United States Patent [19]
Green et al.

[11] **3,871,337**
[45] **Mar. 18, 1975**

[54] **ROTATING CYLINDER INTERNAL COMBUSTION ENGINE**

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[22] Filed: **Sept. 5, 1972**

[21] Appl. No.: **286,294**

[52] **U.S. Cl.** .... **123/8.47,** 123/18 R, 123/43
[51] **Int. Cl.** **F02b 53/00**
[58] **Field of Search** .... 123/8.47, 18, 43 R; 418/34, 164, 265; 91/339

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Attorney, Agent, or Firm—Perry Carvellas, Esq.

[57] **ABSTRACT**

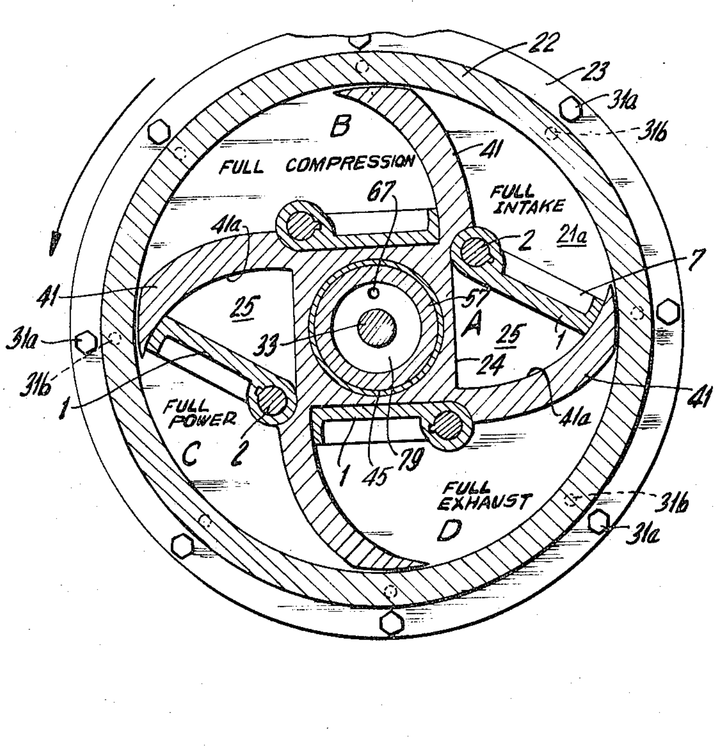
A rotary internal combustion engine comprising an oscillating rectangular piston plate and related fixed and moving parts, a rotary engine body and a stationary engine body. The rotary engine body contains therein the rectangular piston plate carried on a rotatable piston carrier. This piston plate is hinged at one end to a shaft and adapted for inward and outward movement relative to the central axis of the engine. The engine contains a combustion chamber the sides of which are formed by the inner wall of the rotary piston carrier and the surface of the rotary engine body adjacent thereto, the inner disc wall of the stationary engine body, the inner surface of the piston plate and inner surface of the curved member in contact with the outer edge of the piston plate. the rectangular piston plate is fixedly connected to the shaft, which shaft is in turn fixedly connected to a first linking means. The piston plate, shaft and first linking means are movably connected to a second linking means, a throw and a driving gear.

The fixed relationship between the piston plate, shaft and first linking means and their movable relationship with the second linking means, throw and driving gear are such that during the combustion-power cycle, when a compressed fuel-air mixture is burned in the combustion chamber and the piston plate is made to oscillate outwardly, the oscillatory motion of the piston plate is changed to rotary motion of the driving gear.

The driving gear drives against a stationary main gear fixedly connected to the stationary engine body causing rotation of the driving gear, the rotary piston carrier and the rotary engine body around the stationary main gear and relative to the stationary engine body.

The rectangular piston plate is closely dimensioned with respect to the inner wall of the rotary piston carrier, the inner wall of the stationary engine body and inner surface of the curved wall member.

12 Claims, 8 Drawing Figures



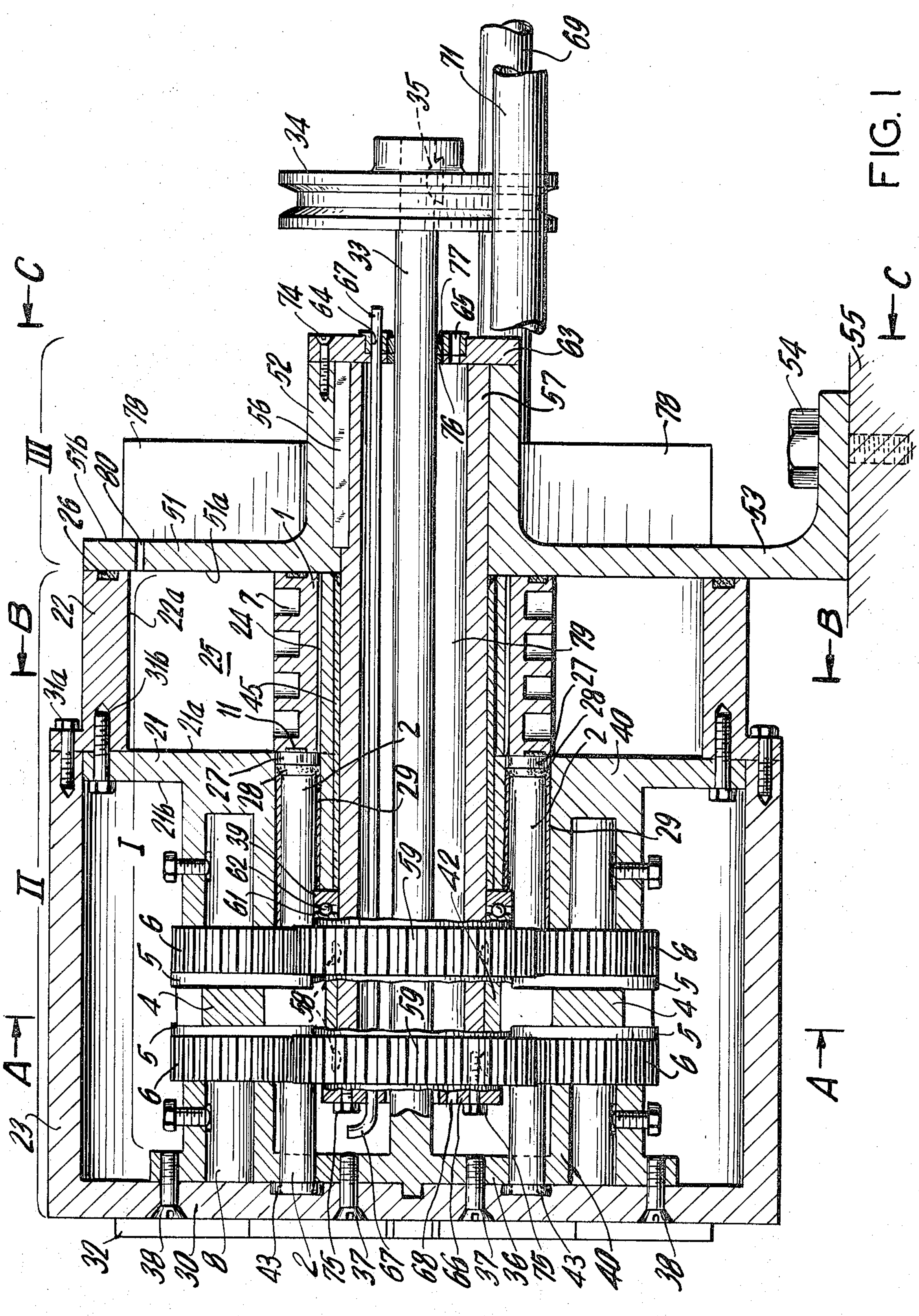
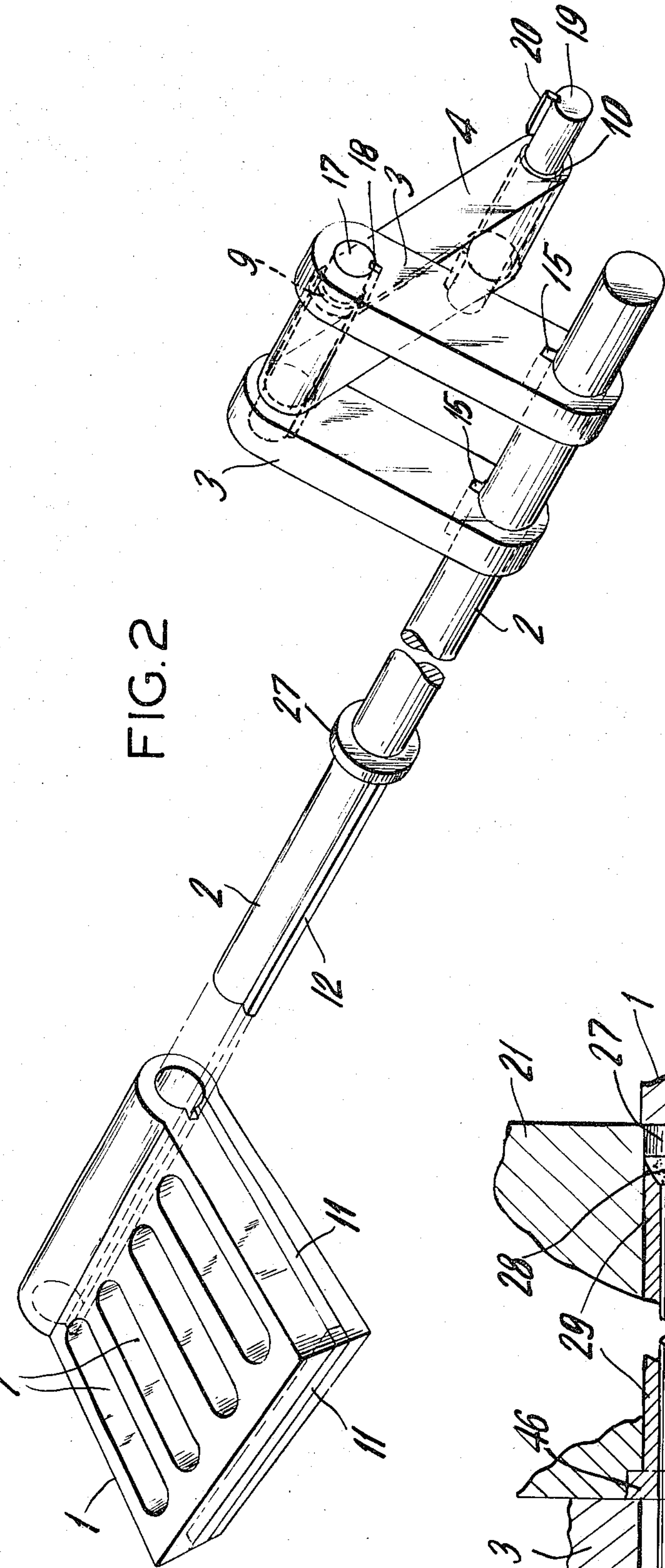


FIG. 1


20
19
4
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17
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3
9
15
15
3
2
27
2
12
11
7
11
1

FIG.2

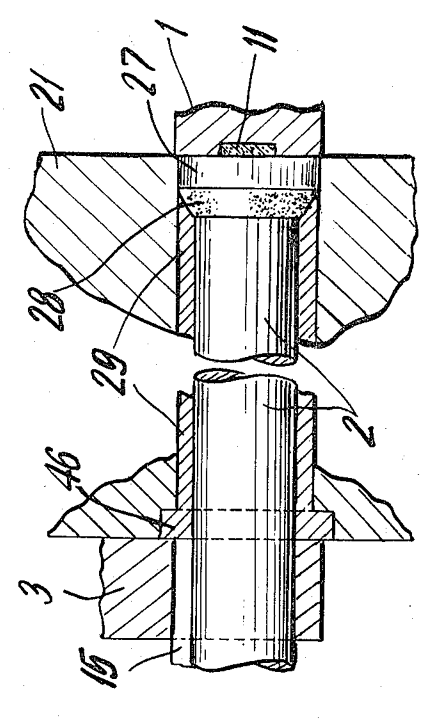
21
27
1
11
28
29
2
29
2
46
3
15

FIG.3

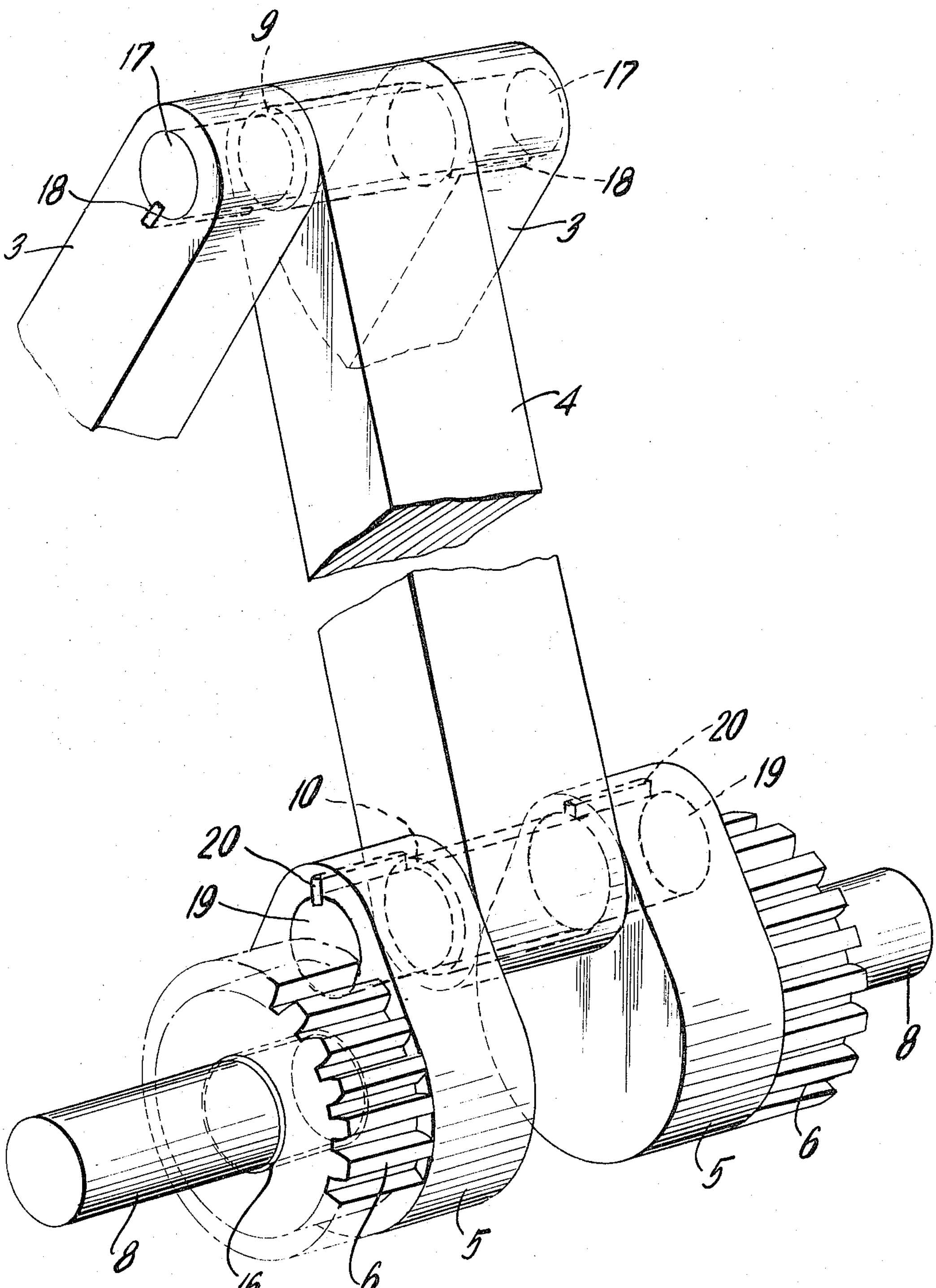

FIG. 4

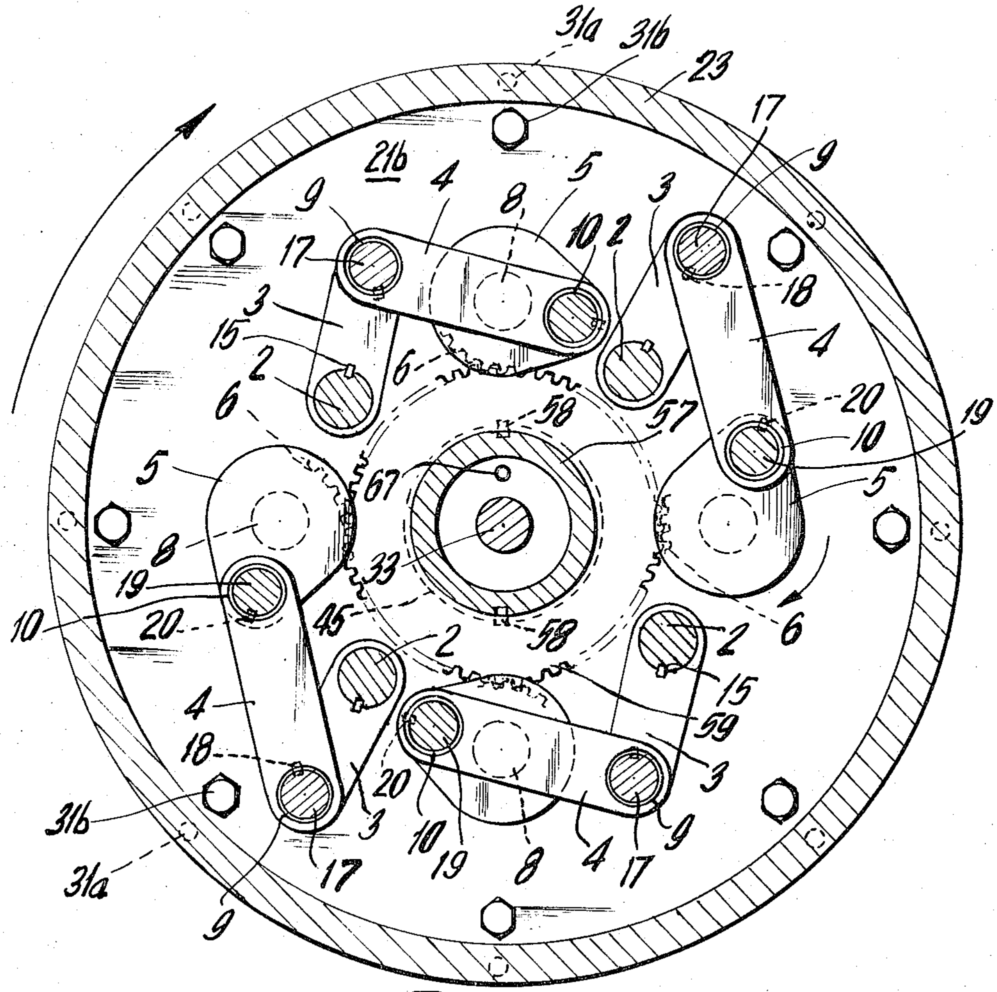
31a
31b
23
21b
2
3
4
5
6
8
9
10
15
17
18
19
20
33
45
57
58
59
67

FIG. 5

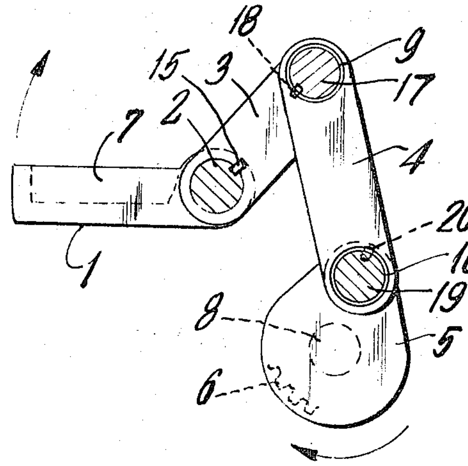
1
2
3
4
5
6
7
8
9
10
15
17
18
19
20

FIG. 5A

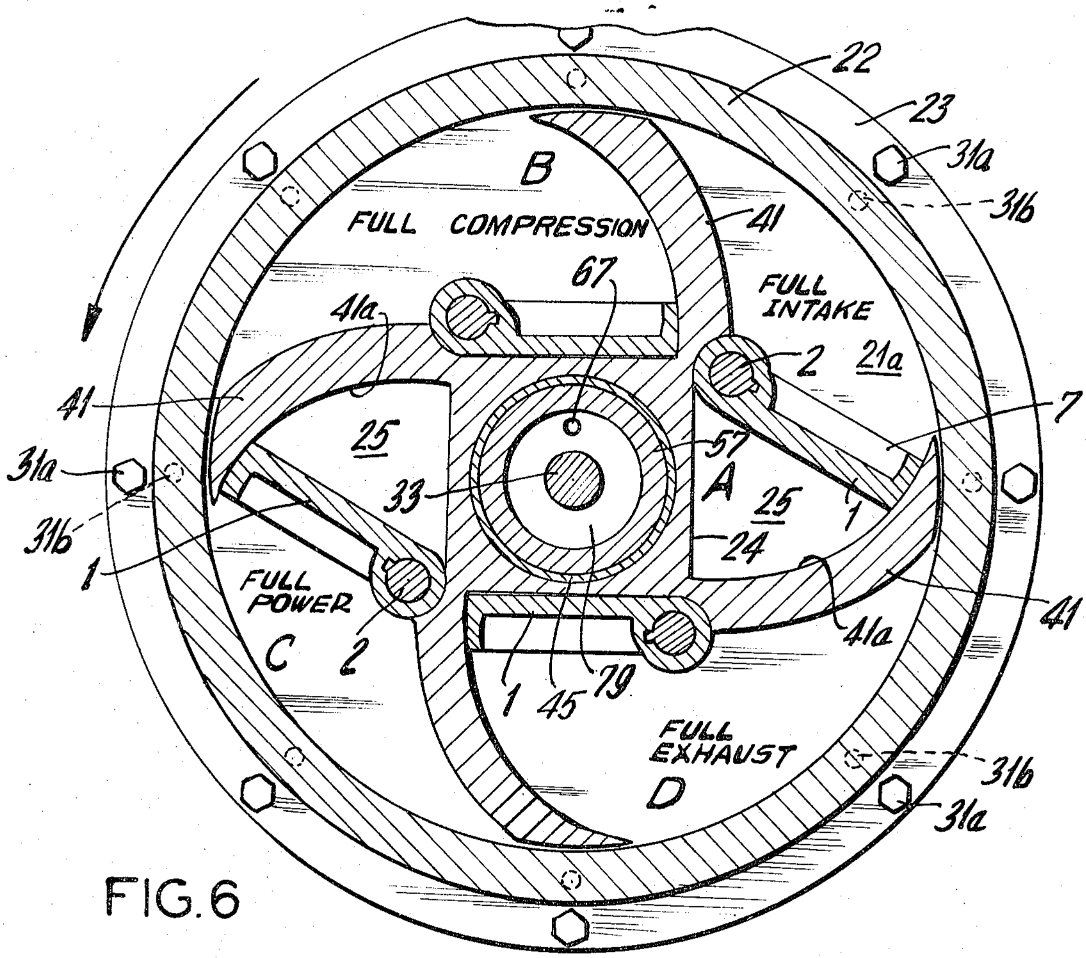
22
23
31a
31b
B
FULL COMPRESSION
41
67
FULL INTAKE
41a
2
21a
7
41
25
57
31a
A
33
25
31b
1
1
24
FULL POWER
41
41a
C
2
1
45
79
FULL EXHAUST
31b
D
31a

FIG. 6

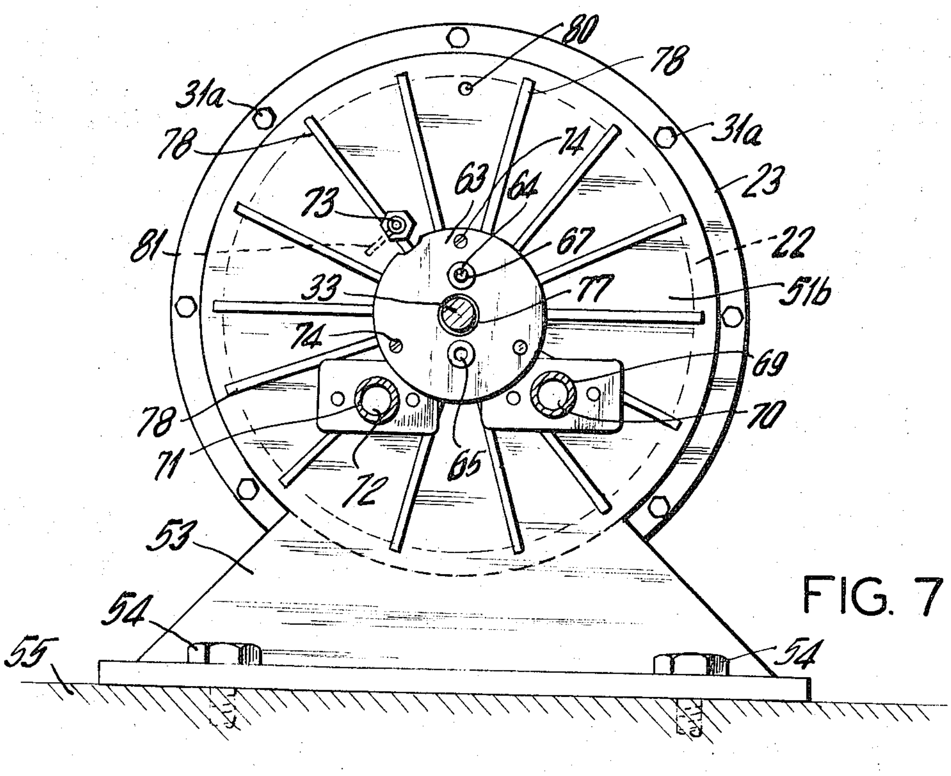
80
78
31a
78
31a
74
73
63
64
23
81
67
22
33
77
51b
74
69
78
70
71
72
65
53
54
55
54

FIG. 7

ROTATING CYLINDER INTERNAL COMBUSTION ENGINE

INTRODUCTION

This invention relates to a new and useful improvement in rotary internal combustion engines.

The invention particularly relates to a rotary internal combustion engine which is compact and simple in design and yet capable of developing a large amount of power relative to its overall size and weight.

The invention more particularly relates to a novel four cycle rotary internal combustion engine comprising oscillating piston plates in which the oscillatory motion of the piston plates outwardly and inwardly caused by the combustion of a compressed fuel-air mixture in the combustion chamber is effectively and efficiently changed into useful rotary motion.

BACKGROUND OF THE INVENTION

The principal characteristics of rotary internal combustion engines are well known. Engines of this type generally convert the pressure of the expanding combustion gases to rotary motion more efficiently than do reciprocating engines of the same size, weight and displacement and they eliminate the need for conventional valves and their associated mechanisms, timing gears, cams and cam followers.

However, previously known rotary engines, for example, of the rotary piston type, though capable of producing relatively high power output for their weight and size have been generally too complex and in operation have exhibited excessively high wear and short useful life of the moving parts and relatively high fuel consumption. In operation, they generally have excessively high nitrous oxides and unburned or partially combusted hydrocarbons in their exhaust, all adding to the problem of air pollution.

A second type of rotary engine which utilizes oscillating piston plates similar to the type described herein have generally been ineffective in changing the oscillatory motion of the piston plate to useful rotary motion.

It is an object of this invention to provide a rotary internal combustion engine which is relatively simple, compact, inexpensive, easy to manufacture and capable of generating a high power output for its weight and size.

Another object of the invention is to provide a rotary engine which has a new and efficient means of transmitting the oscillatory motion of the rectangular piston plate to rotary motion of the rotary engine body.

A further object of the invention is to provide an engine of the type described herein which is capable of having the oscillatory motion of the piston plates, in sequence, accomplish the functions of intake, compression, combustion-power and exhaust.

Another object of the invention is to provide a rotary engine which is easy to maintain and which can use conventional carburation and ignition.

The engine can be broadly broken down into three principle parts.

I - An oscillating rectangular piston plate and related fixed and moving parts.

II - A rotary engine body having a rotary piston carrier on which is carried the rectangular piston plate and related parts of Part I.

III - A stationary engine body.

A brief description of the figures of drawings of the present invention is given below.

FIG. **1** is a cross-section of a preferred embodiment taken along a vertical line generally through the central axis. For purposes of clarity the teeth of the driving and stationary gears are shown in elevation.

FIG. **2** is an isometric drawing of the rectangular piston plate and the related fixed and moving parts.

FIG. **3** is a vertical section taken through the center line of shaft **2** as it passes through the rotary piston plate carrier.

FIG. **4** is an isometric drawing of the connecting links, throws and driving gear.

FIG. **5** is a cross-section taken generally along line A—A of FIG. **1** looking in the direction indicated by the arrows showing the relationship between the connecting links, throw, drive gear and stationary main gear.

FIG. **5A** is a schematic view of the arrangement of the rectangular piston plate, the first and second linking means, the throw and drive gear.

FIG. **6** is a vertical section taken generally along line B—B of FIG. **1** looking in the direction indicated by the arrows showing four combustion chambers in the various cycles of fuel intake, compression, combustion-power and exhaust.

FIG. **7** is an end view taken generally along line C-C of FIG. **1** looking in the direction indicated by the arrows showing the ignition means, fuel inlet and exhaust means and the oil inlet and outlet means.

DESCRIPTION OF THE INVENTION

The rotary internal combustion engine of the present invention comprises a rotary engine body including a housing, an end disc and a rotary piston carrier operably connected thereto, and a stationary engine body including a stationary end disc and a stationary main driven gear connected thereto.

An embodiment of the engine of the present invention comprises a four cycle engine. As illustrative of this embodiment an engine having four combustion chambers spaced 90° apart is described. The combustion chambers rotate with the rotary engine body and in each complete 360° revolution to go through all four cycles of intake, compression, ignition (combination-power) and exhaust.

The combustion chambers are in a sense connected to the rotary piston plate carrier and rotate with the carrier and relative to the stationary disc of the stationary engine body. The stationary disc contains and/or has located thereon a fuel-air intake port, an ignition means and an exhaust port. Each combustion chamber during rotation in turn comes into contact with and passes each of the fuel intake port, ignition means and exhaust port.

Each rectangular piston plate in each combustion chamber oscillates twice, inwardly and outwardly, for each revolution of the rotary piston carrier. The rotation of the combustion chambers past the intake port, the ignition means and the exhaust port is coordinated with the inward and outward oscillation of the rectangular piston plates such that each combustion chamber in turn goes through the four engine cycles.

During the intake cycle of each combustion chamber, the rectangular piston plate will move away from the central axis of the engine to draw the fuel-air mixture into the combustion chamber. The plate will then oscillate inwardly to compress the air-fuel mixture and at the proper time come into contact with the ignition means which ignites the mixture and starts the combustion-power cycle causing the piston plate to oscillate outwardly away form the central axis of the engine. At the end of the power cycle the piston plate begins to oscillate inwardly as the combustion chamber approaches and comes into contact with the exhaust port such that the spent combustion gases are expelled through the exhaust port.

Referring to FIGS. **6** and **7** of the drawings a brief description of the operation of the engine will be given. Combustion chamber **25** in position A is in the full fuel-air mixture intake position having received the said mixture through the fuel inlet port **70** during the time the combustion chamber **25** passed over inlet **70** in going from the full exhaust position D to full intake position A. The rotary piston plate carrier **21** of the engine as shown in FIG. **6** rotates counter-clockwise. The fuel-air mixture in combustion chamber **25** is fully compressed at position B. Continued rotation, from the fully compressed position B, brings combustion chamber **25** up to and over ignition means **73**, see FIG. **7**, which at precisely the proper moment causes ignition and combustion of the compressed fuel-air mixture. The combustion chamber **25** at the completion of combustion power cycle is at position C. At position C the combustion chamber **25** is at about its maximum volume and contains the spent or burnt combustion gases. The combustion chamber **25** continues its rotation and passes from position C, full power cycle, to position D, full exhaust cycle. In doing so, as the combustion chamber comes up to and over exhaust port **72** the rectangular piston plate closes expelling the burnt combustion gases out through exhaust outlet line **71**. In operation two diametrically opposed piston plates oscillate towards the center of the engine while the other two diametrically opposed piston plates oscillate away from the center of the engine. As each of the four piston plates reach the end of their travel, they reverse themselves and then travel in the opposite direction. This occurs twice for each piston plate per revolution of the rotary piston carrier. The above-described cycles take place continuously for each of the four combustion chambers in turn, once per each 360° revolution of the rotary piston carrier. The operation of the engine provides a balanced almost continuous smooth power output by providing one power cycle for each combustion chamber per revolution and four power cycles per 360° revolution for the engine itself.

The engine of the present invention provides substantial advantages and engineering, manufacturing and design improvements over conventional engines of comparable size including: more horsepower per pound, more mileage per gallon, fewer total parts, fewer moving parts, simplified ignition and fuel intake system, smooth continuous combustion-power output, very light and compact per CC of displacement and horsepower, ease and simplicity of manufacture, assembly and maintenance, capability of operation on all types and grades of fuels, obtains substantially complete combustion of fuel such that exhaust pollution is minimized, and high degree of reliability and useful life.

Another advantage is that the engine performs all the functions of an internal combustion engine without the use of intake and exhaust valves and all the complex mechanism normally required for the timing and operation of such valves.

Another advantage of the construction of the engine is that it provides a simplified means of ignition. Once started the engine can have automatic self-ignition. This involves the use of an ignition combustion gas bypass means whereby a small portion of the combustion gases from the previously fired combustion chamber is by-passed into the next to be fired combustion chamber containing compressed fuel-air mixture.

A further advantage of the present invention is that the lubricating oil means for lubricating and cooling the engine operates as a sealed unit. The lubricating oil is not exposed to the atmosphere and can thus not volatilize. The lubricating oil is not directly exposed to the combustion chambers and thus is not subjected to oxydative degradation. Both of these features act to further minimize any air pollution that may result from operation of the engine.

A still further advantage is that in one embodiment of the present invention separate sealing means around at least the side edges of the rectangular piston plate may be omitted.

A specific advantage of the present invention as compared to a conventional reciprocating internal combustion engine is that the engine of the present invention provides one power stroke per combustion chamber for each complete revolution of the engine, e.g. drive shaft, whereas the convention engine provides only one power stroke per two complete revolutions of the drive shaft. The engine of the present invention is thus capable of producing about twice the power of a conventional engine of the same number of combustion chambers and displacement.

Other advantages of the present invention will become obvious to those skilled in the art by the following description of the three principal parts of the engine and the description of the accompanying figures of the drawings.

In the description that follows, like reference numerals indicate like parts.

The three principal parts of the engine of the present invention are described with reference to the parts of the figures of the drawings related thereto.

PART I - Referring primarily to FIG. **1** of the drawings, Part I of the engine comprises the oscillating rectangular piston plate **1** fixedly connected and hinged to shaft **2**, which shaft is in turn fixedly connected to a first linking means **3**, see FIG. **2**. The piston plate **1**, shaft **2** and first linking means **3** are movably connected to a second linking means **4**, throw **5** and driving gear **6** whereby the oscillating motion of the piston plate is changed into a rotary motion of the planetary or driving gear **6**, see FIGS. **4** and **5**.

The lightening slots **7** in piston plate **1** allow reduction of the overall weights of the engine while at the same time not reducing the strength thereof. With reference to FIG. **1**, shaft **8** is shown supported in the rotary engine body and is connected by suitable bearing means to planetary or drive gear **6**. Bearing means **9** movably connects linking means **3** to linking means **4** and bearing means **10** movably connects linking means **4** to throw **5**, see FIGS. **2** and **4**.

Piston plate **1** can have recesses, see FIG. **2**, on its side edges and outer edge in which recesses sealing and bearing means **11** can be placed. The sealing and bearing means can be pressed outwardly by suitable spring means not shown.

PART II - The rotary engine body comprises rotary piston carrier plate or disc **21** on which is movably connected shaft **2** and the rectangular piston plate **1** of Part I. The connecting links **3** and **4** and throw **5** are movably connected to each other by suitable bearing means. Throw **5** and gear **6** of Part I are fixedly connected to each other and rotate around shaft **8.** Disc **21** is an integral part of the rotary engine body and is fixedly connected to outer wall cover of housing **22** and housing cover **23,** both of which rotate therewith. The sides or walls of the combustion chamber **25** are formed by the inner wall surface **21***a* of the rotary piston carrier and the surface **24** of the rotary engine body adjacent thereto, the inner disc wall surface **51***a* of the stationary engine body (Part III), the inner surface of piston plate **1** and the inner surface **41***a* of the curved member **41** in contact with the outer edge of piston plate, see FIG. **1** and FIG. **6.**

A suitable gas seal and bearing means, e.g., carbon seal **26** is inserted into a recess in the outer edge of curved wall **22** and rotates therewith and provides gas sealing means and bearing means. A vent **80** can be provided in disc **51** for venting and collecting any blow-by gases from the combustion chamber. The collected gases, to reduce air pollution, can be recycled to the fuel intake means and burned. The rectangular piston plate **1** oscillates inwardly and outwardly on shaft **2** (Part I) in the combustion chamber. Shaft **2** is supported by flange **27** recessed in disc **21** and is sealed by oil seal means **28.** Shaft **2** oscillates on bearing means **29.** Shaft **2** is supported by bearing **43** which seats in a recess formed in end disc **30.** Support for shaft **2** is thus provided by flange **27** in disc **21,** bearing means **29** in part **40** of the rotary engine body and bearing means **43** in disc **30.** Disc **30** is integral with housing cover **23** and is fixedly connected to disc **21** by bolts **31***a* and **31***b* and rotates therewith. Clutch face **32** is fixedly connected by suitable means to disc **30** and can be used as the principal power take-off means. Auxiliary power take-off means is provided by shaft **33,** which is fixedly connected by suitable means to disc **30,** and pulley means **34** and which is fixedly attached by key **35** to the end of shaft **33.** Shaft **8** is supported by part **40** of the rotary engine body and the planetary or drive gear **6** (Part I) is operably connected thereto.

Looking right to left at FIG. **1,** shaft **33** is integrally connected to shaft support member disc **36,** which disc is fixedly connected to the inner side of disc **30** by suitable bolts **37.** Bolts **38** fixedly connect disc **30** to the portion of the rotary engine body **40,** which is integral with disc **21.** Suitable oil sealing means not shown are provided between disc **30** and part **40** of the rotary engine body. Thrust bearing raceway **39** and raceway **61** support thrust bearing **62.** The thrust bearing prevents outward movement of the rotary engine body due to the expansionary pressure of the combustion gases in combustion chamber **25.** Raceway **61** is integrally connected to the stationary engine body (Part III) and provides the surface and support which prevents the outward movement. Raceway **39** (Part II) is the part of the rotary engine body through which the outward pressure is transmitted through bearing **62** to raceway **61.**

Raceways **39** and **61** may be made as a part of the rotary engine body **40** and stationary hollow shaft **57,** respectively, or may be made separately and welded or otherwise integrally attached to these respective parts. End bolts **75** in cooperation with end plate **66,** raceway **61** and spacer **42** hold main gears **59** in position.

Main bearing **45** can be fixedly connected to the rotary engine body and will rotate with the rotary engine body around the stationary hollow shaft **57.**

The cooling and lubricating oil filling the interior of the rotary engine body (Part II) is supplied through oil inlet port **64** and oil line **67.** The oil is returned through port **68,** the hollow portion **79** of shaft **57,** and oil outlet port **65** (Part III) see FIGS. **1** and **7.**

The portion of the rotary engine body identified at **40** provides bearing support means for shaft **8,** about which gears **6** rotate, can form raceway **39** and provides support for the bearing means for shaft **2** (Part I).

The entire inside of the rotary main engine body is filled with oil to cool and lubricate the moving parts therein. The cooling and lubricating oil is in a sealed system and is not exposed to the atmosphere or combustion gases. The closed system feature prevents air pollution by vaporization of lubricating oil fumes and prevents oxidative degradation of the oil.

PART III - The stationary engine body carries and supports the rotary engine body and provides the means for connecting the engine to a suitable base or support means. The stationary engine body comprises disc **51,** the inner portion **51**a of which as discussed above, forms a part of the combustion chamber **25.** Disc **51** is integral with cylindrical hub **52.** The lower portion of disc **51** forms legs **53,** for supporting the engine through which bolts **54** pass to secure the engine to a suitable base, e.g., an engine block **55.** Hub **52** is fixedly connected by key **56** to hollow main shaft **57.** Main shaft **57** is fixedly connected by means of key **58** to stationary main gear **59.** See FIGS. **1** and **5.** Main bearing **45** is operably connected to shaft **57** and rotates with the rotary engine body around shaft **57.** Thus, stationary main gear **59,** hollow main shaft **57,** hub **52,** disc **51** secure legs **53** are stationary and secured to a suitable base by bolts **54** while the rotary engine body (Part II) rotates with main bearing **45** on shaft **57** and around the central axis of shaft **57.** Thrust bearing raceways **39** and **61** and thrust bearing **62** prevent the outward movement of the rotary piston carrier **21** due to the pressure of the expanding gases in the combustion chamber **25** of the rotary main engine body. End plate **63** on the right end of hollow shaft **57** (FIG. **1**) has passing therethrough oil inlet port **64** and inlet line **67,** oil outlet port **65** and auxiliary power take-off shaft **33** (Part II). End plate **66** on the left end of shaft **57** has passing therethrough shaft **33,** oil inlet line **67** and oil return port **68.** Shaft **33** rotates on bearing **77** which is sealed by oil seal **76.** Disc **51** has passing therethrough fuel inlet line **69** through port **70,** and exahust outlet line **71** through port **72** and ignition means **73.** The outer wall of disc **51** contains thereon air cooling fins **78** which radiate outwardly from the center of disc **51,** see FIG. **7.** End bolts **74** secured end plate **63** to hub **52** and end bolts **75** secure end plate **66** to hollow shaft **57.**

ENGINE OPERATION

The operation of the engine will be described with reference to the Figures of the drawings. Each of the Figures of the drawings will be discussed in turn.

FIG. 1.

Now referring to FIG. 1 and the various other figures as applicable, the specific features of the engine will be discussed in connection with its operation. FIG. 1 is an expanded side view taken through a vertical section along the central axis of the engine. FIG. 1 shows Part I comprising the rectangular piston plate 1 and related parts, rotary engine body Part II and stationary engine body Part III each part of which was discussed above.

A mixture of fuel and air in vapor phase is fed through fuel inlet line 69 through fuel inlet port 70 (FIG. 7) into combustion chamber 25, see position A, (FIG. 6). The fuelair mixture is drawn into the combustion chamber 25 as the rectangular piston plate 1 oscillates outwardly and while at the same time the rotary piston plate carrier 21 rotates in a counterclockwise direction and moves from position D to position A, comes up to, over and passes the fuel inlet port 70. At position A the fuel intake cycle is complete.

FIGS. 2 to 4

The rectangular piston plate 1 has slots 7 in its upper surface which reduce its overall weight. The piston plate is fixedly connected to shaft 2, by key 12 of shaft 2. Shaft 2 has thereon flange 27 and packing and oil seal gland or gasket 28 both of which set in the wall of disc 21. Gasket 28 prevents oil seepage from the interior of the rotary engine body (Part II) into the combustion chamber 25. Shaft 2 oscillates with piston plate 1 on bearing means 29 first in one direction then in the other. Bearing 29 is supported in part 40 of the rotary engine body and forms a thrust face 46 which is operably connected to link 3, see FIG. 3. Shaft 2 is fixedly connected to link 3 by key 15. There are two parts to link 3. Shaft 17 passes through the two parts of link 3 and through link 4, operably connecting link 3 to link 4. Shaft 17 is fixedly connected to link 3 by key 18. Bearing means 9 provide a movable connecting means between link 3 and link 4. Shaft 2 continues through both portions of link 3 and is supported by bearing means 43 recessed in end disc 30. There are two parts to throw 5. Shaft 19 passes through both parts of throw 5 and through link 4. Link 4 is moveably connected by bearing means 10 to shaft 19 and throw 5. Shaft 19 is fixedly connected by key 20 to throw 5. Throw 5 is fixedly connected or pinned to drive gear 6, by means not shown. Shaft 8 passes through the center of planetary or drive gear 6. Gear 6 is comprised of two parts and is movably connected to shaft 8 by suitable bearing means 16.

It can be seen from the drawings that because of the fixed relationship of rectangular piston plate 1, shaft 2 and connecting link 3 and the movable relationship of these parts with link 4, throw 5 and gear 6 that the oscillatory motion of the rectangular piston plate outwardly and inwardly in the combustion chamber 25 due to the combustion of the compressed fuelair mixture is changed into rotary motion of drive gear 6. The drive gear 6 (Part I) drives against stationary main gear 59 and because the latter does not rotate causes planetary rotation of the gear 6 around stationary main gear 59. The planetary rotation of gear 6 around main gear 59 causes the rotary piston carrier 21 and the rotary engine body (Part II) to rotate around the stationary main gear and the central axis of the hollow main shaft 57 of the stationary engine body (Part III). The rotation, see FIG. 5, is clockwise.

With reference to FIG. 1, the rotation of the top portion of the rotary engine body (Part II) would be towards the viewer. With reference to the rotary piston carrier surface 21*a* of disc 21 shown in FIG. 6, the rotation would be counterclockwise. In viewing FIGS. 5 and 6, consider FIG. 5 as turned over and placed facedown under FIG. 6.

FIGS. 5 and 5A

FIG. 5 is a cross-section taken generally along line A—A of FIG. 1 looking in the direction indicated by the arrows showing the relationship between the connecting links 3 and 4, throw 5, drive gear 6 and stationary main gear 59. The outer surface 21*b* of the rotary piston plate 21 can be seen in the background.

Shaft 8 is stationary and gear 6 is rotatably connected thereto and rotates thereon using suitable conventional bearing means 16. The shaft 8 as previously mentioned is fixedly connected to rotary engine body part 40 (Part II). The rotary engine body 40 carries and supports shaft 8, throw 5 and gear 6. Gear 6 rotates around shaft 8 in a clockwise direction, causing planetary rotation of gear 6 around main gear 59 also in a clockwise direction. Because main gear 59 is stationary, it causes the rotary piston carrier disc 21 to rotate in a clockwise direction around main gear 59. FIG. 5A is a detailed view of the arrangement of the rectangular piston plate 1, the first linking means 3, the second linking means 4, throw 5 and drive gear 6. This figure also shows the relationship of shaft 17, key 18 and bearing means 9 to linking means 3 and 4; and the relationship of shaft 19, key 20 and bearing means 10 to linking means 4 and throw 5.

FIG. 6

FIG. 6 is a vertical section taken generally along line B—B of FIG. 1 looking in the direction indicated by the arrows showing four combustion chambers 25 in the various cycles of fuel intake (position A), compression (position B), combustion-power (position C) and exhaust (position D). The inner wall 21*a* of rotary piston plate carrier 21 can be seen in the background. In this figure, position A, on the right-hand side of the drawing shows combustion chamber 25 after completion of the full intake cycle. FIG. 6 shows the inner surface 41*a* of curved member 41 and the surface 24 of the rotary engine body, both of which form walls of combustion chamber 25. The drawing also shows in cross-section a view of the rectangular piston plate 1, shaft 2, main bearing 45, hollow main shaft 57 and oil inlet line 67. The lubricating and cooling oil flows into the engine through line 67 in a direction away from the viewer and out of the engine through the hollow portion 79 of the main shaft 57 in a direction towards the viewer. The auxiliary power take-off means shaft 33 is also shown. The lightening slots of rectangular piston plate 1 are shown at 7.

After the intake cycle at position A is completed, the next cycle is compression of the fuel-air mixture in combustion chamber 25 which takes place and is shown at position B. The rotary engine body rotates counter-clockwise and combustion chamber 25 passes from position B to position C during which time the fully compressed fuel-air mixture comes up to and into contact with ignition means 73, see FIG. 7. Ignition means 73, when the fuel-air mixture is at optimum compression ignites the mixture and causes combustion thereof. The combustion chamber 25 at the completion of the combustion power cycle is at position C. The rotary piston plate 21 continues its counter-clockwise rotation and combustion chamber 25 rotates from position C up to and past exhaust port 72 to position D. In passing from position C to position D the rectangular piston plate 1 begins to close, reducing the volume of combustion chamber 25 and forcing the burned combustion gases out of the combustion chamber 25 as the combustion chamber 25 passes exhaust port 72 and out of the engine via exhaust outlet line 71. When combustion chamber 25 reaches position D, it is in the full exhaust position and the entire operation beings again, that is, the combustion chamber 25 moves from position D to position A and in doing so begins the fuel-air mixture intake cycle. Each of the four combustion chambers 25 undergo each of the four cycles during each 360° revolution of the rotary piston carrier 21. There is thus four power cycles per 360° rotation providing a continuous, smooth power output.

FIG. 7

FIG. 7 is an end view taken generally along line C—C of FIG. 1 looking in the direction indicated by the arrows showing the ignition means 73 and in dotted lines an alternate ignition means 81, fuel inlet port 72 and exhaust port 70 and the oil inlet port 64 and oil outlet port 65. This view of the drawing also shows end plate 63, fuel inlet line 71, exhaust line 69 and auxiliary power take-off shaft 33. In the background is shown the outer wall 51*b* of disc 51 and cooling fins 78 radiating outwardly from the center thereof. Supporting legs 53 carry and support the engine on the engine block 55 and are secured thereto by bolts 54.

The alternate ignition means 81 provides an embodiment in which the engine, once started, for example by conventional means, can have automatic self-ignition. This involves the use of an ignition combustion gas by-pass shown by dotted lines 81. The gas by-pass can be formed by making a small recess in the inner wall surface 51*a* which recess for a short period of time connects the two combustion chambers 25 that are in positions C and B (see FIG. 6). In this manner during operation of the engine a small portion of the still burning combustion gases from the previously fired combustion chamber (position C) is by-passed into the next to fire combustion containing compressed fuel-air mixture (position B). The by-pass still burning combustion gases ignite the compressed fuel-air mixture. Thus, the operation of the engine once started will be self-sustaining.

In an embodiment of the engine the rectangular piston plates can be very closely dimensioned with respect to the inner wall of rotary piston carrier, inner disc wall of the stationary engine body and the inner wall of the curved member such that the engine can be operated without separate gas seal or bearing means at the sides and/or outer edge of the piston plate. In this embodiment, the sizing of the rectangular piston plate with respect to the inner wall surfaces of combustion chamber is very closely controlled. The clearance between each side edge and the outer edge of the piston plate and surface of the combustion chamber is maintained and controlled at a minimum. Because of the very rapid oscillatory motion of the piston plate in the combustion chamber and the very close tolerances, the intake, compression, combustion-power and exhaust cycles can be carried out without substantial loss of gas pressure into or out of the combustion chamber. In order to improve the operation of this embodiment of the engine, the edges of the piston plate and/or the said inner wall surfaces of the combustion chamber can be treated to improve the gas seal and contact between the surfaces.

At least a portion of the inner surface of the piston plate and the opposing surface of the rotary engine body can be made flat, concaved or convexed and/or combinations thereof. Further, a portion of the inner surface of either the piston plate and/or the opposing surface of the rotary engine body can be recessed to provide additional engine displacement.

The rotary engines of the present invention can be built throughout the same horsepower and displacement range as conventional lawn mower, motorcycle, automobile, truck, marine and aircraft engines with the important difference that the engines of this invention will be approximately 40 to 60 percent lighter in weight and one third to one fourth the size for the same displacement and horsepower engine. Engines having two combustion chambers are particularly applicable for lawn mowers, and motorcycles and small cars. Four, six and eight or more combustion chamber engines are particularly applicable for use in automobiles and trucks and marine and aircraft uses.

Depending on the size, power output and the particular use the engine is put to, the main power can be taken off through a suitable clutch plate, automatic transmission, pulley and/or gear means. The auxiliary power take-off shaft means can be connected to a pulley or other suitable means and used to drive auxiliary equipment such as a generator, oil pump, gasoline pumps, etc.

The engines can be placed vertically, horizontally or any angle so long as they are securely mounted on a suitable base.

The engine ignition can be provided by a conventional glow plug and coil or by a conventional diesel type engine firing. Alternatively, an automatic self-ignition means may be used such that once started the engine can have automatic self-ignition. This embodiment involves the use of the combustion gas by-pass means as discussed above.

The engine is engineered and designed to operate on a wide range of fuels from low octane to high octane gasoline, diesel fuel, kerosene, alcohol, and liquified gases such as propane, butane, natural gas, etc. Where a medium octane fuel is used, it can be mixed with air in a conventional carburator and throttled to the fuel intake line. Alternatively, the fuel and air can be fed to the engine by a conventional fuel injection means using conventional automotive equipment.

The engine is both lubricated and cooled by means of oil. The oil fills the interior portion of the rotary engine body. Because of the rotary motion, the oil will be forced outward by centrifugal force to cool and lubricate all the parts in the rotary engine body. The warm oil is cycled to an air or water cooled radiator means or other suitable heat exchange means and cooled prior to return to the engine.

The various engine parts such as the casing and housing of the rotary engine body can be bolted, welded and/or otherwise fastened together. The stationary engine body parts can be bolted, welded and/or otherwise fastened together. The engine parts are easily made by forging, casting and machining. The engine parts can be made of cast or forged iron, steel or aluminum. The engine can easily be assembled by moderately skilled labor. Repair and maintenance of the engine is equally simple. The piston plate edges and the surfaces of the walls of the combustion chamber can be suitably treated and/or lined to improve the gas seal and to minimize wear and promote smooth relatively frictionless bearing surfaces.

It is to be understood that the form of the invention herein shown and described is to be taken as an illustrative example thereof and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention such that the scope thereof should be limited only to the scope of the appended claims.

What is claimed is:

1. A rotary internal combustion engine comprising, a stationary engine body having a fixed end wall, a rotary engine body supported by the stationary engine body and including an inner wall surface, at least one combustion chamber within one of the engine bodies, the inner wall surface of the rotary engine body and the fixed end wall of the stationary engine body defining walls of the combustion chamber, oscillating means movable in said combustion chamber, a shaft fixedly connected to said oscillating means and operably connected to said rotary engine body, planetary gear means, and linking means interconnecting said planetary gear means and said shaft to transmit through said shaft, during the combustion power cycle, the oscillatory motion of said oscillating means and to convert said oscillatory motion to rotary motion of the planetary gear means, both the planetary gear means and the linking means being disposed adjacent only one side of the combustion chamber.

2. The rotary internal combustion engine of claim 1 which further comprises (includes a) fuel intake means, exhaust outlet means and ignition means all contained in the wall of the stationary engine body.

3. The rotary internal combustion engine of claim 1 which includes at least two combustion chambers within the rotary engine body.

4. The rotary internal combustion engine of claim 1 which (includes an) further comprises automatic selfignition gas by-pass ignition means in the wall of the stationary engine body.

5. A rotary internal combustion engine comprising a stationary engine body having a fixed end wall, a rotary engine body supported by the stationary engine body and including an inner wall surface, at least one combustion chamber, said combustion chamber being located between the inner wall surface of the rotary engine body and the fixed end wall of the stationary engine body, said walls defining walls of the combustion chamber, a fuel intake means and an exhaust outlet means contained in the end wall of the stationary engine body, means which oscillate inwardly and outwardly in said combustion chamber, a shaft fixedly connected to said oscillating means and hingedly connected to said rotary engine body, a first linking means fixedly connected to said shaft, a second linking means operably connected to said first linking means, a planetary gear means, and a throw operably connected to said second linking means and said planetary gear means whereby the oscillatory motion of the oscillating means is transmitted, during the combustion power cycle, through said shaft and first and second linking means and throw and is converted to rotary motion of said planetary gear means, the first and second linking means, the planetary gear means and the throw all being located adjacent only one side of the inner wall surface of the rotary engine body.

6. A rotary internal combustion engine comprising, a stationary engine body having a fixed end wall, a rotary engine body supported by the stationary engine body and including an inner wall surface, at least one combustion chamber within one of the engine bodies, the inner wall surface of the rotary engine body and the fixed end wall of the stationary engine body defining walls of the combustion chamber, a piston plate which oscillates inwardly and outwardly in said combustion chamber, a shaft fixedly connected to the piston plate and hingedly connected to said rotary engine body, first linking means fixedly connected to said shaft, second linking means operably connected to said first linking means, a planetary gear, a main gear, in meshing engagement with the planetary gear, and a throw operably connected to the second linking means and the planetary gear whereby the oscillatory motion of the piston plate is transmitted during the combustion power cycle through said shaft and first and second linking means and throw and is converted to rotary motion of the planetary gear which drives against the main gear, the first and second linking means, the planetary gear and the throw all being disposed adjacent only one side of the combustion chamber.

7. A rotary internal combustion engine comprising, a stationary engine body having a fixed end wall surface, a rotary engine body supported by the stationary engine body and including an inner wall surface, the rotary engine body containing a rotary piston carrier, at least one combustion chamber, said combustion chamber being located between the inner wall surface of the rotary engine body and the fixed end wall of the stationary engine body, said walls defining walls of said combustion chamber, piston means carried by the rotary piston carrier and movable inwardly and outwardly in said combustion chamber, a shaft fixedly connected to said piston means and hingedly connected to said rotary engine body, a first linking means fixedly connected to said shaft, a second linking means operably connected to said first linking means, a planetary gear means, a throw operably connected to said second linking means and said planetary gear means whereby the motion of the piston means is transmitted, during the combustion power cycle, through said shaft and first and second linking means and throw and is converted to rotary motion of said planetary gear means, the first and second linking means, the planetary gear means and the throw all being located adjacent only a single side of the inner wall surface of the rotary engine body.

8. A rotary internal combustion engine comprising, a stationary engine body having a fixed end wall surface, a rotary engine body supported by the stationary engine body and including an inner wall surface, the rotary engine body including a rotary piston carrier, at least one combustion chamber, said combustion chamber being located between the inner wall surface of the rotary engine body and the fixed wall surface of the stationary engine body, said walls defining walls of said combustion chamber, a piston plate which oscillates inwardly and outwardly in said combustion chamber, a shaft fixedly connected to the piston plate and hingedly connected to said rotary engine body, a first linking means fixedly connected to said shaft, a second linking means operably connected to said first linking means, a planetary gear, said stationary engine body having connected thereto a main gear in meshing engagement with the planetary gear, and a throw operably connected to said second linking means and said planetary gear whereby the oscillatory motion of the piston plate is transmitted, during the combustion-power cycle, through said shaft and first and second linking means and throw and is converted to rotary motion of said planetary gear which drives against said main gear, the first and second linking means, the planetary gear and the throw all being disposed adjacent only a single side of the combustion chamber.

9. A rotary internal combustion engine comprising, a stationary engine body having a fixed end wall surface; a rotary engine body supported by the stationary engine body and including a housing, an end disc and a rotary piston carrier within the housing; at least one combustion chamber, said combustion chamber being located between the end disc of the rotary engine body and the fixed end wall surface of the stationary engine body; a piston plate which oscillates inwardly and outwardly in said combustion chamber; a main gear carried by the stationary engine body; and drive means disposed adjacent only one side of said end wall for transmitting power from the piston plate to the rotary engine body, the drive means including a shaft fixedly connected to the piston plate and hingedly connected to said rotary engine body, a first linking means fixedly connected to said shaft, a second linking means operably connected to said first linking means, a planetary drive gear and a throw operably connected to said second linking means and said planetary drive gear whereby the oscillatory motion of the piston plate is transmitted through said shaft and first and second linking means and throw and is converted to rotary motion of said planetary gear which drives against said main gear.

10. The rotary internal combustion engine of claim 9 which includes at least four combustion chambers between said end disc and said fixed end wall.

11. The rotary internal combustion engine of claim 9 which (includes an) further comprises automatic self-ignition gas by-pass ignition means in the inner wall surface of the stationary engine body.

12. The rotary internal combustion engine of claim 9 which includes an oil inlet and oil outlet means for the rotary engine body and in which the oil is otherwise sealed in the rotary engine body.

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