

**Rotary Internal Combustion Engine:
Inventor: Gary Allen Schwartz**

The following is a design for a circular engine that can run on multiple fuels. It is much more efficient than traditional reciprocating engines. It is being offered as a public domain document for anyone who would like to build it. However, the inventor asks that it not be used for military purposes. Any royalties or franchise fees are voluntary and would be welcome. Gary@GaryAwake.com

ABSTRACT

This engine replaces the piston and cylindrical chamber of the reciprocating engine with a chamber of rectangular, semi cylindrical, or sinusoidal shape embedded in a ring shaped engine body .

The shape of the engine block may be ring shaped (figure 1.b) or barrel shaped (figure 6). The engine may contain any number of chambers, and may be layered with any number of rings (figure 1.b) or barrels (figure 6.a). When composed of multiple layers, the chambers in some layers may be used for combustion as the driving force, while the chambers in alternate or other layers are used for the function of pumping gases or fluids.

**Rotary Internal Combustion Engine:
Inventor: Gary A. Schwartz**

I claim

1. An internal combustion engine of the rotary type comprising, two pairs of ring shaped housings formed with two ring shaped side walls and perpendicularly interior facing sinusoidal shaped surfaces aligned in opposition , of which one housing forms chambers which function as both the intake and compression chambers, and the other housing forms chambers which function as both the combustion and exhaust chambers;

a rotating ring shaped rotor which contacts and separates the two sinusoidal ring shaped housings on their outer and inner circumferences and upon the convex surfaces of the sinusoidal shaped surfaces such that it forms a rotating flat surface to seal and complete the intake and compression chambers on one side and the opposing combustion and exhaust chambers on the other side and into which there are two or more perpendicular channels to guide and contain two or more reciprocating

pistons or shuttles and containing channels for the transfer of the compressed air / fuel mixture;

two or more fuel supply channels in communication with the beginning of the concave sinusoidal slope of the intake chambers in the ring shaped housing;

four or more compression communication channels within the rotating center ring which allow for the transfer of the compressed fuel air mixture from the end of the concave slope of the compression chamber into the beginning of the concave slope of the combustion chamber by way of check valves;

exhaust ports in communication with a vicinity of the end of the concave slope of the exhaust chambers in the ring shaped housing;

two or more vane shaped shuttles that reciprocate together within the channels in said rotating ring and are held in dynamic tension by resilient springs against the sinusoidal chamber walls and which function to provide a surface upon which the expansion of combusting fuel exerts motive power and as a moving partition dividing the function of one set of chambers simultaneously for intake and compression functions and the opposing chambers simultaneously for combustion and exhaust functions;

an ignition device such as a spark plug located in the vicinity of the beginning of the concave slope of the combustion chamber;

wherein all or a portion of the fuel supply channel and the exhaust channel are disposed in the ring shaped engine housing and the compression communication channel is disposed in the rotating ring.

2. An embodiment of the engine according to claim one in which the plane of the sinusoidal chambers and separating ring have been rotated 90 degrees so as to be parallel to the axis of rotation.

3. An engine according claim 1 wherein there is a means for admitting compressed air into the combustion chambers and wherein the combustion fuel is injected directly into the chambers containing compressed air and before igniting by means of a direct injection system.

4. A rotary engine according to claim one which is powered by compressed gas or other expanding gases and liquids.

5. A rotary engine according to claim one which is powered by the implosion of Brown's Gas.

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

Prior art engine designs lose efficiency and create vibration as a result of the reciprocal movements of a larger mass piston or asymmetrical rotating disks. Earlier rotary designs also have more moving parts, such as rotating valves (USPTO6,132,197 Adamovski, et.al. October 17, 2000) The prior art rotating disk design of Kajino (6032636 Kajino March 7,2000) has efficiency losses due to the direction of expanding gases toward overcoming resistance against its reciprocating movements caused by the tensioning spring utilized to maintain the seal of the reciprocating rotating disc. This design also has both efficiency losses and vibration due to the larger mass of the reciprocating disc. The prior art sinusoidal rotary engine design of Pfeiffer (4,004,556 January Pfeiffer 25, 1977) requires two or more reciprocating vanes for each chamber.

Engines designs of prior art transfer the movement power to rotating shafts and often require flywheels to provide continuity of momentum and smooth out vibration.

OBJECTS AND ADVANTAGES

The object of the present invention is to produce an improved internal combustion engine, which is of the rotary type with reduced efficiency losses due to the reduced mass of reciprocating parts. Another object is to produce an apparatus which has less maintenance and greater efficiency due to fewer moving parts than prior art rotary reciprocal engines. Another object is to produce an apparatus which also has chambers for compressing a gas and/or pumping a fluid. Another object is to produce an apparatus which may be utilized as a four cycle rotary internal combustion engine or as a two cycle rotary internal combustion engine. Another object is to produce an apparatus which has the strokes of suction, compression, ignition/expansion and exhaustion. Another object is to produce an apparatus which may be utilized as a compressor, or as a pump, and as an engine powered by the expansion of liquids or gases.

The present invention concerns a ring shaped rotary engine for conducting suction, compression, expansion and exhaustion in two or more variable volume chambers formed by two housings containing sinusoidally shaped interior walls, an adjoining rotating ring, and a reciprocating shuttle.

The present novel ring shaped rotary apparatus of this invention may be utilized as an internal combustion engine fueled by petroleum, hydrogen or a variety of combustible fuels, as a combination internal combustion engine and a compressor and/or pump, as a steam engine, as an implosion

driven engine fueled by Brown's Gas (US 4,014,777), and as an engine powered by expanding gases or heated liquids.

The ring shape of the rotor of the present invention acts as it's own flywheel, creating a smooth rotation.

The lighter weight of the shuttle / vane reduces vibration effects and results in much higher efficiency.

The shuttle could be comprised of highly magnetic material and the sinusoidal shape of the shuttle's movement would allow for the generation of a sinusoidal electric wave form to be produced as a result of the placement of electrical windings within or surrounding the rotor.

The ring shape and fewer moving parts than prior art permits a relatively thin design allowing for placement under a vehicle, which would provide better utilization of interior space in a vehicle and a lower center of gravity resulting in greater stability in handling.

The present invention can be constructed with spokes or other means to transfer movement power to a central shaft, or can be constructed without a central shaft, allowing the placement of propellers or turbines in the center for aeronautic applications and for providing the movement of large amounts of air through the center of the engine. In addition, the ring shaped design allows the engine to surround a vehicle or other mechanical apparatus to which the power of this engine design may be applied.

The length and height of the sinusoidal shape can be varied to alter the volume of the chambers to accommodate different fuels and to accommodate a variety of compression ratios.

The apparatus of this invention is relatively simple in construction and operation, and requires far fewer parts than conventional engines and prior art rotary engines, resulting in lower weight and lower cost of production and maintenance.

Fuel may be introduced into the combustion chambers by way of a carburation device that mixes fuel and air, or the fuel may be injected into the combustion chambers separately from the air. The air may also be compressed by a separate compressor and introduced into the combustion chamber under pressure. **(does this have to be a separate claim?)**

The cooling system of this rotary engine may be cooled by means of a liquid cooling system , or by an air cooling system, or by a combination of these two systems. In the liquid cooling system, the coolant is circulated in the cavity formed behind the sinusoidal chamber walls and within the side walls and then to a radiation device and back into the engine.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic explanatory view for the inside of the rotary engine taken along a longitudinal cross section of the engine;

FIG. 2 is a perspective view of the outside of the rotary engine;

FIG. 3 is a perspective view of the rotor ring;

FIG. 4a is a perspective view of the reciprocating shuttle/vane;

FIG. 4b is an explanatory view of the reciprocating shuttle/vane seal and spring;

FIG. 5 is a schematic explanatory view for the inside of the ring shaped rotary engine taken along a perpendicular cross section of the engine;

FIG. 6a is an explanatory view for showing the beginning of both the combustion stroke and the exhaust stroke and the end of both the compression stroke and intake suction stroke;

FIG. 6b is an explanatory view for showing the middle of the combustion stroke and the exhaust stroke, and before the intake suction stroke;

FIG. 6c is an explanatory view for showing the end of both the combustion stroke and exhaust stroke, and the beginning of both the intake suction stroke and the compression stroke;

FIG. 6d is an explanatory view for showing between the exhaust stroke and the combustion stroke, and the middle of the intake suction stroke and the compression stroke;

FIG. 7 is an explanatory view for showing an embodiment of the present invention in which the rotor and chambers have been rotated 90 degrees from the previous embodiment;

FIG. 8 is an explanatory view for showing an embodiment of the present invention in which power is derived from compressed or expanding liquids or gases.

LIST OF REFERENCE NUMERALS

2	Upper Sinusoidal Chamber Wall
2'	Lower Sinusoidal Chamber Wall
3	Rotor
4	Upper Vane/Shuttle Seal
4'	Lower Vane/Shuttle Seal
5	Vane/Shuttle
6	Rotor Top Seal

6'	Rotor Bottom Seal
7	Vane/Shuttle Side Seal
8	Compressed Fuel Communication Channel
9	Compressed Fuel Communication Channel Check Valve
10	Exhaust Port
10'	Lower Exhaust Port
11	Intake Port
11'	Lower Intake Port
12	Exhaust Line
12'	Lower Exhaust Line
13	Intake Line
13'	Lower Intake Line
14	Shuttle Top Seal Spring
15	Shuttle/Vane Channel
15b	Shuttle/Vane Seal Channel
16	Spark Plug/Ignition Device
17	Inlet Port
17'	Lower Inlet Port
18	Sinusoidal Chamber Wall Seal Tensioning Spring
19	Sinusoidal Chamber Wall Seal
19'	Lower Sinusoidal Chamber Wall Seal
20	Inlet Line
20'	Lower Inlet Line
21	Inner Upper Side Wall
21'	Inner Lower Side Wall
22	Outer Upper Side Wall
21'	Outer Lower Side Wall
23	Shuttle Top Seal Spring
24	Housing
25	Rotor Gear Teeth
30	Compression Chamber
30	Lower Compression Chamber
31	Exhaust Chamber
31'	Lower Exhaust Chamber
33	Fuel/Air Intake Chamber
33'	Lower Fuel/Air Intake Chamber
34	Fuel Air Compression Chamber
34'	Lower Fuel Air Compression Chamber
35.	Expansion Chamber
35'	Lower Expansion Chamber

DESCRIPTION OF THE PREFERRED EMBODIMENTS

and interior facing surface of the upper outer side wall 22 (**not shown, see FIG. 5**).

Fuel/air intake chamber 33 is formed between interior facing surface of the lower sinusoidal chamber wall 2', the lower flat surface of the ring shaped rotor 3, the lower trailing edge of the rotor shuttle 5, the interior facing surface of the lower inside side wall 21', and the interior facing surface of the lower outer side wall 22' (**not shown, see FIG. 5**).

Fuel/air compression chamber 34, is formed between the interior facing surface of the lower sinusoidal chamber wall 2', the lower flat surface of the ring shaped rotor 3, the lower leading edge of the rotor shuttle 5, the interior facing surface of the lower inside side wall 21', and the interior facing surface of the lower outer side wall 22' (**not shown, see FIG. 5**).

The position of the shuttle shown is near the end of the combustion and exhaust cycle above the rotor 3 and the beginning of the intake and compression cycles on the lower side of the rotor 3. The fuel air mix is drawn in through intake port 13 into intake chamber 33 by the vacuum created as the shuttle progresses the rotor from left to right, and as the shuttle travels up or down within shuttle channel 15 and follows the contour of the sinusoidal chamber wall. Simultaneously, fuel/air is being compressed ahead of the shuttle 5 in compression chamber 34. Above rotor 3, the combustion cycle is nearing it's conclusion in combustion chamber 30 as the pressure forces of said combustion moves the rotor to the right by exerting pressure upon the trailing side of shuttle 5 and simultaneously forces the exhaust in exhaust chamber 31 out through exhaust port 10.

Sealing of combustion and exhaust functions is accomplished by upper rotor seals 6, shuttle side seals 9, shuttle top seal 4, and the upper sinusoidal wall seals 19.

Sealing of intake and compression functions is accomplished by lower rotor seals 6', shuttle side seals 9, shuttle bottom seal 4', and the lower sinusoidal wall seal 19'.

The compressed fuel air mixture is transferred from compression chamber 34 by way of the compressed fuel communication channels 8, which are sealed by check valves 9, until the end of the compression cycle, at which time said check valves open allowing the compression fuel air mixture to communicate through to combustion chamber 30. The compressed fuel communication channels 8 are machined through the rotor 3 at an angle to allow said compressed fuel communication channels to originate before the lower leading edge of the shuttle 5 and to circumvent shuttle 5 emerging just behind the upper trailing edge of said shuttle.

Ignition is accomplished by a spark plug or other ignition device 16.

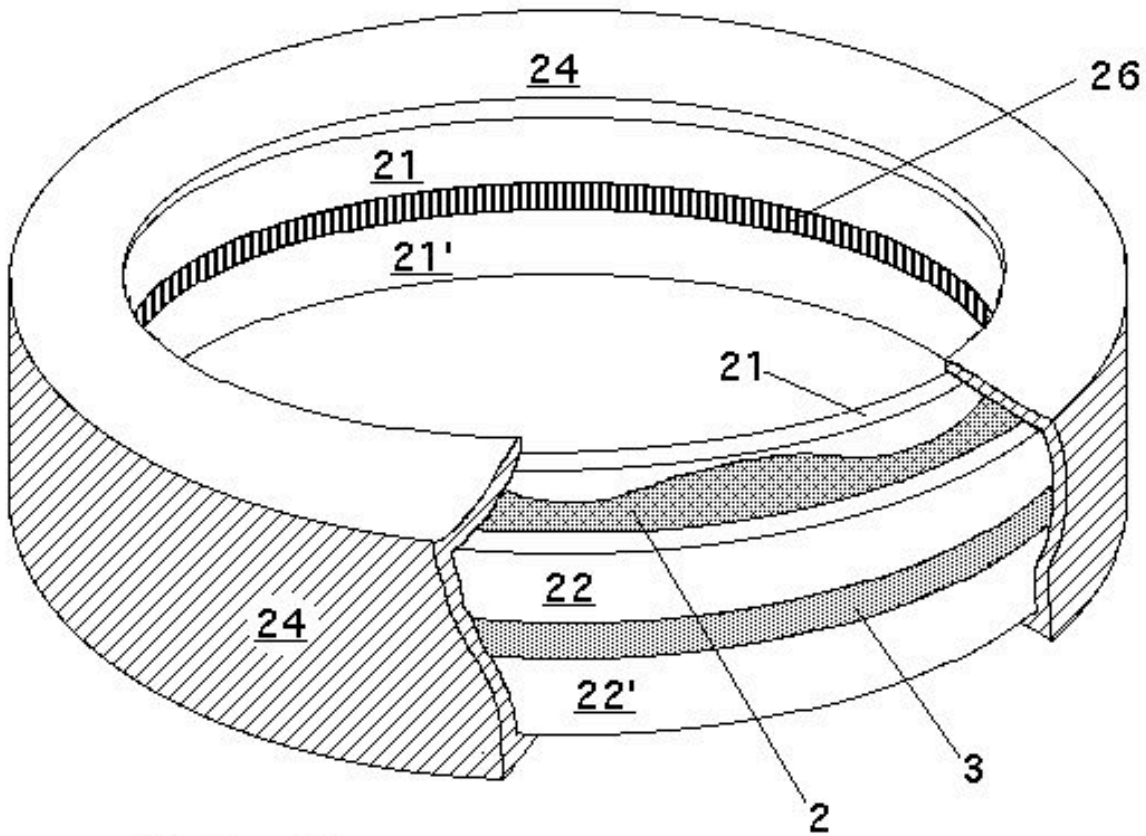


FIG. 2

FIG. 2 is a perspective view of the outside of the rotary engine according to the present invention. The engine housing 24, is shown with a cutaway to expose the upper outer side wall 22, and the outer lower side wall 22', the top of the upper sinusoidal chamber wall 2, and the rotor 3. In this particular embodiment, gears 26 are shown on the inside of the rotor 3, as one means for coupling the movement of the rotor to other mechanical mechanisms. **Another embodiment of the present invention would allow for gears to be machined on the outside edge of the rotor 3. In another embodiment, cooling ribs could be attached to or machined into the inside edge of the rotor 3.** The housing 24 serves to hold the upper side walls 21 and 22, the rotor 3, and the lower side walls 21' and 22' in place. This could also be accomplished by other means such as coupling bolts, allowing for more efficient air cooling with the addition of cooling ribs to both the inside and outside of the rotor 3.

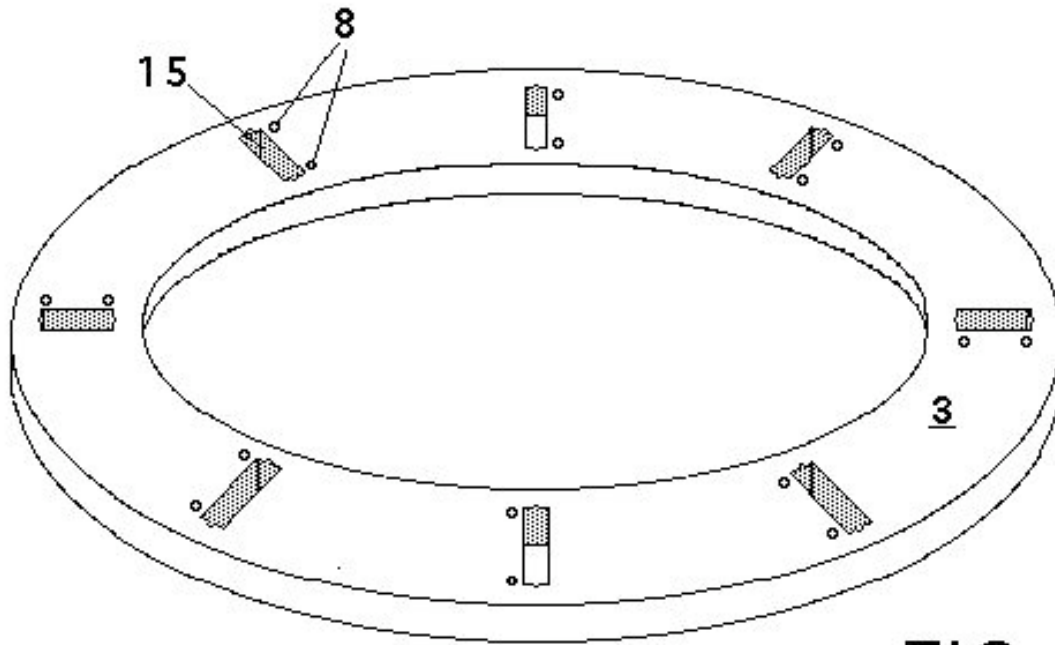


FIG. 3a

FIG. 3 is a perspective view of the rotor ring 3 that separates the sinusoidal housings and provides channels 15 for the movement of the reciprocating vanes (not shown) and compressed fuel communication channels 8 for of the rotary engine.

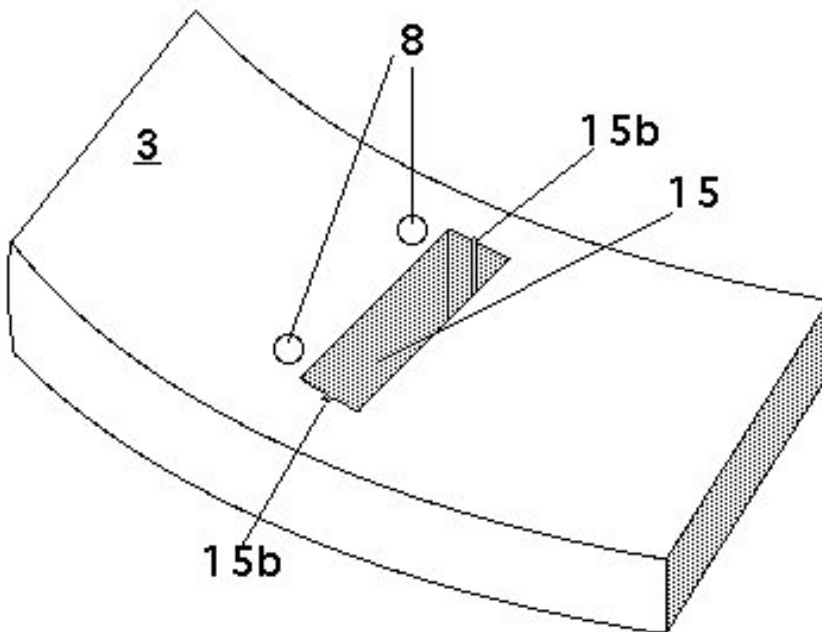


FIG. 3b

FIG. 3b is an enlargement of a section of the perspective view of the rotor ring 3 in FIG. 3 to demonstrate that there are guide channels 15b to accommodate the side seals 6 machined into the side walls of the shuttle channel of the shuttle 4 (not shown).

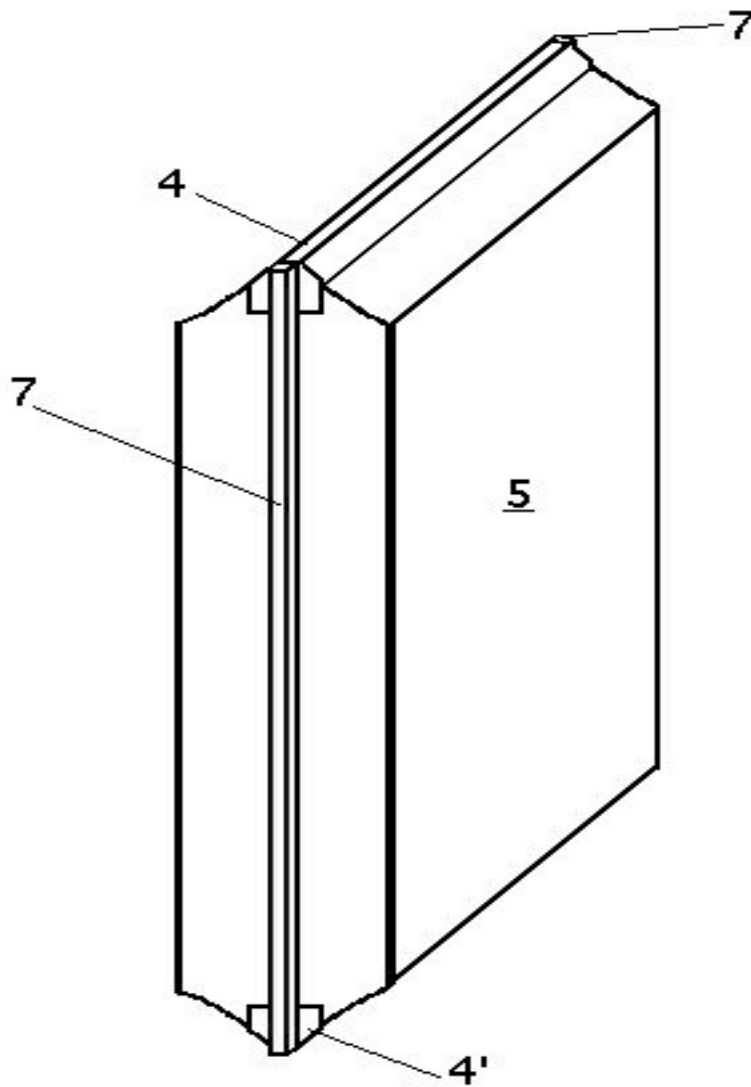


FIG. 4a

FIG. 4a is a perspective view of the reciprocating vane 5 with side seals 7 and upper seal 4 and lower seal 4'. The seals are constructed of resilient steel and the upper and lower seals 4 and 4' are held in dynamic tension by a spring (shown in FIG. 4b) against the inside of the upper and lower sinusoidal chamber walls (see FIG 1).

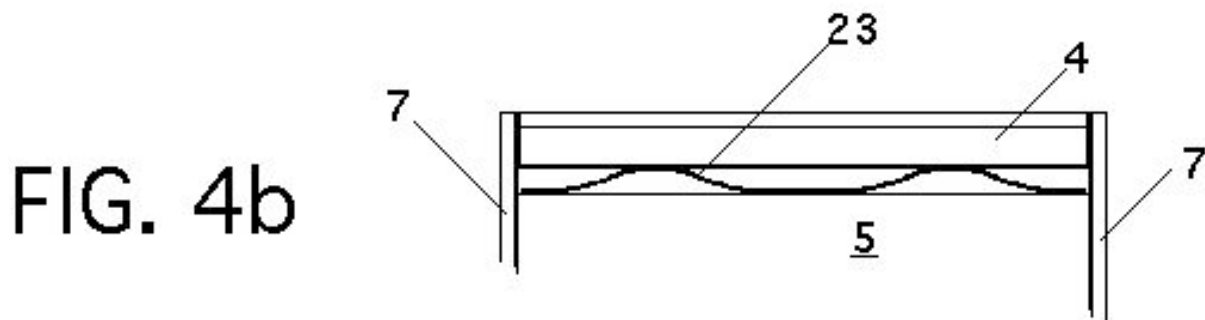


FIG. 4b

FIG. 4b is a side view of the shuttle top seal spring 23 which provides dynamic tension against the inside of the sinusoidal chamber wall 2 (**not shown see FIG 1**) for the shuttle 5 as it progresses.

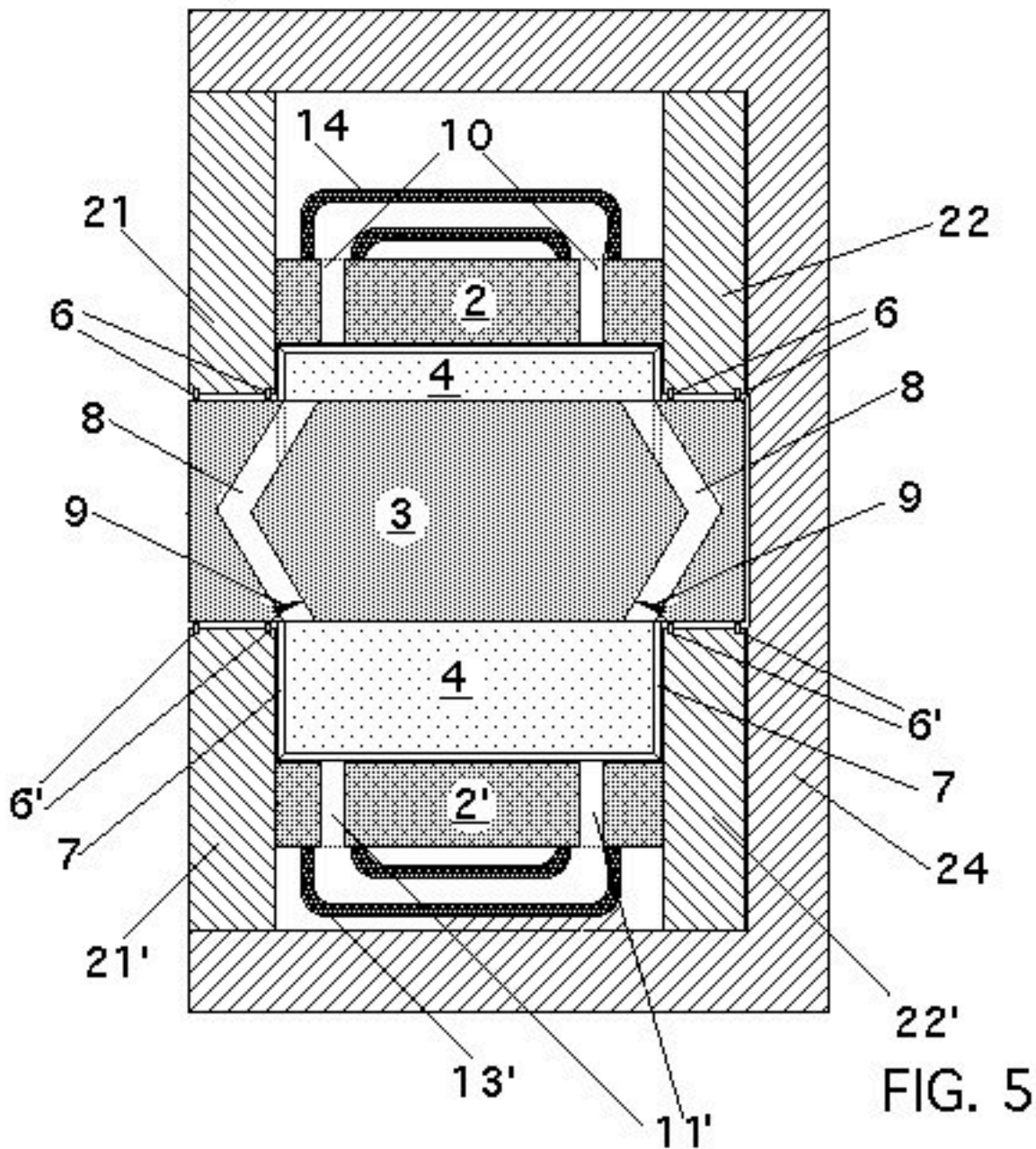


FIG. 5 is a schematic explanatory view for the inside of the ring shaped rotary engine **according to the present invention** taken along a perpendicular **or radial** cross section of the engine. The shuttle 4 is shown positioned at the low point of the sinusoidal chamber walls 2 and 2'. The compressed fuel communication channels 8 are machined through the rotor 3 at angles to allow said compressed fuel communication channels to circumvent said shuttle.

The exhaust ports 10 communicate to the exhaust gas line 14. Said exhaust line can exit the engine through either the inner upper side wall 21, or through the top of the engine housing according to how the engine is to be utilized. The fuel/air intake line 13 communicate to the fuel/air intake ports 11. **The intake line 13 may carry only air when fuel injection (not shown) is used or a fuel air mix when carburation (not shown) is used.**

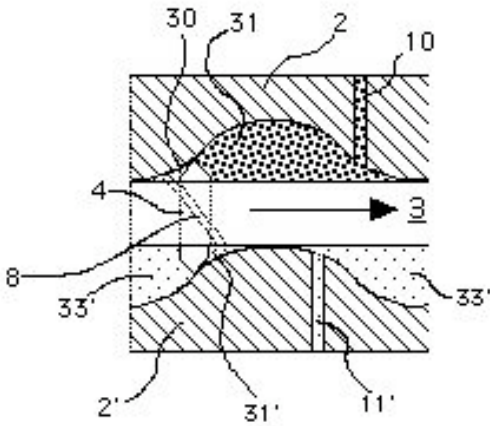


FIG. 6a

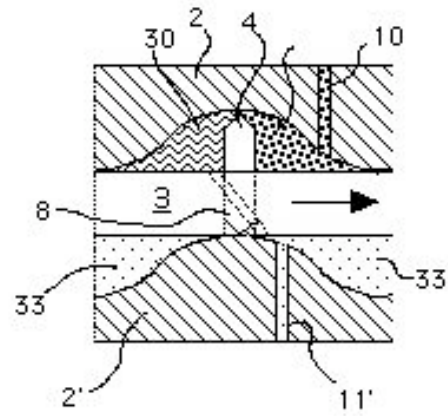


FIG. 6b

FIG. 6a is an explanatory view for showing the beginning of the combustion cycle in combustion chamber 30, and the beginning of the exhaust cycle in the exhaust chamber 31. The end of the compression cycle is occurring in compression chamber 34 and the end of the intake suction cycle is occurring in the intake chamber 33. At this point in the cycle the compressed fuel communication channel check valve 9 (see figure 1), has just opened, allowing the compressed fuel to travel up into the compressed fuel communication channel 8, and into said combustion chamber. Immediately following this movement of compressed fuel/air, the fuel mix is ignited by the spark plug or other ignition device 16 (see figure 1). The explosion of fuel and air forces the shuttle and rotor to travel from left to right reducing the volume of chamber 31 and forcing the exhaust gases remaining in chamber 31 to exit through exhaust port 10.

FIG. 6b is an explanatory view for showing the middle of the combustion cycle in the upper chamber 30 and the exhaust cycle in chamber 31 and also showing the conclusion of the intake suction cycle.

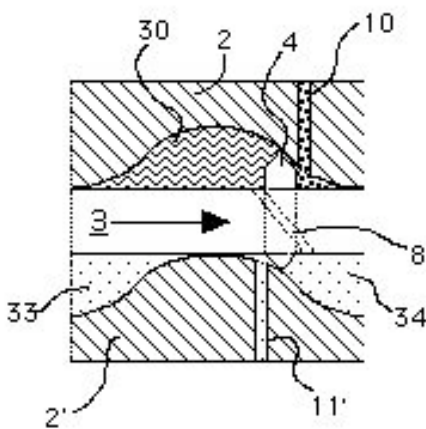


FIG. 6c

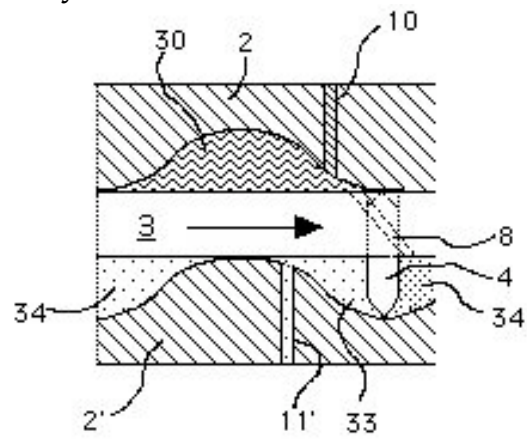


FIG. 6d

FIG. 6c is an explanatory view for showing near the end of both the combustion cycle in chamber 30 and exhaust cycle in chamber 31. Also shown is the beginning of both the intake suction cycle and the compression cycle in the lower chambers 33 and 34. The leading edge of the bottom of the shuttle 4 has just entered the lower slope of the lower sinusoidal shaped chamber wall 2' forming compression chamber 34 ahead of the shuttle 4, and simultaneously, the lower trailing edge of shuttle 4 has formed intake chamber 33. As the movement of the rotor 2 and shuttle 4 progress the volume of chamber 33 is expanded, drawing in the fuel air mix, and the volume of chamber 34 is reduced, compressing the fuel air mix remaining in the chamber from the previous cycle.

FIG. 6d is an explanatory view for showing the conclusion of the combustion cycle in the upper chambers and the middle of the intake suction cycle in chamber 33, and the compression cycle in chamber 34. The explosion of fuel in chamber 30 has completed and gases are allowed to begin to exit through exhaust port 10.

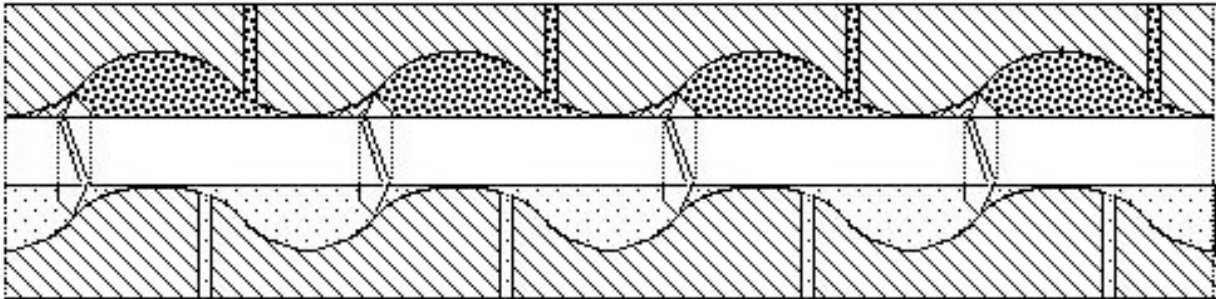


FIG. 6e

FIG. 6e is an view for showing the simultaneous movement of multiple cells, shown here in the beginning phase.

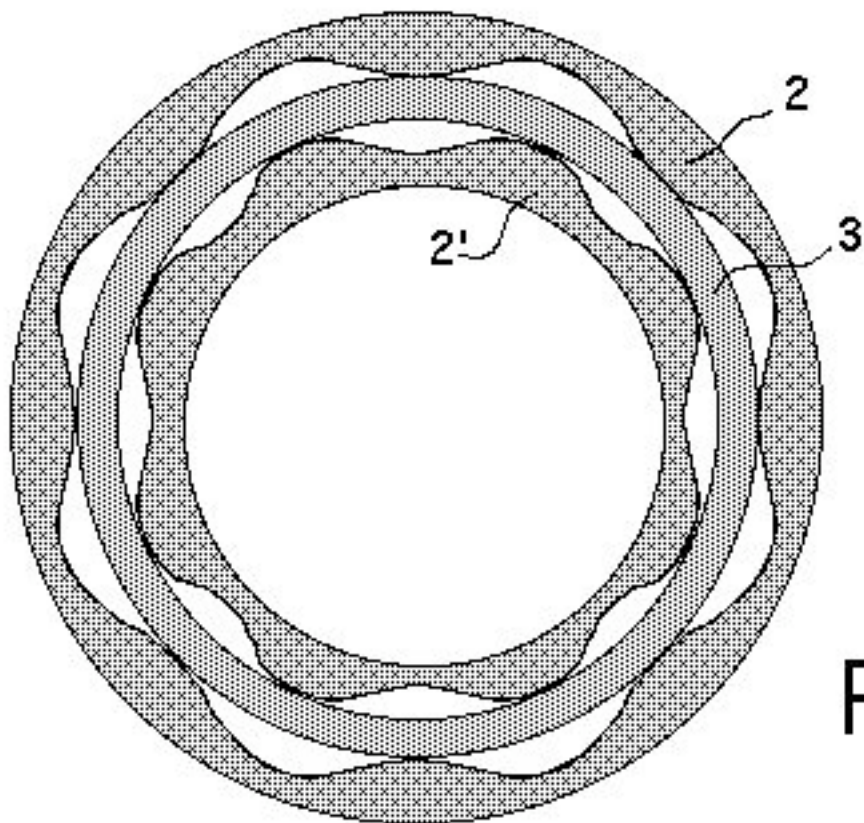
**FIG. 7**

FIG. 7 is an explanatory view for showing an embodiment of the present invention in which the rotor 3, and sinusoidal chamber walls 2 & 2'' have been rotated 90 degrees from the previous embodiment.

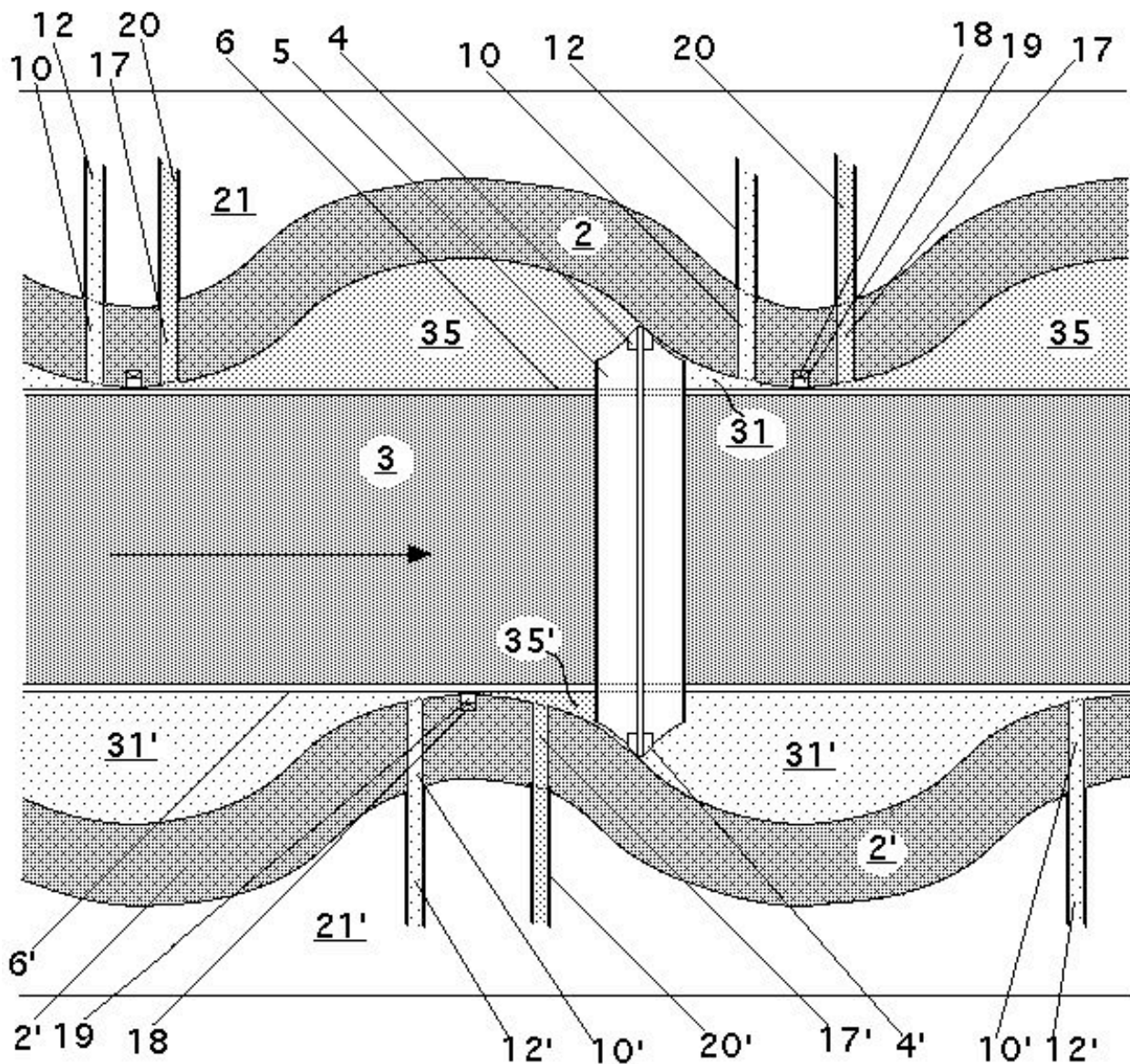


FIG. 8

FIG. 8 is an explanatory view for showing an embodiment of the present invention in which power is derived from compressed or expanding liquids, refrigerants, or gases (hereafter referred to as GAS) . FIG 8 shows the shuttle 5 approaching of the end of the expansion cycle above the rotor 3 and the beginning of the expansion cycle below the rotor 3. The GAS has entered through input port 17 behind (to the left of) the top of the shuttle 5 and is nearing the end of it's expansion phase (about 90%) and has pushed the shuttle 5 toward the end of the expansion chamber 35 thus transferring motive power to the rotor 3. This has also facilitated the evacuation of 90% of the already expanded GAS from exhaust chambers 31 through the exhaust ports 10 ahead of (to the right of) the shuttle.

Simultaneously, compressed GAS is just entering the lower expansion chamber 35' from inlet port 17' behind (to the left of) the bottom portion of

the shuttle 5 and is at the beginning of the expansion phase. The GAS in the space of the chamber in front of (to the right of) the bottom of the shuttle 5 in exhaust chamber 31' has already fully expanded from the last pass of the shuttle 5 and is beginning to be exhausted out of the chamber through the exhaust ports 10' by the movement of rotor 3 and the shuttle 5 as it approaches the exhaust port 10'.

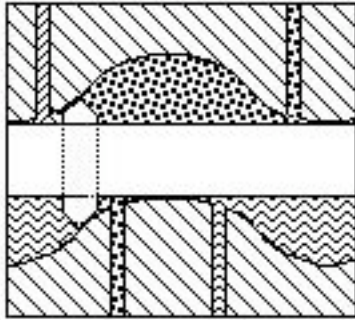


FIG. 9a

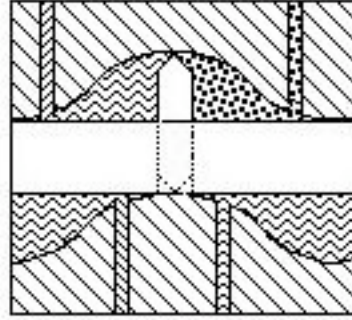


FIG. 9b

FIG. 9.a is an explanatory view for showing air, steam, or refrigerant under pressure (collectively referred to hereafter as "GAS") as it is about to enter the upper chamber behind (to the left of) the top shuttle and is at the beginning of the expansion phase. The GAS in the space of the chamber in front of (to the top right of) the top shuttle has already fully expanded from the last pass of the shuttle and is about to be exhausted out of the chamber through the exhaust ports.

The GAS behind (to the bottom left of) the bottom shuttle is nearing the end of its expansion phase (about 85%) and has pushed the shuttle and shuttle ring toward the end of the chamber. This has also facilitated the evacuation of 85% of the already expanded GAS through the exhaust ports ahead of (to the bottom right of) the shuttle.

9.b Compressed GAS has entered the upper chamber behind (to the top left of) the top shuttle and is about 50% onto the expansion phase. The GAS in the space of the chamber in front of (to the top right of) the top shuttle is now 50% exhausted through the exhaust ports.

The GAS behind (to the bottom left of) the bottom shuttle is at the end of its expansion phase and has pushed the shuttle and shuttle ring toward the end of the chamber. This has also facilitated the evacuation of all of the already expanded GAS from the previous cycle through the exhaust ports ahead of (to the bottom right of) the shuttle.

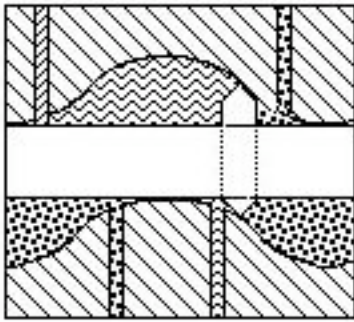


FIG. 9c

9.c The GAS behind (to the top left of) the top shuttle and is about 80% into the expansion phase. The GAS in the space of the chamber in front of (to the right of) the top shuttle is now 80% exhausted through the exhaust ports to the top right of the shuttle.

The GAS behind (to the bottom left of) the bottom shuttle is just past top dead center of the sinusoidal chamber wall. The bottom chambers are filled with fully expanded GAS which is now at ambient pressure since the opening of the exhaust port on the right side of the bottom chamber is fully exposed to the gas.

9.d The GAS behind (to the top left of) the top shuttle is at the end of it's expansion phase and has pushed the shuttle and shuttle ring past the end of the top chamber.

Compressed GAS is 50% into the bottom chamber behind (to the bottom left of) the bottom of the shuttle and is 50% into the expansion phase. The GAS in the space of the chamber in front of (to the bottom right of) the bottom shuttle has already fully expanded from the last pass of the shuttle and is about 50% exhausted out of the chamber through the exhaust ports.

When this engine design is powered by compressed gas, the communication channels and check valves which are necessary in the internal combustion may be eliminated resulting in an even simpler engine. In addition, both the upper and lower chambers may be utilized for expansion and propulsion, or the upper chambers may be used for propulsion and the lower chambers for pumping gas or liquids.

SUMMARY OF THE INVENTION

The engine of this invention is entirely different from the known rotary-reciprocal type engine in that the piston of previous conventional engines has been replaced with a reciprocating vane of considerably less mass than typical reciprocating engines and less mass than rotary-reciprocal pistons in prior art and is moved in and out of the chamber by following the sinusoidal contour of the chamber (figure 3.a) sealed by the pressure

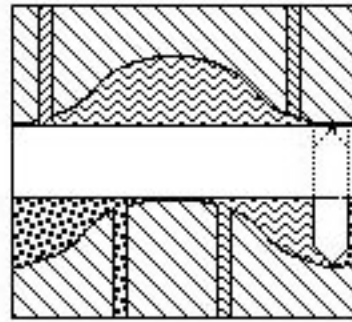


FIG. 9d

provided by an internal metal spring. The engine of this invention requires only one reciprocating vane per chamber, resulting in less friction losses, and reduced maintenance costs.

The ignition system for this rotary engine may consist of any suitable method to ignite the fuel in the combustion chambers by means of an electrical spark or heat.

Any suitable fuel may be utilized in the engine of this invention, suitable fuels include but are not limited to organic gases such as butane, methane, ethane, and propane, alcohols such as methanol, ethanol, propanol etc., gasoline or hydrogen.

The cooling system of this rotary engine may utilize a liquid coolant or air or a combination of the two.

IMPLOSION

When this engine design is used with implosion fuels such as Brown's gas (a stoichiometric gas of mono atomic oxygen and mono atomic hydrogen), ignition occurs when the shuttle has just entered the chamber. (When Brown's gas implodes, there is an 1800 to 1 reduction in volume, resulting in strong implosive forces.) The resulting implosion causes the shuttle to be drawn forward by the pressure differential behind the shuttle and the resulting vacuum ahead of it.

The implosion force is initiated by a spark/ignition device located just past the input port. These are fired shortly after the fuel has been injected and the shuttle has passed the spark/ignition device. The fuel input port will have a reciprocating valve which will open for fuel injection and close just before ignition.

While the invention has been described with respect to a limited number of embodiments, it will be appreciated that many variations, modifications and other applications of the invention may be made.

Inventor: Gary Allen Schwartz

Variations/ alternative embodiments

One internal combustion version may be a diesel design.

This is an engine that may be driven by the stoichiometric mixture of hydrogen and oxygen known as "Brown's Gas."

The shuttle itself may be constructed entirely or partially of **magnetic** material, acting as the magnetic rotor so as to generate electric current in windings which surround the ring shaped chamber walls (figure 8.)
or by magnets imbedded in the spring chamber of the shuttle (figure 4).