United States Patent [19]
Sarich

[11] **3,787,150**
[45] **Jan. 22, 1974**

[54] **ROTARY MOTOR**

[76] Inventor: **Tony Ralph Sarich,** 2 Hadley Pl., Karrinyup, Bayswater, Australia 6018

[22] Filed: **July 6, 1971**

[21] Appl. No.: **159,834**

[30] **Foreign Application Priority Data**
July 6, 1970 Australia 1737/70

[52] **U.S. Cl.** **418/61,** 123/8.45
[51] **Int. Cl.** **F02b 53/00**
[58] **Field of Search** 123/8.45; 418/61, 177, 151, 418/63, 64

[56] **References Cited**

UNITED STATES PATENTS

3,318,291	5/1967	Hallenbeck	418/61 X
1,686,505	10/1928	Stastny	418/151 X
3,368,537	2/1968	Cavallone	123/8.45
3,132,632	5/1964	Kehl	123/8.45
3,063,429	11/1962	Niemann	418/61

FOREIGN PATENTS OR APPLICATIONS

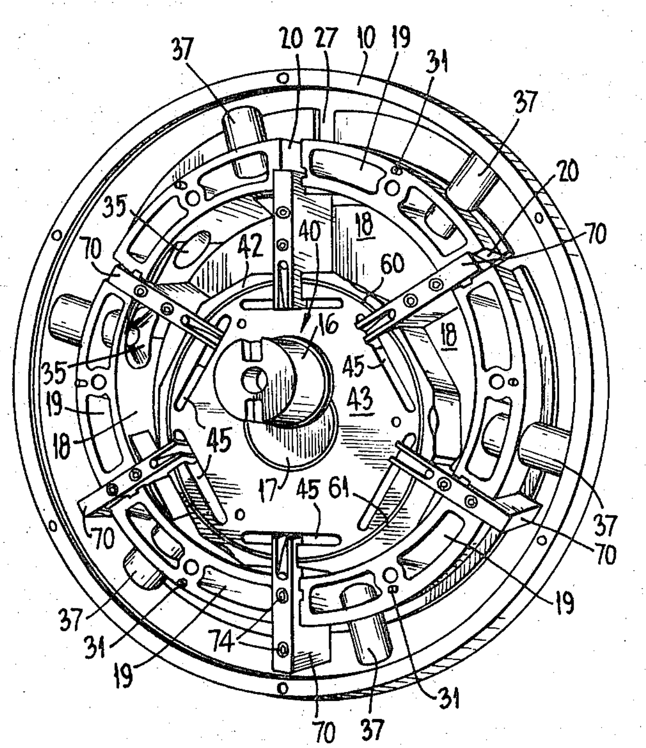
716,565	10/1931	France	418/173
295,146	4/1965	Netherlands	123/8.45
973,191	10/1964	England	123/8.45

Primary Examiner—Al Lawrence Smith
Assistant Examiner—Michael Koczo, Jr.
Attorney, Agent, or Firm—E. F. Wenderoth et al.

[57] **ABSTRACT**

A rotary vanes type motor having a plurality of vane mounted for reciprocal movement in a housing in a radial direction with respect to a shaft journalled in the housing. A piston member is eccentrically mounted on the shaft in the housing so that the piston member will orbit without rotation in the housing as the shaft rotates. The vanes are connected to the piston member so as to reciprocate when the piston member orbits. The housing, vanes, and piston member defining a plurality of chambers to which a working fluid may be admitted in sequence to induce orbiting of the piston member and resulting rotation of the shaft.

15 Claims, 4 Drawing Figures



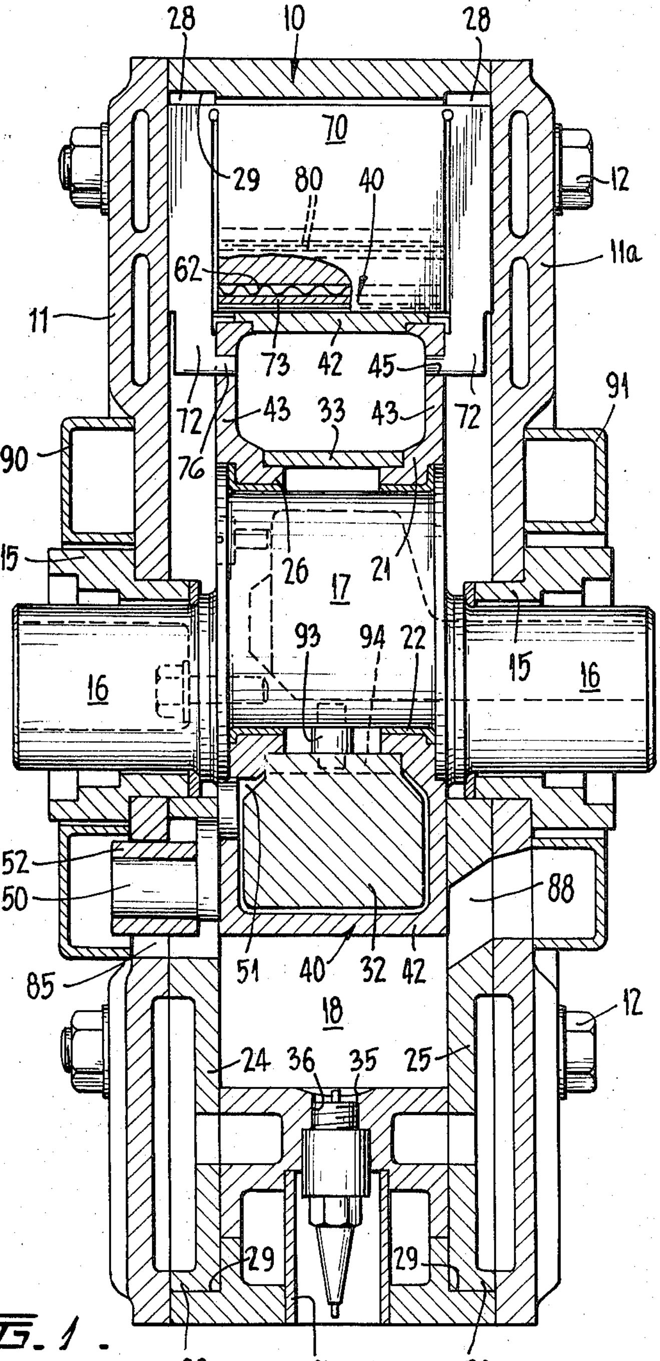


FIG. 1.

INVENTOR

TONY RALPH SARICH

BY Wenderoth, Lind + Ponack

ATTORNEYS

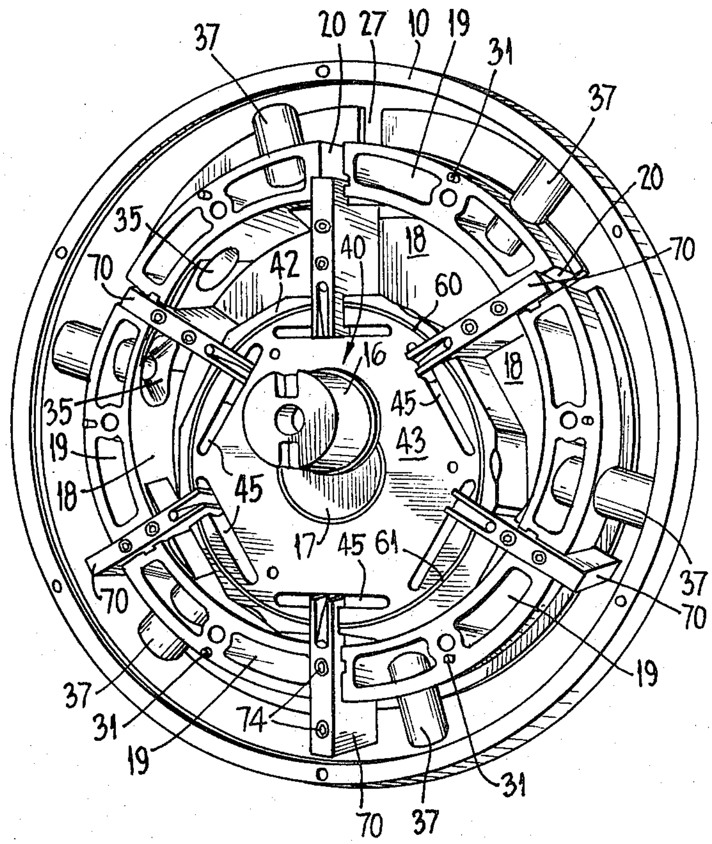


FIG. 2.

INVENTOR

TONY RALPH SARICH

BY Wenderoth, Lind & Ponack

ATTORNEYS

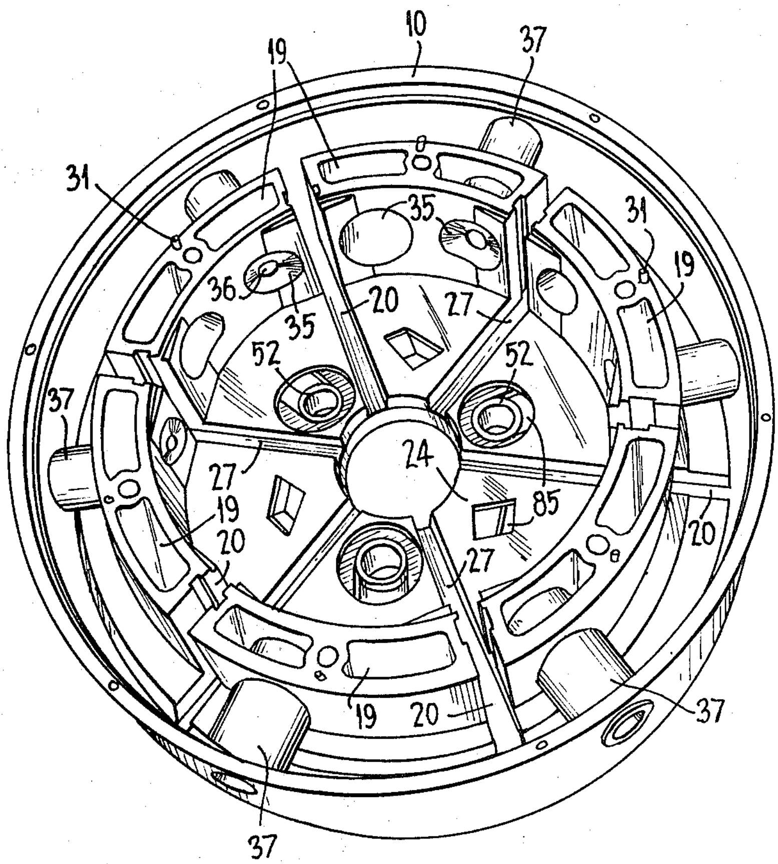


FIG. 3

INVENTOR

TONY RALPH SARICH

BY Wenderoth, Lind & Ponack

ATTORNEYS

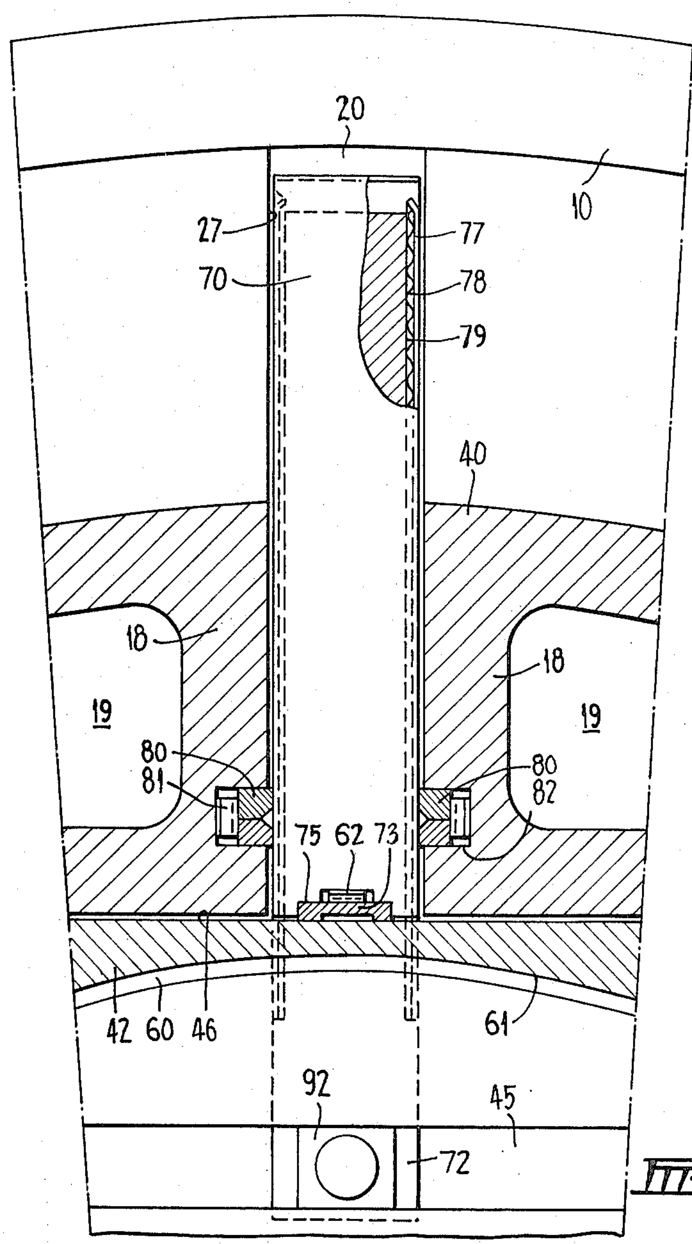


FIG. 4

INVENTOR

TONY RALPH SARICH

BY Wenderoth, Lind & Ponack

ATTORNEYS

ROTARY MOTOR

This invention relates to a rotary motor which may be operated on the internal combustion engine principle, but may also operate as a steam engine or hydraulic motor.

There have been proposed numerous constructions of rotary motors, many incorporating sliding vanes which divide a cavity formed between a stationary and rotary member into a plurality of chambers. A common problem encountered in previously proposed vane-type rotary motors, is the provision of adequate support for the sliding vanes, and the maintaining of an effective seal between the sliding vanes and the stationary housing and rotor. It has been the practice to support the vane for reciprocating sliding movement either in the stationary housing or in the rotor, with the projecting portion of the vane completely unsupported. Suitable spring devices are provided to urge the vanes in a direction to maintain engagement between the free end of the vane and the rotor or housing as the case may be.

One principal disadvantage of these constructions is that the vane is only supported at one end and thus, when the vane is in its extended position, it is subjected to substantial bending stresses. In order to withstand these stresses it has been necessary to use vanes of substantial thickness and hence of increased weight. The weight of the vanes introduces inertia problems and consequently necessitate strong spring devices to induce the necessary movement in the vanes to maintain contact at their free end with the co-operating rotor or housing. Also deflection of the vane due to only one end being supported causes increased frictional resistance to sliding movement of the vane.

It is the principal object of the present invention to provide a rotary motor of the vane-type, in which the supporting and sealing problems inherent in previously proposed vane-type rotary motors are substantially reduced to provide an effective motor.

With the above stated object in view, there is provided an engine comprising a housing having a cavity defined by an internal peripheral wall and opposed end walls, a shaft rotatably supported in the housing, a piston member journalled eccentrically on said shaft to describe an orbital path within the cavity upon relative rotation between the shaft and housing, a plurality of vanes disposed radially to and spaced equally about the shaft axis and supported in the housing for reciprocal movement radially with respect to the shaft axis, said vanes being connected to the piston member so that the piston member can move relative to each vane in a direction at right angles to the direction of reciprocation of the respective vane and at right angles to the shaft axis to permit orbiting of the piston member upon reciprocation of the vanes relative to the housing, sealing means operatively disposed between each vane and the piston member, the housing peripheral wall and the housing end walls to divide the cavity into a plurality of chambers the volume of each chamber varying as the piston member orbits, and means to regulate the admission to and exhausting from each chamber in sequence of a working fluid to induce orbiting of the piston member and resultant rotation of the shaft.

As the piston member describes a purely orbital movement, there is no angular movement between the vanes and the piston member, and consequently the vanes may be connected to the piston member. Accordingly, it is not necessary to provide any spring devices to induce the reciprocating movement of the vanes as this is positively induced by the connection between the vanes and piston member.

The orbital movement of the piston member within the cavity of the housing is such that the piston member maintains a constant angular relation to any diametral plane passing through the shaft axis.

As the vanes are only subjected to pure reciprocal movement relative to the housing each vane may be slidably supported in respective radial slots in each end wall and peripheral wall of the cavity.

Thus there is provided an engine comprising a housing having a generally cylindrical cavity defined by a peripheral wall and opposed end walls, a shaft rotatably supported in the housing coaxial with the cavity, a piston member disposed within the cavity and journalled eccentrically on said shaft to describe an orbital path about the shaft axis when the shaft rotates, a plurality of vanes disposed radially to and spaced equally about the shaft axis, each vane being slidably supported in respective slots in each end wall and the peripheral wall for reciprocal movement radially with respect to the shaft axis, each vane being connected to the piston member to reciprocate relative to the housing upon orbiting of the piston member relative to the housing, sealing means operatively disposed between each vane and the piston member, the housing peripheral wall and the housing end walls to divide the cavity into a plurality of chambers, the volume of each chamber varying as the piston member orbits, and means to regulate the admission to and exhausting from each chamber in sequence of a working fluid to induce orbiting of the piston member and resultant rotation of the shaft.

The supporting of the vanes in the slots in the end walls of the chamber substantially reduces the stresses in the vanes, particularly when they are in their extended position, and thus the vanes will not bend or deflect, and may be made of a lighter construction with a resultant reduction in inertia loads.

Some further advantages inherent in this construction are:

1. There is no contact between the peripheral surfaces of the piston member and the chamber, and thus accurate machining of these surfaces is not necessary, and there is no wearing thereof.

2. The pressure differential on the opposite sides of the vanes, at any point in their working cycle, is small in comparison with many other vane type engines. The maximum pressure differential occurs when the vane is retracted to its fullest extent, and hence has a minimum area exposed to the pressure difference.

3. The surfaces of the vanes which are in wearing contact with the piston member or housing may be flat surfaces, and thus uniform wear on these surfaces does not interfere with their functioning. The flat surfaces also simplify seal construction as flat seal strips may be used.

4. Lubrication and cooling of the vanes may be simply effected by an oil spray directed onto the face of the vanes when in the retracted position as substantially the whole surface of the vane is then outside the working chamber. Further, the incoming charge of gas will contact a large exposed surface of the vane as the vane is in its fully extended position.

Conveniently there is provided at least one member having two journalled sections eccentric with respect to one another, one rotatably supported in the housing and the other in the piston member with the axes thereof parallel to the shaft axis, the eccentricity of the journalled sections and the location thereof relative to the shaft being such as to guide the piston member in the orbital path when the shaft rotates. Preferably there are three such members spaced equally about the shaft axis.

The invention will be more readily understood from the following description of an internal combustion engine as illustrated in the accompanying drawings. The engine illustrated operates on the two-stroke cycle, but it will be readily understood that by the provision of suitable valve mechanisms, the engine may operate on the four-stroke cycle. Similarly, it will be readily understood that with appropriate modifications, the engine may operate as a steam engine or hydraulic motor.

Referring now to the drawings:

FIG. 1 is a section view of the engine along a diametral plane.

FIG. 2 is a perspective view with the exhaust end cover and chamber end plates removed to show the cam member and vanes.

FIG. 3 is a perspective view similar to FIG. 2 with the vane and cam member also removed.

FIG. 4 is an enlarged sectional view of portion of the housing and cam member showing the arrangement of seals for one vane.

The engine comprises a cylindrical outer casing **10**, opposed end cover plates **11, 11*a*** attached by bolts **12** around their periphery to the outer casing **10.** Bearings **15** supported in the cover plates rotatably support the crank shaft **16** for rotation about an axis co-axial with the outer casing **10.**

The six arcuate peripheral combustion chamber sections **18** are disposed within the outer casing **10** in a generally circular formation co-axial with the shaft **16.** The chamber sections **18** have cavities **19** formed therein which constitute a cooling water jacket. The arcuate length of the chamber sections **18** is such that when assembled slots **20** are provided between adjacent sections **18,** the slots **20** extending the full axial and radial dimension of the sections and radially with respect to the crank shaft. The six chamber sections define an internal surface of generally hexagonal shape with the corners of the hexagon rounded by a curved surface which blends smoothly with the adjacent straight sides.

Associated with each of the chamber sections **18** are two opposed chamber end plates **24, 25,** of generally sector shape, which extend from the outer casing **10** to the vicinity of the crank shaft **16.** The chamber end plates **24, 25** also define between adjacent radial faces, radial slots **27** which register with the slots **20** defined by the chamber sections **18.** The outer peripheral edge **28** of the chamber end plates are received in the recess **29** in the outer casing **10** and the end cover plates **11, 11*a*,** chamber sections **18** and chamber end plates **24, 25,** and held in assembly by the bolts **12** extending through aligned apertures therein and the locating dowels **31.**

Two part spherical combustion cavities **35** are provided in the internal peripheral surface of each chamber section **18,** with a threaded spark plug aperture **36** communicating with one of each cavities. Associated with each spark plug aperture **36** is a sleeve **37** extending between the chamber section **18** and the outer casing **10** to house, and provide access, to the spark plug.

The crank shaft **16** has the piston member **40** mounted on the eccentric journal **17** of the crank shaft through the bearings **21** to permit relative angular movement therebetween. The piston member **40** comprises the peripheral ring and integral side plate **42,** and attached side plate **43,** with six equally spaced slots **45** in each side plate. The slots **45** in each side plate are arranged in the formation of a hexagon having an axis coincident with the axis of the eccentric journal **17** of the crank shaft. Corresponding slots **45** in the respective side plates **42, 43** are in alignment in the axial direction.

The three eccentrics **50** are supported in bearing **52** in the inlet end cover plate **11** in equally spaced relation about the axis of the crank shaft and engage apertures **51** in side plate **43** of the piston member **40.** The throw of the eccentrics **50** are arranged in relation to that of the crank shaft so that when the crank rotates the piston member describes an orbital path. The orbital path is such that the slots **45** retain a constant angular relation to any radial plane passing through the axis of the crank shaft **16.** Annular seal rings **60,** located in respective grooves **61** in each side plate of the piston member, are pressed against the chamber end plates by the respective spring strips below the seal rings.

The crank shaft **16** is of two-piece construction whereby the web **21** and journal **22** may be detached from the eccentric journal **17** to permit assembly of the piston member **40** to the journal **17.** The counterweight **32** has an integral cylindrical mounting portion **33** rotatably supported on the spigots **26** on the respective side plates of the piston member. The counterweight is disposed diametrically opposite the eccentric journal **17** of the crankshaft and is caused to rotate with the crankshaft by the pin **93** engaging the slot **94** in the counter-weight. The counter-weight is made of bronze so that bearing bushes are not required. This arrangement of the counter-weight provides both static and dynamic balance. The vanes **70** are of generally rectangular shape and are supported in the slots **20** and **27** for sliding movement in the radial direction relative to the crank shaft **16.** Each vane **70** is connected to the piston member **40** by two legs **72** extending along each radial edge of the vane and secured to the vane by studs **74.** The laterally projecting pin **76** at the inner end of each leg is received in a slipper **92** which slidably engages the respective slots **45** in each side plate of the piston member so that the vanes reciprocate in response to orbital movement of the piston member **40.** The seal strip **73** located in the recess **75** in the radially inner edge of the vane engages the outer peripheral surface **46** of the piston member. The spring strip **62** below the seal strip **73** maintains the latter in engagement with the peripheral surface **46.**

It will be noted that the portions of the peripheral surface of the piston member along which the respective vanes move are flat and parallel to the associated slots **45** in the side plates. The peripheral surface of the piston member **40** is thus of generally hexagonal shape with the corners rounded.

Seal strips **77** and associated spring strip **78** are provided in radially extending grooves **79** in each side face of each vane, adjacent each end thereof. The seal strips **77** engage the walls of the radial slots **27** formed between the chamber end plates **24, 25.**

Further seal strips **80** and associated spring strips **81** are provided in grooves **82** in each end face of the arcuate chamber sections **18** to engage the opposite side faces of each vane.

The construction so far described provides sic chambers defined by the arcuate sections **18**, the chamber end plates **24, 25** the vanes **70**, and the piston member **40.** During each complete cycle of orbital movement of the piston member the volume of each chamber undergoes a complete cycle of variation from minimum to maximum and return to minimum. It will be thus understood that the application of a fluid under pressure to each chamber in sequence when the chamber is at or near minimum volume will apply a force to the portion of the piston member of the chamber to induce orbital movement of the piston member **40** and resultant rotation of the crank shaft **16.**

The following description relates to the further details of construction shown in the drawings relevant to an internal combustion engine but it will be readily understood by those skilled in the art the nature of modification necessary in order to operate the engine by the use of other working fluids such as steam or hydraulic fluid.

Referring again to the drawings, inlet ports **85** extend through the end cover plate **11** and the respective chamber end plates **24** to communicate with the respective chambers. The ports **85** are opened and closed by the piston member **40** during the orbital movement thereof. Similar exhaust ports **88** are provided in the opposite end cover plate **11a** and chamber end plates **25,** and are likewise opened and closed by the piston member **40.** It will be noted the three of the inlet ports **85** are in the vincinity of the bearings **52** supporting the eccentrics **50.**

Each inlet port **85** communicates with the inlet manifold **90** and all exhaust ports **88** communicate with the exhaust manifold **91.**

This porting arrangement allows the engine to operate on the two stroke cycle, and the actual shape and location of the ports may be readily determined by those skilled in the art.

As the two stroke cycle does not provide suction to draw the mixture into the chamber, a suitable blower (not shown) is provided to deliver the mixture to the inlet manifold **90** communicating with each inlet port **85.** The blower may be driven by the crank shaft **16** or may be an exhaust driven turbo-blower. The fuel may be supplied by a conventional carburettor or a fuel injection system may be used. It will be appreciated that the engine may also operate on the diesel principle, either two or four stroke cycle.

If the engine is to operate on the four stroke cycle inlet and exhaust ports may be provided in the arcuate peripheral chamber section **18** with mechanically or other suitably operated valves to control the admission and exhaust of the charge to each chamber.

A feature of this engine is that the rate of increase in volume of each chamber relative to the angular movement of the crank shaft is not uniform, the rate being initially high. In the engine shown in the drawings the volume of each cylinder increases to approximately 68 percent of maximum volume during the initial 90° of rotation of the crank shaft from top dead centre. This results in a high torque at low engine revolutions.

The engine shown in the drawings has provision for the fitment of conventional spark-plugs and these would be energised in sequence by a conventional magneto or coil and distributor ignition system. If the engine operated on the diesel principle, a suitable injector would be fitted to as a substitute for the spark-plug.

In order to reduce the loading on the connections between the vanes and the orbiting piston member the gallery between the outer casing **10** and the chamber sections **18,** may be filled with a liquid such as oil. as the vanes are moved in a radially outward direction by the orbiting piston member, the oil displaced by the outwardly moving vanes will impart a corresponding radially inward movement to other vanes and consequently the inwardly directed force applied by the piston member to the inwardly moving vanes will be reduced. Alternatively, or in addition, the ends of the vanes adjacent the piston member may have surfaces projecting laterally therefrom within the engine chambers, so that the fluid pressure in the chambers will apply a force to the vanes to move them in a radially inward direction.

I claim:

1. An engine comprising a housing having a cavity defined by an internal peripheral wall and opposed end walls; a shaft rotatably supported in said housing; a piston member journalled eccentrically on said shaft to describe an orbital path within said cavity upon relative rotation between said shaft and housing; a plurality of vanes disposed radially to and spaced equally about the axis of said shaft and supported in said housing for reciprocal movement radially with respect to said shaft axis, each of said vanes being connected to said piston member so that said piston member can move relative to each vane in a direction at right angles to the direction of reciprocation of the respective vane and at right angles to said shaft axis to permit orbiting of said piston member upon reciprocation of said vanes relative to said housing; sealing means operatively disposed between each of said vanes and said piston member, said housing peripheral wall and said housing end walls to divide said cavity into a plurality of chambers, the volume of each chamber varying as said piston member orbits; and means to regulate the admission to and exhausting from each of said chambers in sequence of a working fluid to induce orbiting of said piston member and resultant relative rotation between said shaft and housing.

2. An internal combustion engine comprising a housing having a cavity defined by an internal peripheral wall and opposed end walls; a shaft rotatably supported in said housing; a piston member journalled eccentrically on said shaft to describe an orbital path within said cavity upon relative rotation between said shaft and housing; a plurality of vanes disposed radially to and spaced equally about the axis of said shaft and supported in said housing for reciprocal movement radially with respect to said shaft axis, each of said vanes being connected to said piston member so that said piston member can move relative to each vane in a direction at right angles to the direction of reciprocation of the respective vane and at right angles to said shaft axis, whereby orbiting of said piston member effects reciprocation of said vanes relative to said housing; sealing means operatively disposed between each of said vanes and said piston member, said housing peripheral wall, and said housing end walls to divide said cavity into a plurality of chambers, the volume of each chamber varying as said piston member orbits; and means to regulate the admission to, ignition in and exhausting from each of said chambers in sequence of a gaseous mixture to induce orbiting of said piston member and resultant relative rotation between said shaft and housing.

3. An internal combustion engine as claimed in claim **2**, wherein each of said vanes is slidably supported in respective slots in each of said end walls and said peripheral wall of said housing.

4. An internal combustion engine as claimed in claim **2**, further comprising at least one member having two journal sections eccentric with respect to one another, one of said sections rotatably supported in said housing and the other of said sections rotatably supported in said piston member, with the axis of each section parallel to said shaft axis, the eccentricity of said journal sections and the location thereof relative to said shaft being such as to guide said piston member in the orbital path when said shaft rotates.

5. An internal combustion engine as claimed in claim **2**, wherein each of said vanes has a radially inwardly extending portion at each axial end thereof, each said portion being connected to said piston member to prevent relative movement between said vane and piston member in the radial direction and to permit relative movement therebetween in a direction at right angles to the direction of reciprocating movement of said vane.

6. An engine comprising a housing having a generally cylindrical cavity defined by a peripheral wall and opposed end walls; a shaft rotatably supported in said housing coaxial with said cavity; a piston member disposed within said cavity and journalled eccentrically on said shaft to describe an orbital path about the axis of said shaft when said shaft rotates; a plurality of vanes disposed radially to and spaced equally about said shaft axis, each of said vanes being slidably supported in respective slots in each of said end walls and said peripheral wall for reciprocal movement radially with respect to said shaft axis; each of said vanes being connected to said piston member to reciprocate relative to said housing upon orbiting of said piston member relative to said housing; sealing means operatively disposed between each of said vanes and said piston member, said housing peripheral wall, and said housing end walls to divide said cavity into a plurality of chambers, the volume of each chamber varying as said piston member orbits; and means to regulate the admission to and exhausting from each of said chambers in sequence of a working fluid to induce orbiting of said piston member and resultant rotation of said shaft.

7. An engine as claimed in claim **6**, further comprising at least one member having two journal sections eccentric with respect to one another, one of said journal sections rotatably supported in said housing, and the other of said journal sections rotatably supported in said piston member with the axis of each section parallel to said shaft axis, the eccentricity of said journal sections and the location thereof relative to said shaft being such as to guide said piston member in the orbital path when said shaft rotates.

8. An engine as claimed in claim **6**, wherein said piston member has an external peripheral surface including a plurality of flat setions spaced equally about the axis of said piston member, and extending the full width of said piston member in the axial direction thereof, said flat sections sealably engaging with the radially inner end of one of said vanes and extending in a plane normal to the direction of reciprocation of the respective vane.

9. An engine as claimed in claim **6**, wherein each of said vanes has a radially inwardly extending portion at each axial end thereof, located in said respective slots in each of said end walls, each of said portions being connected to said piston member to prevent relative movement between said vane and piston member in the radial direction and to permit the relative movement therebetween in the direction at right angles to the direction of reciprocation of said vane.

10. An engine comprising a housing having a generally cylindrical cavity defined by a peripheral wall and opposed end walls; a shaft rotatably supported in said housing coaxial with said cavity; a piston member disposed within said cavity and journalled eccentrically on said shaft to describe an orbital path about the axis of said shaft when said shaft rotates; a plurality of vanes disposed radially to and spaced equally about said shaft axis, each of said vanes being slidably supported in respective slots in each of said end walls and said peripheral wall for reciprocal movement radially with respect to said shaft axis, said vanes being independently connected to said piston member so that said piston member can move relative to each vane in a direction at right angles to the direction of reciprocation of the respective vane and at right angles to said shaft axis to permit orbiting of said piston member upon reciprocation of said vanes relative to said housing; sealing means operatively disposed between each of said vanes and said piston member, said housing peripheral wall and said housing end walls to divide said cavity into a plurality of chambers, the volume of each of said chambers varying as said piston member orbits; and means to regulate the admission to and exhausting from each of said chambers in sequence of a working fluid to induce orbiting of said piston member and resultant rotation of said shaft.

11. An engine as claimed in claim **10**, further comprising at least one member having two journal sections eccentric with respect to one another, one of said journal sections rotatably supported in said housing and the other of said journal sections rotatably supported in said piston member with the axis of each section parallel to said shaft axis, the eccentricity of said journal sections and the location thereof relative to said shaft being such as to guide said piston member in the orbital path when said shaft rotates.

12. An engine as claimed in claim **10**, wherein said piston member has an external peripheral surface including a plurality of flat sections spaced equally about the axis of said piston member, and extending the full width of said piston member in the axial direction thereof, said flat sections sealably engaging with the radially inner end of one of said vanes and extending in a plane normal to the direction of reciprocation of the respective vane.

13. An engine as claimed in claim **12**, wherein each of said vanes has a radially inwardly extending portion at each axial end thereof, each said extending portion of said vanes having a slipper member mounted thereon, said piston member having radial end walls at each axial end thereof, and a pair of slots associated with each of said flat sections of said peripheral surface, one of said slots in each of said end walls, each of said slots extending parallel to the associated flat section, said slipper members on each of said vanes slidably engaging the respective slots to connect said vane to said piston member to prevent relative movement between said vane and piston member in the radial direction and to permit relative movement therebetween in a direction parallel to said flat section of said piston member peripheral surface with which the vane engages.

14. An engine as claimed in claim **10,** wherein each of said vanes has a radially inwardly extending portion at each axial end thereof, located in said respective slots in each of said end walls, each said portion being connected to said piston member to prevent relative movement between said vane and piston member in the radial direction and to permit the relative movement therebetween in the direction at right angles to the direction of reciprocation of said vane.

15. An engine as claimed in claim **10,** wherein said piston member is hollow, and a counter-weight is mounted within said piston member and rotatably supported by said piston member of rotation in unison with said shaft about said shaft axis, said counter-weight being of a mass and disposition relative to said shaft to statically and dynamically balance said shaft.

* * * * *