July 9, 1963 S. F. THOMPSON 3,096,745

ROTARY ENGINE

Filed July 9, 1956 2 Sheets-Sheet 1

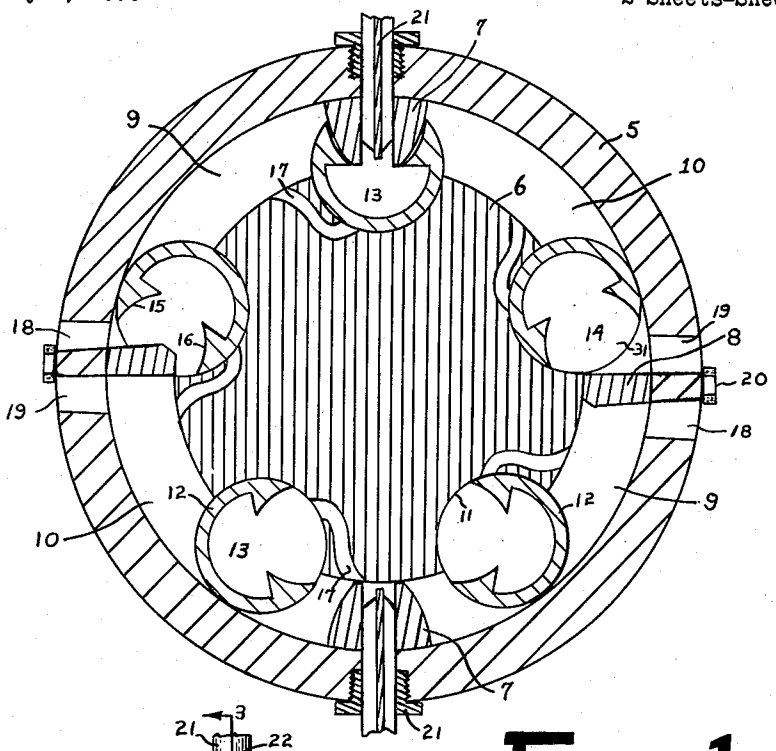


Fig 1

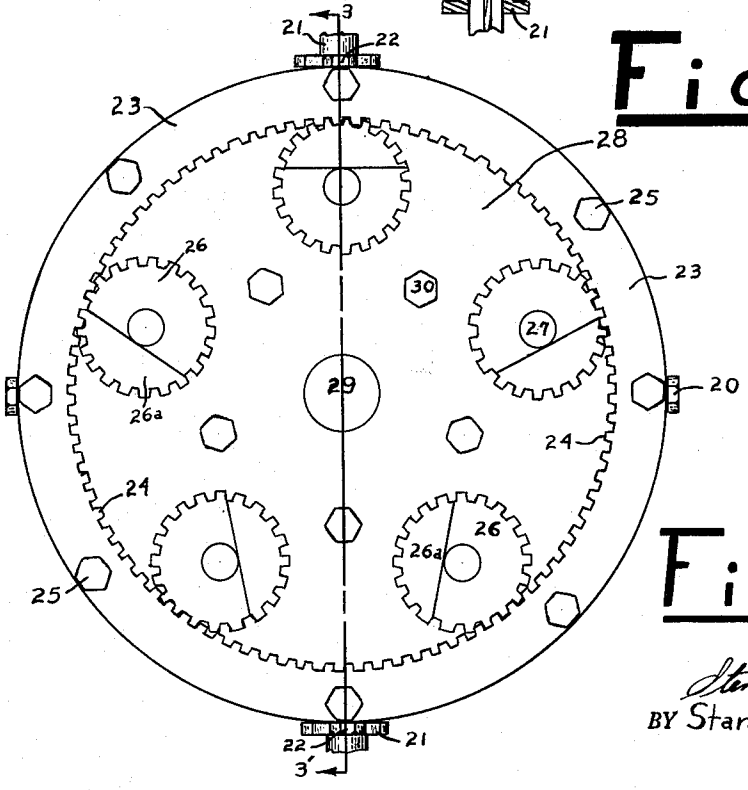


Fig 2

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ROTARY ENGINE

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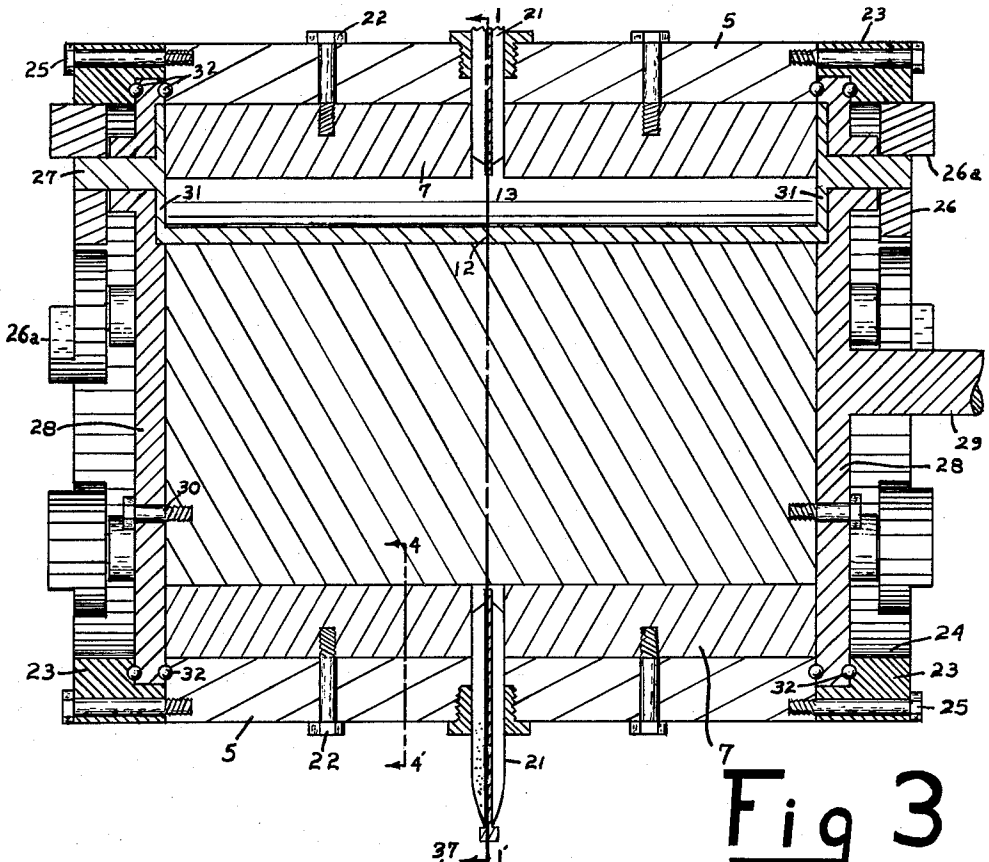


Fig 3

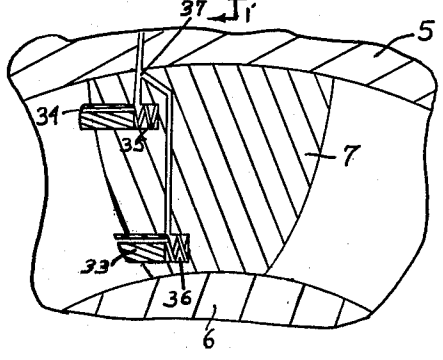


Fig 4

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ROTARY ENGINE

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My invention relates to improvement in rotary engines.

The primary object of my invention is to provide a rotary engine of high efficiency which is simple in construction and operation.

Another object of my invention is to provide a rotary engine in which there is a minimum leakage of the gases of the various cycles and a minimum mixing of gases of the various cycles.

A further object of my invention is to provide a rotary engine in which the reaction force of the expanding gases is utilized.

An additional object of my invention is to provide a rotary engine in which the bearing load is maintained and supported on or near the periphery of the rotating parts.

Further and additional objects and advantages of my invention will appear during the course of the following description.

In the accompanying drawings, forming a part of this application, and in which like numerals are employed to designate like parts throughout the same,

FIGURE 1 is a sectional view taken along the line 1—1¹ as shown in FIGURE 3,

FIGURE 2 is an external view showing the gearing arrangement turning the planetary pistons,

FIGURE 3 is a sectional view taken along the line 3—3¹ as shown in FIGURE 2, and

FIGURE 4 is an enlarged fragmentary view of a cross section of one of the compression-power abutments taken along the line 4—4¹ as shown in FIGURE 3, showing sealing bars and a lubrication means which was not included in FIGURE 2 in order to avoid confusion.

In the drawings, wherein for the purpose of illustration, is shown a preferred embodiment of my invention, the numeral **5** designates a stationary housing which is of hollow cylindrical construction. In the drawings intake and exhaust manifolding means are not shown however it should be understood that they may be provided. Located within the stator **5** is a piston housing rotor **6**, the diameter of which is less than the diameter of the inner wall of the stator **5** thus forming between the rotor and stator an annular chamber in which there protrudes compression—power abutments **7** and exhaust—intake abutments **8**. The annular chamber **9** formed clockwise of the exhaust-intake abutments **8** and counter clockwise of the compression-power abutments **7** functions both as an intake chamber and as a compression chamber. The annular chambers **10** formed counter clockwise of the exhaust-intake abutments **8** and clockwise of the compression-power abutments **7** function both as a power chamber and an exhaust chamber.

Located within troughs **11** of the piston housing rotor **6** are planetating hollow pistons **12**. The piston housing **6** and the pistons **12** thus form the engine rotor assembly.

Within the planetating piston **12** is located chamber **13**. It is within this chamber that the ignition of the gases takes place. An aperture **14** is formed between surface **15** and surface **16** of the piston **12** and allows the piston **12** to pass over the abutments **7** and **8** and at the same time to maintain an effective pressure seal between the respective abutments and surfaces of the piston **12**.

Passages **17** are provided in the piston housing rotor **6** to allow the gases expanding within chamber **13** to pass to power chamber **10** when the rotation of the piston **12** has progressed to the point that direct communication is no longer maintained between chamber **13** and

power chamber **10**. At this point the gases still combusting within combustion chamber **13** are contained entirely within the engine rotor assembly. Therefore the passages **17** have been designed so that the rotor may utilize the reaction forces of the expanding gases as they pass from chamber **13** and into power chamber **10**.

Intake port **18** is provided on the clockwise side of abutment **8** and exhaust port **19** is provided on the counter clockwise side. Bolts **20** secure abutments **8** to the stator **5**. When manifolding is provided these bolts will also help secure the manifold but of course would be longer in length. Passing through the stator **5** and abutments **7** are spark plugs **21**. Bolts **22** secure abutments **7** to the stator **5**.

Referring now to FIGURE 2 a sealing ring **23** which has internal ring gear teeth **24** cut into its inner periphery is secured to the stator **5** by means of bolts **25**. Meshing with the internal ring gear teeth **24** are the teeth of spur gears **26** which are secured to axles **27** of the rotating pistons **12**. Made a part of spur gears **26** are balancing weights **26***a* which are so placed and designed as to insure static and dynamic balance of the rotating parts.

On one of the rotating power plates **28** is a power take off shaft **29**. Power plates **28** are secured to the piston housing rotor **6** by bolts **30**. Recessed into the power plates **28** are the piston ends **31** of the planetating piston **12**. The inner surface of the piston ends **31** is flush with the inner surface of power plates **28** thus allowing the ends of abutments **7** and **8** to smoothly pass over the area where these surfaces meet. Bearings **32** located near the periphery of the power plates **28** support the thrust load on the engine and the rolling pistons **12** support the radial load. This arrangement makes it unnecessary for a bearing to support the center shaft when a center shaft is provided.

Referring to FIGURE 4 sealing bars **33** are housed within recesses **36** of abutments **7**. Passages **34** are provided in the sealing bars **33** through which a measured amount of oil is dispensed onto the sliding surface **16** of the piston **12** when the sealing bar **33** is forced against the spring **35** and into its housing recess **36**. This action cuts off direct communication with oil line **37** and forces a measured amount of oil through passage **34** and onto surface **16** of the piston **12** thus lubricating this surface and at the same time maintaining an effective pressure seal.

Operation

My engine operates on a four cycle principle. The operation given here is on the Otto cycle, however it is to be understood that the engine will function equally well on any of the other four cycle principles known to the arts. The operation of the engine is very simple since there are no cam shafts, piston rods, poppet valves, etc. necessary for its operation. A very important part of the invention is that the engine has been designed so that each piston is engaged constantly in performing two cycles and alternates between the intake-compression function and the power-exhaust function. This allows the pistons to be cooled by the incoming gases between each power-exhaust function. The arrangement of the cycles with relation to the planetating pistons helps to prevent leakage of the gases from one cycle to the next and any leakage that does occur is normally returned to the next cycle and utilized by the following piston.

The annular chambers between the stationary abutments are dual purpose in that each is utilized in two of the four cycles and when reference is made to one of the annular chambers its function at the time will usually be mentioned.

As one of the planetating pistons rolls along the internal periphery of the stator **5** and passes the intake port **18**

it creates a partial vacuum in annular intake chamber 9 behind the piston 12 and compresses the gases in front of it in the annular compression chamber 9 which have been drawn in by the preceding piston. It will be noted that there is never an opportunity for the gases being compressed to flow back through passage 17 in the piston housing rotor 6 since communication between this passage 17 and the compression chamber 9 in front of the piston 12 is never allowed.

As the piston 12 continues to move through intake and compression chamber 9 and rotates on its axis direct communication is allowed between the compression chamber 9 (in front of the piston 12) the combustion chamber 13 within the planetating piston 12 before the planetating piston 12 reaches abutment 7. This starts the transfer of the combustible mixture from compression chamber 9 into combustion chamber 13. As the orbital movement continues abutment 7 is received in aperture 14 of the piston 12 and the transfer of the combustible mixture into the combustion chamber is complete. It will be noted that due to the design of the engine and the positions of the various cycles with relation to the planetating piston 12 that leakage between the various cycles is minimized and that any leakage that does occur is transferred to the next cycle. Any tendency for the compressed gases within combustion chamber 13 to leak past abutment 7 and surface 15 of the piston 12 is minimized since the gases in power chamber 10 still are under pressure from the proceeding power cycle and there is little relative pressure difference between power chamber 10 and combustion chamber 13. This condition exists until the piston of the preceding cycle passes exhaust port 19 and allows direct communication between this port and the former power chamber 10 which now becomes exhaust chamber 10. By the time that this has occurred, the outer periphery of piston 12 has made contact with the inner periphery of the stator 7 and a positive pressure seal assured.

Leakage between combustion chamber 13 and compression chamber 9 is minimized through the use of reciprocating sealing bars 33. Although the use of the sealing bars is desired they are not essential to the operation of the engine since surface 16 of the piston 12 maintains close contact with the counter clockwise surface of abutment 7. However any leakage that might occur is trapped by the following piston which has already cut off communication with intake port 18 and is used in the next cycle.

When the compression of the combustible mixture within chamber 13 has been completed, ignition takes place through the use of spark plug 21 in abutment 7. The expanding gases cause rotation of the rotor 6 and as the piston 12 withdraws from the abutment 7 a seal is reestablished between the base of abutment 7 and the piston housing rotor 6. Due to the design of the engine there is never direct communication between the combustion chamber 13 and compression chamber 9 through passage 17.

As the orbital motion of the planetating piston continues, the burnt gases of the previous cycle are forced through exhaust port 19 by the advance of the piston 12 through annular chamber 10. When direct communication is lost between combustion chamber 13 and power chamber 10 due to the rotation of piston 12, within its trough 11 of the piston housing rotor 6, communication is reestablished through port 17 and the full effectiveness of the expanding gases is realized since the gases are allowed to pass through port 17 and into the power chamber 10 which is increasing in displacement due to the continual movement of the planetating piston 12. As the gases escape through port 17 of the piston housing rotor 6 into the power chamber 10, the reaction force of the gases is utilized since port 17 is designed to incline at an angle greater than 90° from the direction of rotation of the rotor 6. As the piston 12 continues to rotate within its trough 11 it will be noted that just before direct communication is established between exhaust chamber 10 and combustion chamber 13 that the piston has sealed off communication through port 17 between the combustion chamber 13 and power chamber 10 thus preventing leakage from power chamber 10 to exhaust chamber 10 through passage 17. From this point on and until the planetating piston 12 passes exhaust port 19 the gases in power chamber 10 still provide some useful force.

As the planetating motion of the piston continues it will be noted that the burnt gases remaining within chamber 13 of the piston 12 will be exhausted through exhaust port 19 with the cooperation of abutment 8 and surface 15 of the piston 12 and therefore minimize any leakage of the burnt gases into the intake chamber 9. If desired abutment 8 may be shaped so as to also cooperate with surface 16 of the piston 12 and thus further decrease any tendency for the gases of the exhaust and intake cycles to mix. While this is occurring the piston 12 exposes exhaust port 19 and allows communication of the burnt gases behind the piston in chamber 10 with the exhaust port 19 and the movement of the following piston forces these burnt gases through the exhaust port 19.

Since the above recited operation represents only one half of a revolution of the engine involving only one piston, it therefore follows that there will be two intake, compression, power and exhaust cycles per piston per revolution of the engine. Since the illustrated model is of the five piston variety with four annular chambers there will be 10 complete power strokes per revolution of the engine or five times the number of power strokes that a conventional reciprocating piston four cylinder four cycle engine would produce per revolution.

At this point I would like to bring attention to the fact that due to the design of the engine, there is no necessity for a center bearing located near the center axis of revolution of the engine. In my design the thrust load of the engine is supported by ball bearing assemblies (of course other type bearings will work equally well) near the periphery of the rotating power plates. The radial load is supported by the rolling pistons themselves. Because of this as well as the basic design it is therefore possible to construct an engine of extremely high torque and horsepower per pound of weight of the engine. For example in an engine of my design having 32 cylinders and 38 pistons with a static displacement of only 960 cubic inches there will be 608 complete power cycles per revolution and the engine will displace about 15,360 cubic inch per revolution. This will give an amazing high H.P. to weight ratio as well as smooth operation. An engine of this size could be ring shape with a hollow center and the power would be taken from the engine by means of a ring gear attached to the rotating power plate. External flywheeling is not necessary due to the great number of power pulses per revolution and the lack of reciprocating motion.

In the interest of simplicity a complete cooling and lubrication system has not been shown. However, the engine may be cooled and lubricated by any of the various methods known to the arts.

It should be further noted that any desired compression ratio may be obtained simply by increasing or decreasing the size of the combustion chamber within the planetating piston.

While the aforegoing is preferred construction and operating of my engine it is to be understood that the engine may be constructed in various other ways without departing from the spirit of my invention.

Having thus described my engine I make the following claims:

1. A rotary internal combustion engine comprising a generally cylindrical first member and a concentrically arranged second member, each member having a surface which faces a surface of the other member but is separated therefrom thereby defining therebetween an annu-

lar space, an even number of abutments affixed to said first member and protruding across said space to slidingly contact said surface of said second member, channels in said second member opening toward said surface of said first member, pistons carried by said second member, said pistons being of hollow cylindrical shape and housed in said channels and mounted for rotation relative to said second member, said pistons extending across said space and the outer cylindrical surface of said pistons substantially rollingly contacting said surface of said first member, an opening in the cylindrical walls of said pistons, said first and second members being arranged for relative rotation, said relative rotation of said first and second members and the rotation of said pistons being arranged such that each abutment will engage said opening in the cylindrical walls of said pistons so that said pistons and abutments may pass each other, said openings further communicating with said annular space between said members at some position of piston rotation to permit flow into or out of said hollow interior of said piston, alternate ones of said abutments comprising a first set each having a passage at one side thereof to admit a combustible mixture to said annular space and a passage at the other side thereof to permit the exhaust of an expanded mixture; the others of said abutments comprising a second set having ignition means therein, said relative rotation of said members causing, (1) said pistons receding from said first set of abutments to draw a combustible mixture into said annular space through said inlets, (2) said pistons approaching said second set of abutments to compress said mixture in said annular space to flow into said hollow cylindrical pistons, (3) said pistons which are aligned with said second set of abutments to have the compressed mixture in the hollow piston ignited, (4) said pistons receding from said second set of abutments being forced to move under the influence of the expansion of said ignited mixture flowing from said hollow piston into said annular space and (5) said pistons approaching said first set of abutments expelling said expanded mixture from said annular space.

2. The engine as set forth in claim 1 wherein additional passage means are provided in said second member to communicate said channel with said annular space.

3. The engine as set forth in claim 1 wherein the first member is the stator and the second member is the rotor.

4. A rotary engine comprising a stator, a rotor which defines an annular space therebetween with abutments protruding into the annular space from one of the aforesaid members coacting with pistons carried by the other of the aforesaid members, said abutments dividing said annular space into intake-compression chambers which communicate with an inlet means and motor exhaust chambers which communicate with an outlet means, the coaction of said pistons and abutments forces the compressed fluid into a combustion chamber which communicates with an ignition means, the said combustion chamber communicating with the said rotor which is constructed so that it has passages through which the expanding gases may pass, the passages being so constructed that the engine may take advantage of the reaction force of the gases which pass through the said passages.

5. A rotary engine comprising a stator, a rotor which defines an annular space therebetween with abutments protruding into said annular space from one of the aforesaid members coacting with pistons carried by the other of the aforesaid members, n being total number of abutments of which $\frac{1}{2}n$ are associated with a firing means and $\frac{1}{2}n$ are positioned between an intake and outlet means, the coaction of said pistons and abutments forces the compressed fluid into a combustion chamber which communicates with an ignition means, the said combustion chamber communicating with the said rotor which is constructed so that it has passages through which the expanding gases may pass, the passages within the rotor being so constructed that the engine may utilize the reaction force of the gases which pass through the said passages.

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