reversible sliding vane rotary engine.	engine		
440125	1890	Baker	Abner D	Rotary Engine	Rotating drum in cylinder with seal.	engine		Baker, AD
360766	1887	Dow	Joseph H	Rotary Engine	Early radial flow turbine.	engine		
344339	1886	Baker	Abner D	Rotary Engine	Co-invented with Huyck. Two rotors consecutively push each other along by compression.	engine		Baker, AD
219984	1879	Schneckenberger	Robert	Rotary Steam Engine	Unusual meshing gear and sliding vane configuration.	engine		
144941	1873	Woods	Leonard H	Rotary Engine	Pivoting wipers.	engine	rotary	
110022	1870	Dudgeon	Richard J	Rotary Engine	Pair of meshed gears.	engine		
77373	1868	Hardy	Dexter D	Rotary Engine	See title.	engine		
69383	1867	Andrew	Moses L	Rotary Engine	See title.	engine		
66570	1867	Darling	Jeremiah	Rotary Engine	See title.	engine		
54006	1866	Norton	William J	Rotary Steam Engine	See title.	engine		
39957	1863	Root	John B	Rotary Steam Engine	Square piston in rectangular pistons reciprocate at right angles to generate rotary output.	engine		
29787	1860	Holmes	Perry B	Rotary Engine	See title.	engine		
24388	1859	Hardy	Dexter D	Rotary Steam Engine	See title.	engine		
15641	1856	Carmichael	PDM	Rotary Steam Engine	Curved sliding vane in eccentrically mounted rotor.	engine		
3131	1843	Pilbrow	James H	Rotary Steam Engine	Helical flow 'Terry Turbine'!!!	engine		
2302	1841	Stewart	JA	Rotary Steam Engine	Meshing gear design.	engine		