United States Patent [19]

Raptis

[11] **3,854,460**

[45] **Dec. 17, 1974**

[54] **ROTO-PISTON INTERNAL COMBUSTION ENGINE**

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[21] Appl. No.: **342,891**

[52] **U.S. Cl.** .... **123/44 R,** 123/44 D
[51] **Int. Cl.** **F02b 57/00**
[58] **Field of Search** .... 123/44 R, 44 D

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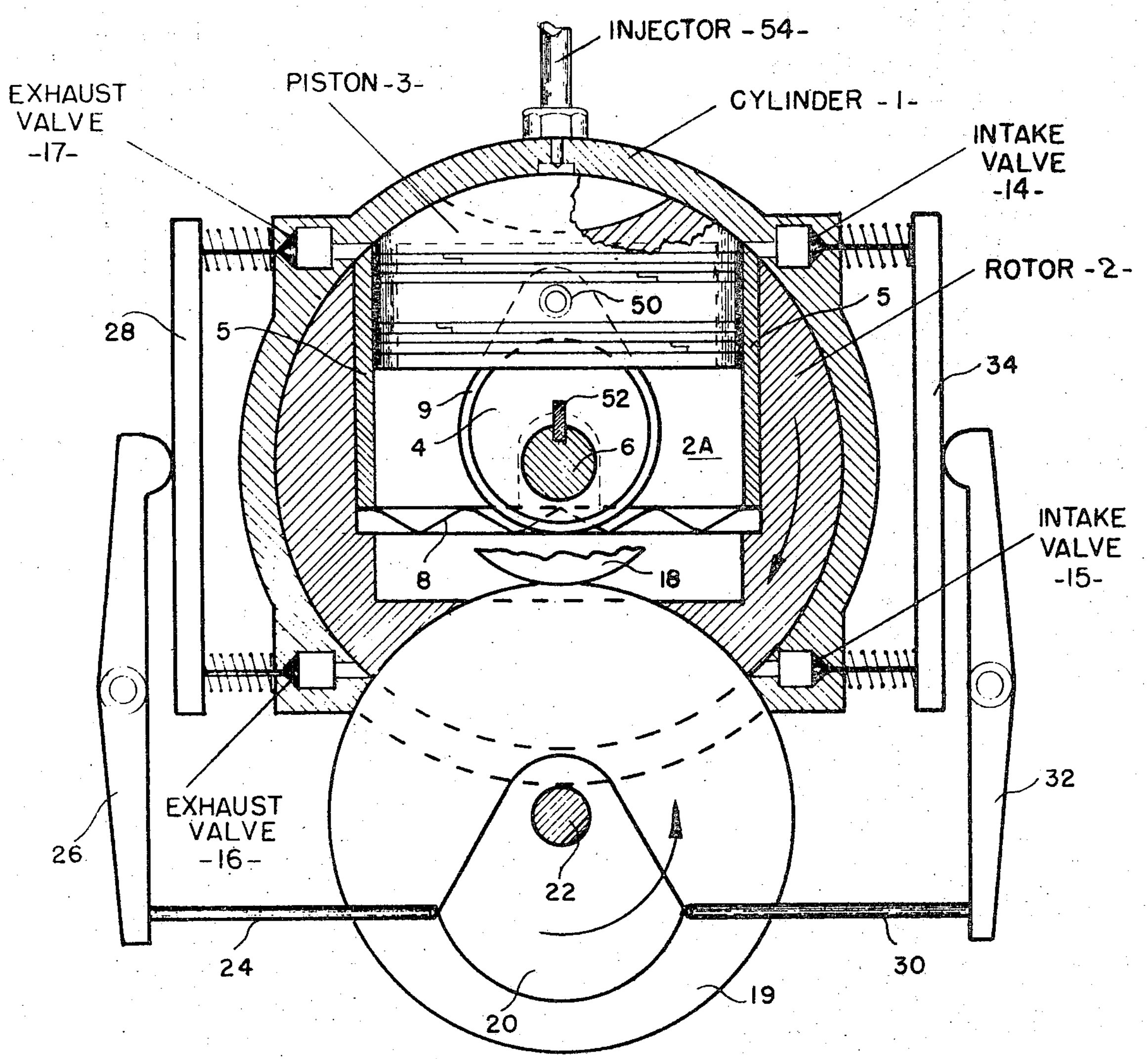
Primary Examiner—C. J. Husar
Attorney, Agent, or Firm—Jessup & Beecher

[57] **ABSTRACT**

An improved roto-piston internal combustion engine is provided which does not require irregularly-shaped parts, and in which the number of operating components is reduced to a minimum. The roto-piston internal combustion engine to be described includes a rotor which is rotatably mounted in a cylinder, and which incorporates a radial pocket. A piston is slidably mounted in the radial pocket, and it is coupled to the rotor by means of a ring connector and an eccentrically mounted disc, so that reciprocal movement of the piston within the pocket produces rotary movement of the rotor within the cylinder.

5 Claims, 14 Drawing Figures



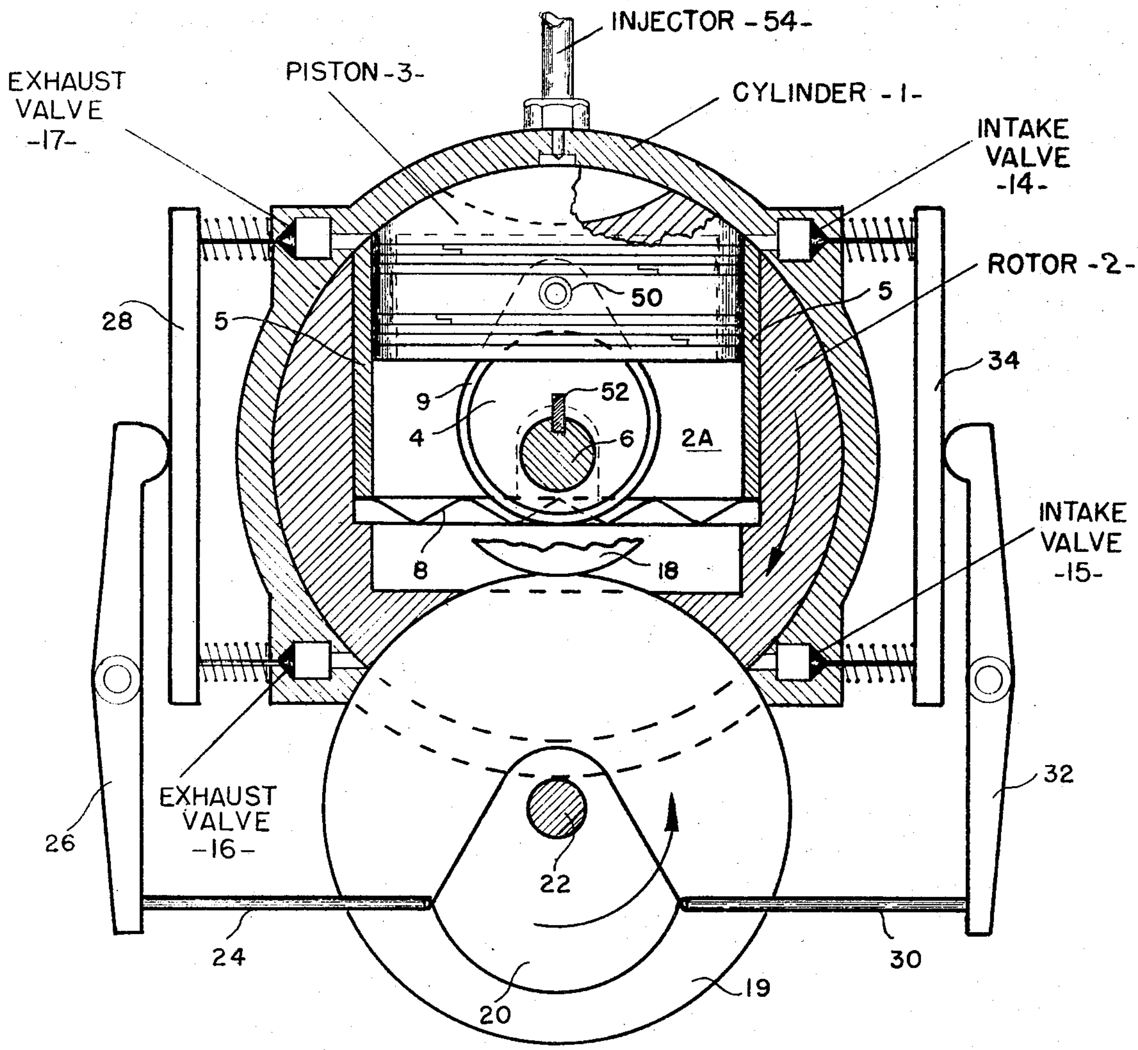

INJECTOR -54-
EXHAUST VALVE -17-
PISTON -3-
CYLINDER -1-
INTAKE VALVE -14-
ROTOR -2-
28
5
50
5
34
9
52
4
6
2A
8
18
INTAKE VALVE -15-
EXHAUST VALVE -16-
32
26
22
24
30
20
19

FIG. 1

FIG. 2

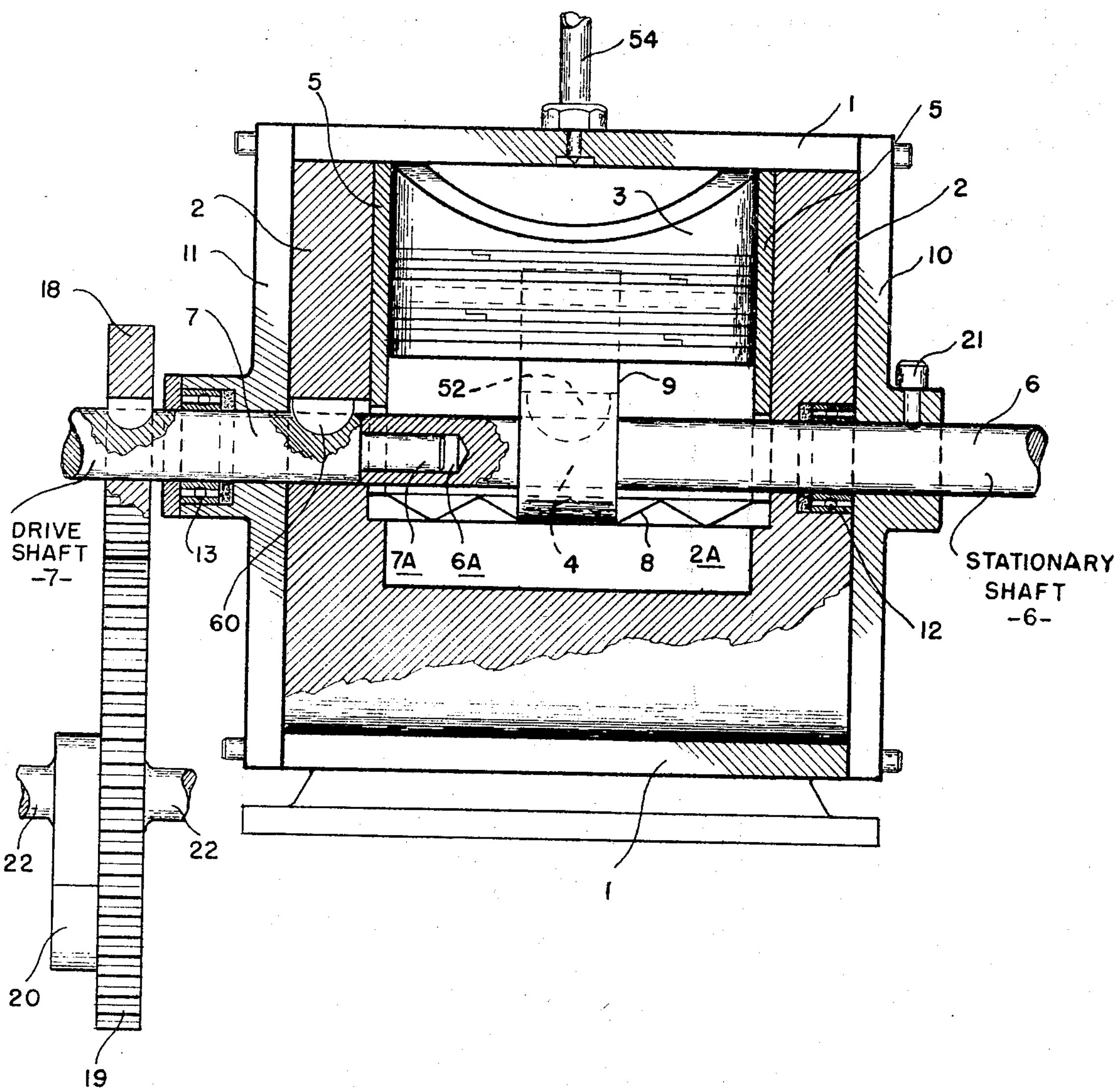
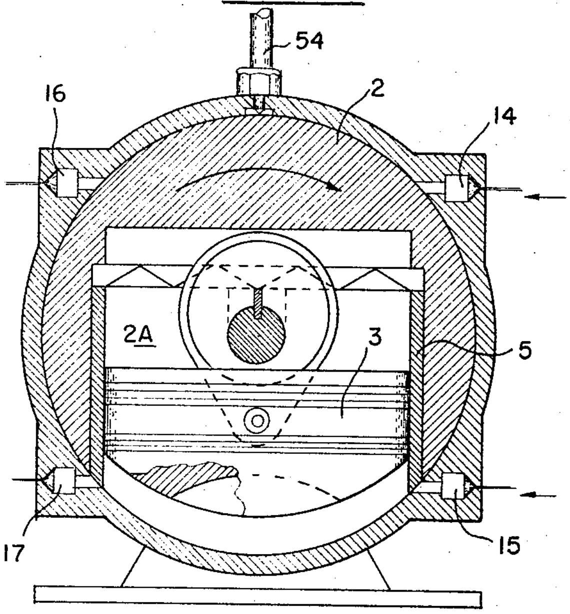
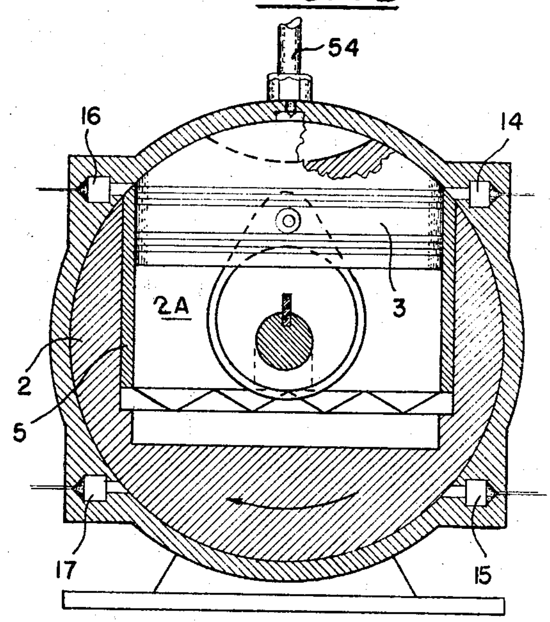

54
5
1
5
3
2
2
11
10
18
7
21
6
52
9
DRIVE
SHAFT
-7-
13
7A
6A
4
8
2A
STATIONARY
SHAFT
-6-
60
12
22
22
1
20
19

FIG. 3A



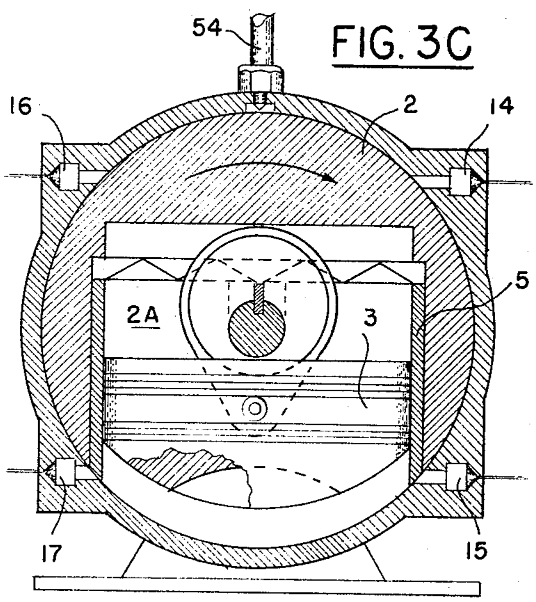
(INTAKE)

FIG. 3B



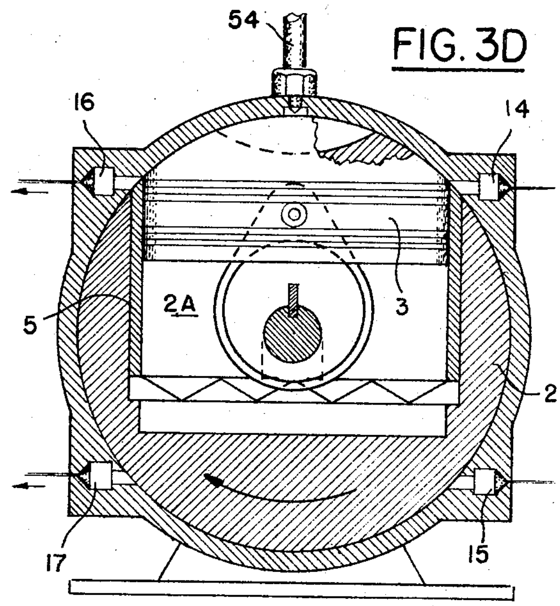
(COMPRESSION)

FIG. 3C



(POWER)

FIG. 3D



(EXHAUST)

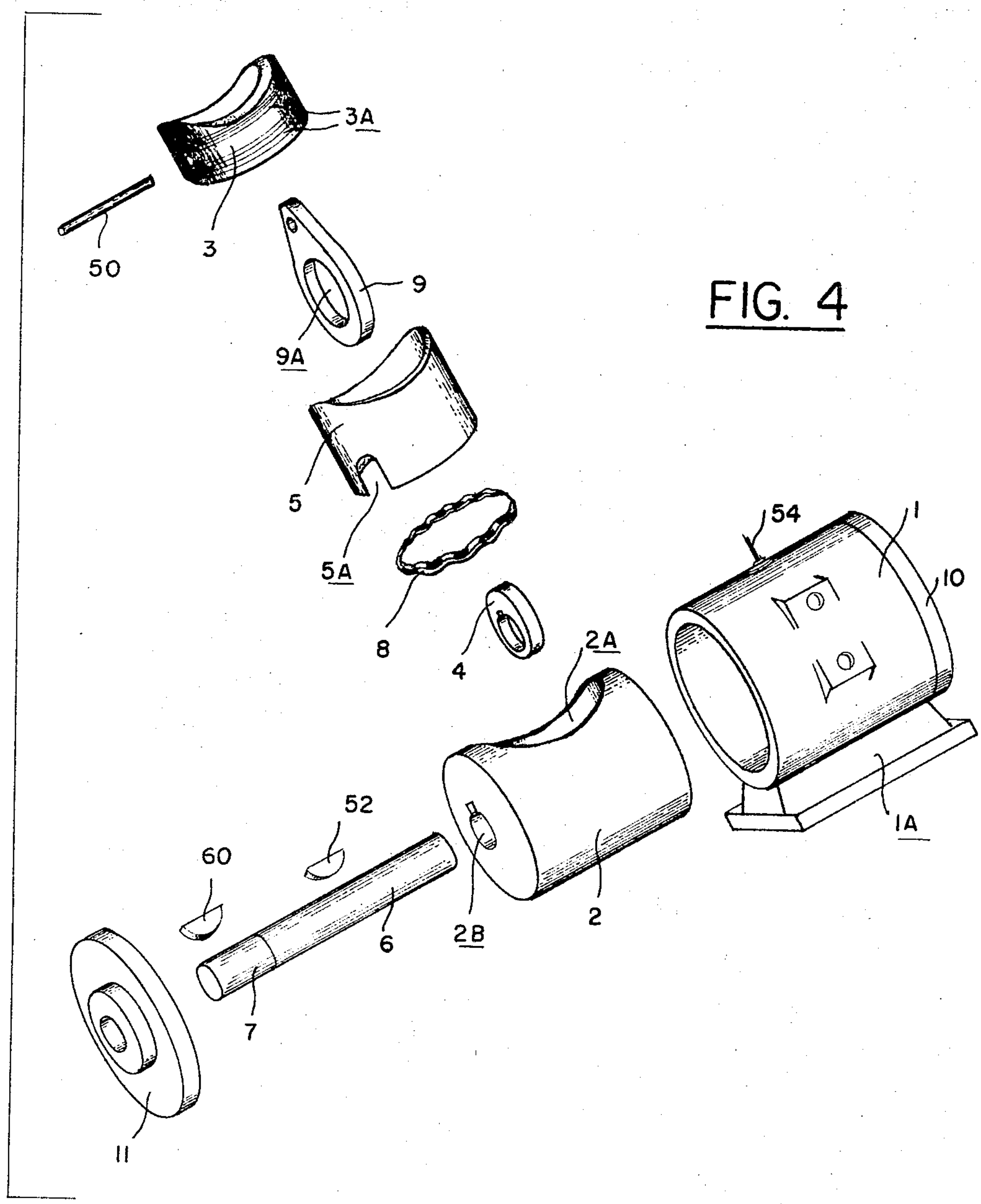


FIG. 4

FIG. 5

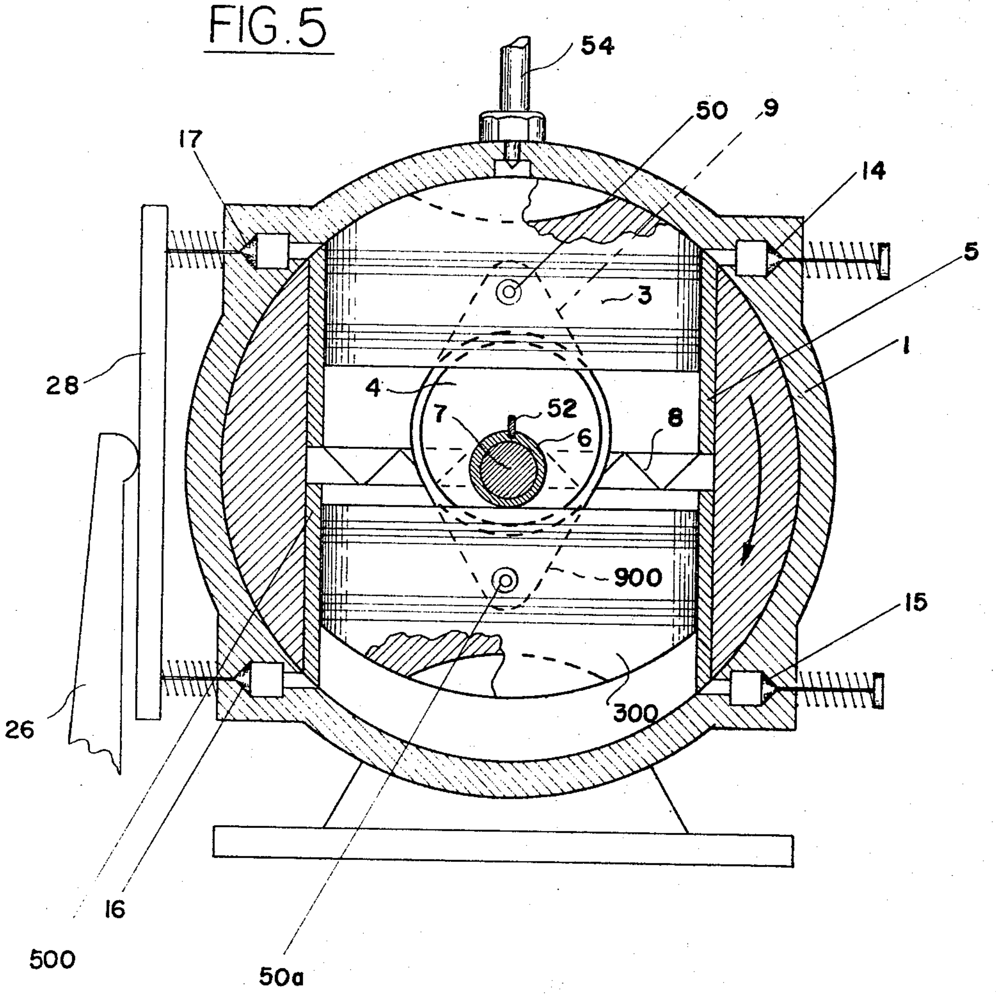


FIG. 6

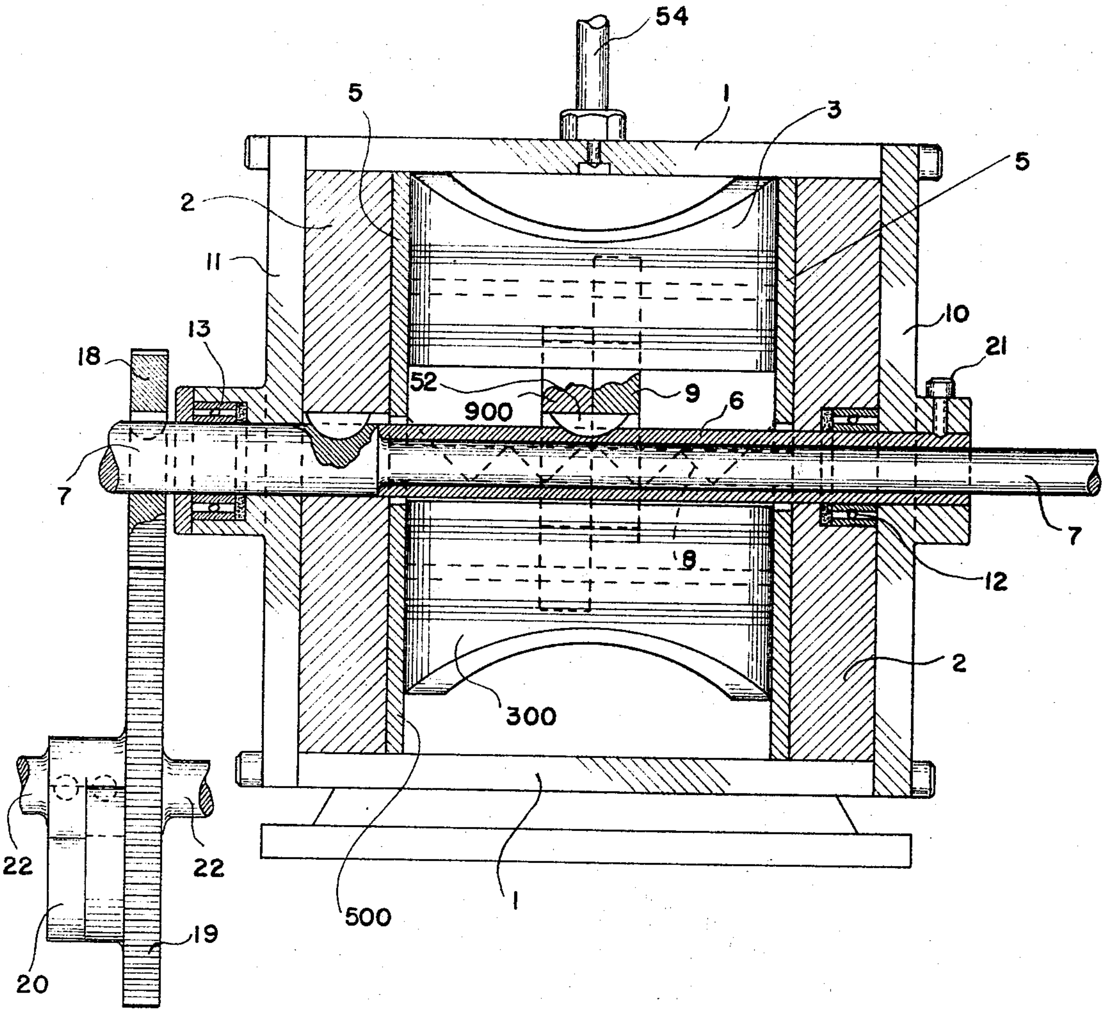


FIG. 7A

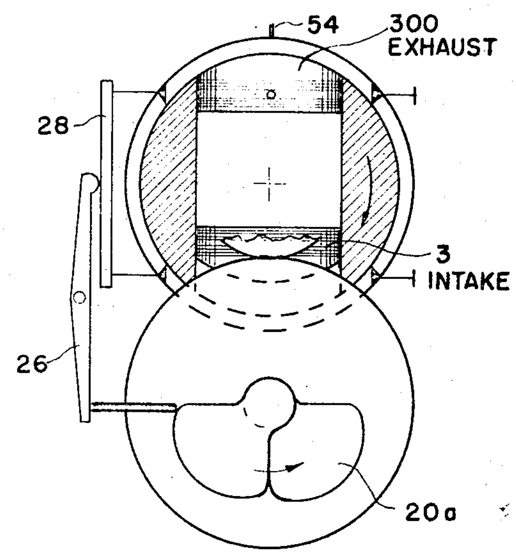


FIG. 7B

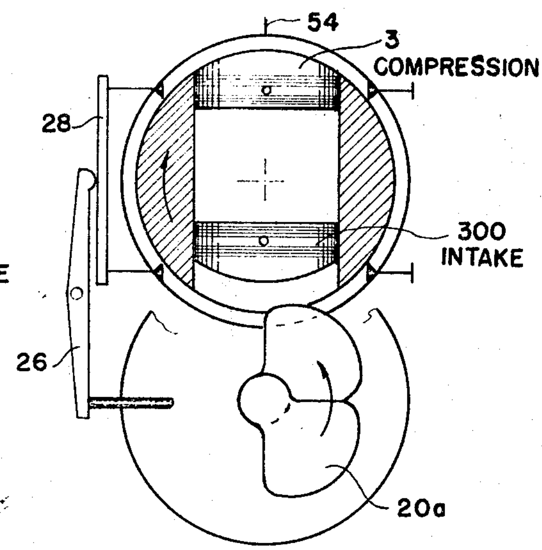


FIG. 7C

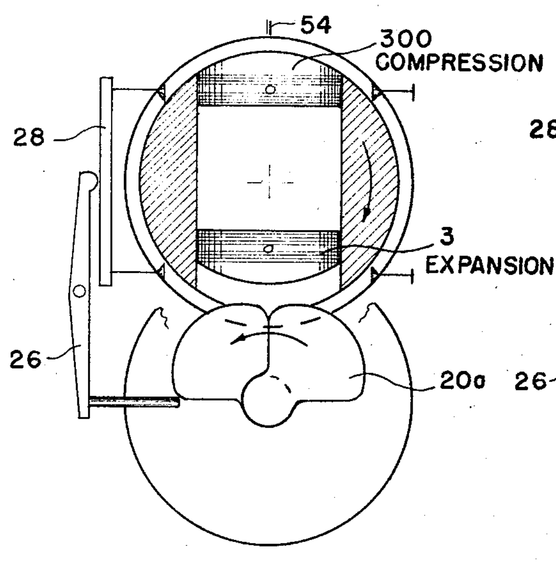
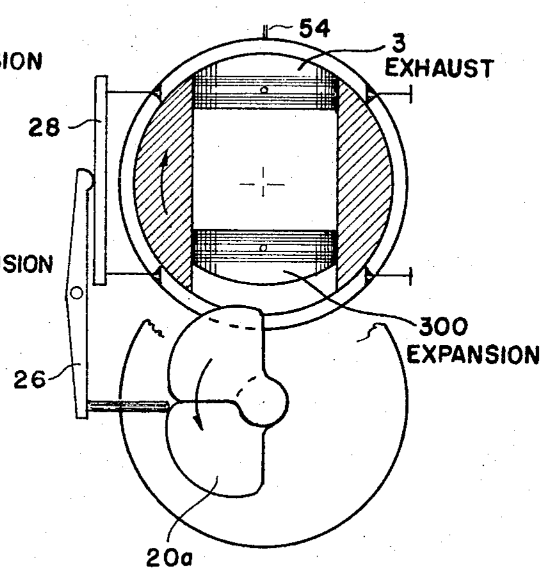


FIG. 7D



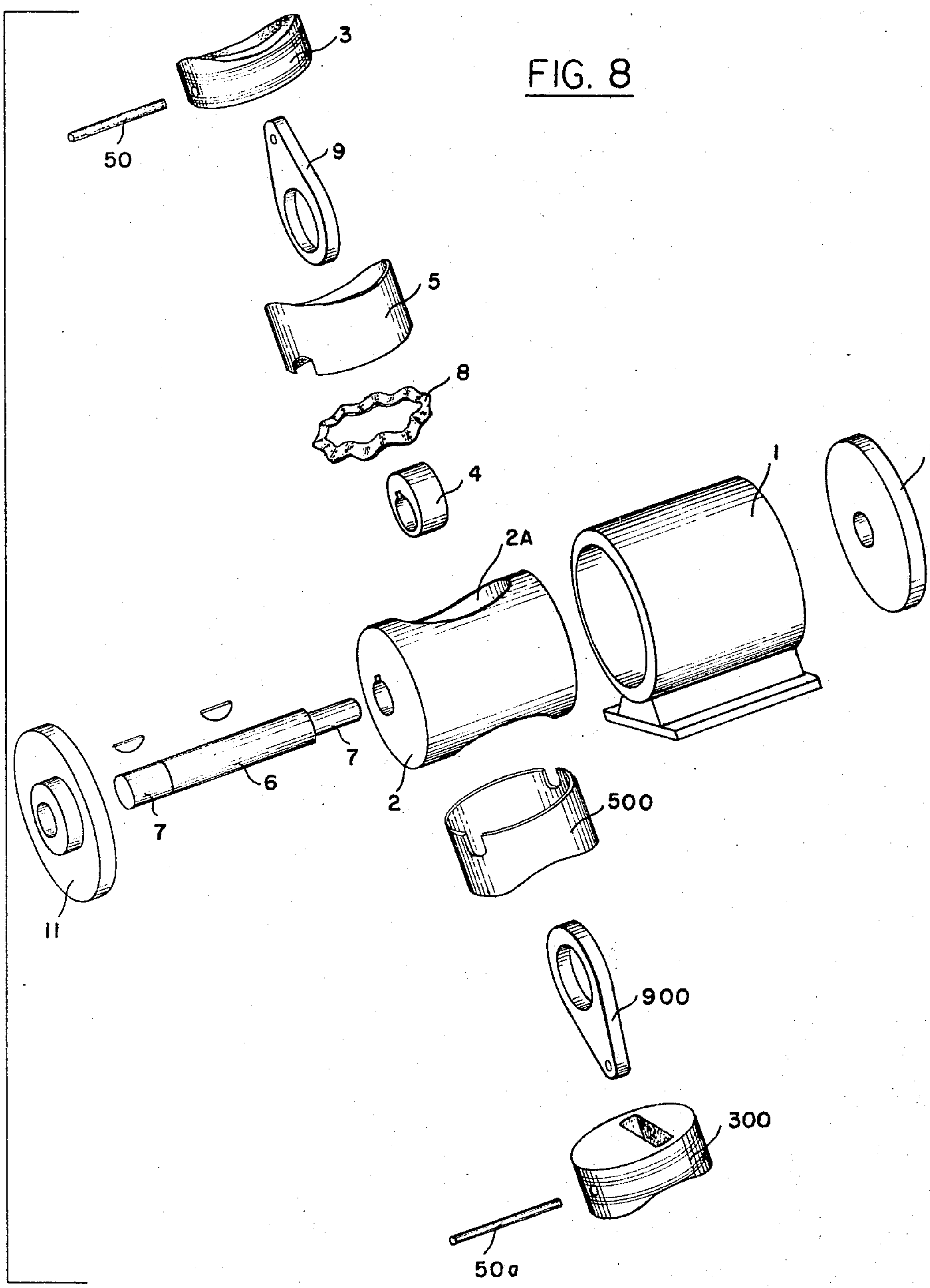


FIG. 8

ROTO-PISTON INTERNAL COMBUSTION ENGINE

BACKGROUND OF THE INVENTION

Rotary internal combustion engines which duplicate to some extent the operation of the usual piston engine are known. Such rotary engines perform the usual intake-compression and power-exhaust cycles by rotating parts. There are two general categories of rotary internal combustion engines known to the art. These comprise, for example, a irst category which is a direct analog of the reciprocating piston engine except that the pistons travel in a circular path; and a second category wherein motion is imparted to a drive shaft by a principal rotating part, or rotor, which is eccentric to the shaft.

A third category of prior art rotary engines is the revolving block engine which combines a reciprocating piston and a rotatable rotor. The internal combustion engine of the present invention is of the latter category, and it serves to combine a reciprocating piston with a rotor by means of a minimum of parts, and without the need for any irregularly shaped components. It is well known that the irregularly shaped components required by the prior art engines of this general category add materially to the expense and manufacturing difficulties of the prior art engines, as well as to maintenance costs.

The roto-piston engine of the present invention, in the embodiment to be described, is a diesel type engine. However, it will become immediately apparent to those skilled in the art, that the engine of the invention can be easily adapted for use as a gasoline engine by the addition of a conventional carburetor and sparkplug ignition system.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-section of an engine constructed to incorporate the principles of the invention, and is representative of one embodiment of the invention;

FIG. 2 is a side section of the motor of FIG. 1;

FIGS. 3A–3D are cross-sectional views, like FIG. 1, illustrating the four operational cycles of the engine;

FIG. 4 is an exploded perspective view of the engine, showing the components which make up the embodiment of FIGS. 1 and 2;

FIG. 5 is a cross-section of a second embodiment;

FIG. 6 is a side section of the second embodiment;

FIGS. 7A–7D represent the operational cycles of the second embodiment; and

FIG. 8 is an exploded perspective view of the components of the second embodiment.

As best shown in FIG. 4, for example, the illustrated embodiment of the invention includes a cylindrical housing 1 which is supported on an appropriate base designated, for example, 1A. A rotor 2 is rotatably supported within the housing 1, The outer diameter of the rotor 2 corresponds with the inner diameter of the cylindrical housing 1, so that the rotor is slidably rotatable with the inner surface of the housing.

The housing 1 has a cover 10 at one end, and a stationary shaft 6 is supported within the cover 10 by means, for example, of a set screw 21 (FIG. 2), the stationary shaft extending through a longitudinal passage 2B in the rotor and across a radial pocket 2A. The stationary shaft 6 extends along the longitudinal axis of the cylinder, and it receives a rotatable shaft 7 at its left-hand end in FIG. 4.

The rotatable shaft 7 extends through a cover 11 at the other end of the cylindrical housing 1. As best shown in FIG. 2, the rotatable shaft 7 has an end 7A of reduced diameter which extends into a cavity 6A in the shaft 6. The rotatable shaft may extend coaxially through the stationary shaft and extend from the right-hand end of the shaft 6 to be coupled, for example, to ancillary equipment such as pumps, generators, and the like. Alternately, other like engines can be coupled to the shaft to multiply the drive power of the assembly. The other end of the shaft 7 is journalled into the cover 11 by means of an appropriate bearing 13. The rotor 2 is keyed to the shaft 7 by means of a key 60, as also shown in FIG. 2.

A sleeve 5 is received in the radial pocket 2A. The pocket 2A has an annular bore of a particular diameter, and the sleeve 5 has a cylindrical shape with an outer diameter corresponding to the diameter of the bore, so that the sleeve is received in sliding fit in the bore 2A. The sleeve has notches, such as the notch 5A (FIG. 4) diametrically disposed to receive the shaft 6, so that there is no tendency for the sleeve 5 to rotate within the pocket 2A. An annular spring 8 is disposed at the bottom of the pocket, and this spring biases the sleeve 5 upwardly, so that its upper edge engages the inner wall of the cylindrical casing 1 to form a compression seal with the inner wall.

A disc 4 is mounted on the stationary shaft 6 in eccentric relationship with the shafts. The disc 4 is keyed to the shaft 6 by means of a key 52. The disc 4 is contained within a circular opening 9A in a ring connector member 9. The ring connector member 9, in turn, is pivotally attached to a piston 3 by means of a pin 50. The piston 3 is equipped with piston rings 3A (FIG. 4), and it moves reciprocally within the sleeve 5, with the rings bearing against the inner wall of the sleeve to form a compression seal therewith.

An examination of FIGS. 1 and 2, for example, will reveal that as the piston 3 is moved reciprocally in the radial pocket 2A, the ring 9 moves around the eccentric disc 4 so as to cause the rotor 2 to rotate. As best shown in FIG. 2, the rotor is supported on the stationary shaft 6 by means of a bearing 12; and it is keyed to the drive shaft 7, so that rotation of the rotor produces corresponding rotation of the drive shaft.

As shown in FIGS. 1 and 2, a gear 18 is mounted on the drive shaft, and it engages a further gear 19 mounted on an idler shaft 22. A cam 20 is also mounted on the idler shaft, so that as the drive shaft rotates, the cam 20 also rotates. The arrangement is such that the cam 20 rotates once for every two revolutions of the drive shaft.

As shown in FIG. 1, the cam 20 is coupled to a pair of rocker arms 26 and 32 by usual push rods 24 and 30. The rocker arms, in turn engage valve actuators 28 and 34 which, in turn, are respectively coupled to a pair of exhaust valves 16 and 17, and to a pair of intake valves 14 and 15. The mechanism is constructed so that for each two revolutions of the rotor 2, first the intake valves open and then the exhaust valves open, for four cycle operation, as shown in more detail in FIGS. 3A–3D. It is evident that the intake valves 14 and 15 may be automatic and open whenever the cylinder suction overcomes the force of the valve springs. Also, the exhaust passages may be coupled to a single passage and a single cam-activated exhaust valve to be used in conjunction with the common passage.

For example, the representation of FIG. 3A shows the rotor in position at the end of the intake stroke, and the beginning of the compression stroke. In the representation of FIG. 3A, the piston has moved form the top to the bottom of the pocket 2A with the intake valves 14 and 15 open, and in the presence of a 180° angular movement of the rotor 2 in a clockwise direction.

The representation of FIG. 3B shows the piston 3 at the end of its compression stroke, during which it moved from the bottom of the pocket 2A (FIG. 3A) to the top of the pocket (FIG. 3B), with al the valves closed, and as the rotor turned another 180° for the compression stroke. During the compression stroke, the injector 54 injects the usual fuel mixture into the top of the pocket, with the sleeve 5 forming a compression seal between the top of the pocket and the inner wall of the cylindrical casing.

The power stroke occurs during the next 180° angular rotation of the rotor 2, the completion of which is shown in FIG. 3, with the piston 3 being driven by the ignited fuel mixture to the bottom of the pocket 2A. Then, for the exhaust cycle, the exhaust valves 16 and 17 are opened by the cam-actuated mechanism shown in FIG. 1, so that as the piston returns to the top of the pocket to the position shown in FIG. 3D, the exhaust gases are removed from the pocket, and the engine is ready for the next cycle.

The embodiment of FIGS. 5–8 is generally similar to the embodiment described above, and like components have been designated by the same numbers. However, in the latter embodiment, and as best shown in FIGS. 5 and 6, a second piston 300 is incorporated in addition to the piston 3, so as to form a double acting engine. The drive shaft 7, as shown in FIG. 6, extends coaxially through the stationary shaft 6 to protrude from the right-hand end of the assembly. As suggested above, this portion of the drive shaft may be used to couple the engine to other similar engines for multiple operation, or to drive ancillary equipment, such as generators, pumps, or the like. Also, and as shown in FIG. 5, only the exhaust valves 16 and 17 are cam-controlled, the intake valves 14 and 15 being automatically actuated. Specifically, during each intake cycle, the intake valves respond to the suction within the cylinder to overcome their spring tension and to open.

The embodiment of FIGS. 5-8 includes a second sleeve 500 which is positioned in axial alignment with the sleeve 5, and which receives the piston 300. The angular spring 8 biases both the sleeves 5 and 500 outwardly so that their respective outer edges engage the inner surface of the cylindrical casing 1 to form compression seals with that surface. The disc 4, which is keyed to the shaft 6 by the key 52 is contained within the ring connector 9, and within a second ring connector 900, the latter ring connector being attached to the piston 300 by means of a pin 50*a*.

An examination of FIGS. 5 and 6, for example, will reveal that as the pistons 3 and 300 are moved reciprocally in opposite directions in the radial pocket 2A, the rings 9 and 900 move around the eccentric disc 4 to cause the rotor 2 to rotate. The representation of FIG. 7A shows the rotor at the end of the intake stroke, and the beginning of the compression stroke, insofar as the piston 3 is concerned; and at the end of the exhaust stroke and the beginning of the intake stroke insofar as the piston 300 is concerned. Prior to the positions shown in FIG. 7A, the piston 3 moved from the center of the radial pocket to the outer position to open (by suction) one of the intake valves, and at the same time the piston 300 moved from the center of the radial pocket to its illustrated end position with one of the exhaust valves whose port is uncovered by the rotor open.

The representation of FIG. 7B shows the piston 3 at the end of its compression stroke, during which it has moved to the top of the pocket with the corresponding intake and exhaust valves closed. During the compression stroke, the injector 54 injects the usual fuel mixture into the top of the pocket, as described above. At the same time, the piston 300 moves to the bottom of the pocket to complete its intake stroke and causes one of the intake valves to open.

The power stroke for the piston 3 occurs during the next 180° angular rotation of the rotor 2, the completion of the power stroke for the piston 3 being shown in FIG. 7C, at the same time, the piston 300 completes its compression stroke. Finally, as shown in FIG. 7D, the piston 3 moves to the top of the pocket for its exhaust stroke, and the piston 300 moves to the bottom of the pocket for its power stroke.

It will be understood that as the rotor turns, the ports of the intake and exhaust valves are opened; and also the exhaust valves are opened and closed by cam action, and the intake valves are opened during the intake strokes by suction when their ports are uncovered by the rotor, so as to permit the engine to operate in the manner described above.

The invention provides, therefore, an improved and simplified roto-piston engine which is efficient in operation, and yet which is simple and inexpensive in its construction. It will be appreciated that although particular embodiments of the invention are shown and described, modifications may be made. It is intended in the claims to cover the modifications which fall within the spirit and scope of the invention.

What is claimed is:

1. An internal combustion engine comprising: a cylindrical casing having a longitudinal axis; a rotor coaxially supported within said casing for rotation about said longitudinal axis, said rotor having a radial pocket formed therein; at least one piston slidably mounted in said radial pocket of said rotor and reciprocally movable therein for rotation of said rotor; a sleeve slidably mounted in said pocket in coaxial relatonship with said piston; resilient means biasing said sleeve against the inner wall of said cylinder to form a compression seal therewith; a stationary shaft extending along the longitudinal axis of said cylinder and across said pocket; connecting means coupled to said stationary shaft and to said piston to produce rotation of said rotor about said stationary shaft as said piston is moved reciprocally in said pocket; a drive shaft rotatably mounted in said casing along the longitudinal axis thereof and disposed in linear axial relationship with respect to said stationary shaft; means keying said rotor to said drive shaft; and intake and exhaust valves mounted on said casing in communication with said radial pocket.

2. The internal combustion engine defined in claim 1, and which includes actuator means for said exhaust valves coupled to said drive shaft.

3. The internal combustion engine defined in claim 1, in which said rotor includes a pair of diametrically positioned radial pockets, and which includes a pair of pistons slidably mounted in respective ones of said radial pockets of said rotor and reciprocally movable therein in mutually opposite directions for rotation of said rotor.

4. The internal combustion engine defined in claim 3, and which includes a pair of sleeves mounted in respective ones of said pockets in coaxial relationship with respective ones of said pistons, and resilient means

biasing said sleeves outwardly and aganist the inner surface of sad cylinder to form respective compression seals therewith.

5. The internal combustion engined defined in claim 1, in which said connecting means comprises a disc member keyed to said stationary shaft in eccentric relationship with said longitudinal axis; and a ring-shaped connector member having an opening therein for rotatably receiving said disc.

* * * * *