Dec. 27, 1955 H. M. PETERSEN 2,728,330

ROTARY INTERNAL COMBUSTION ENGINE

Filed Sept. 13, 1948 4 Sheets-Sheet 1

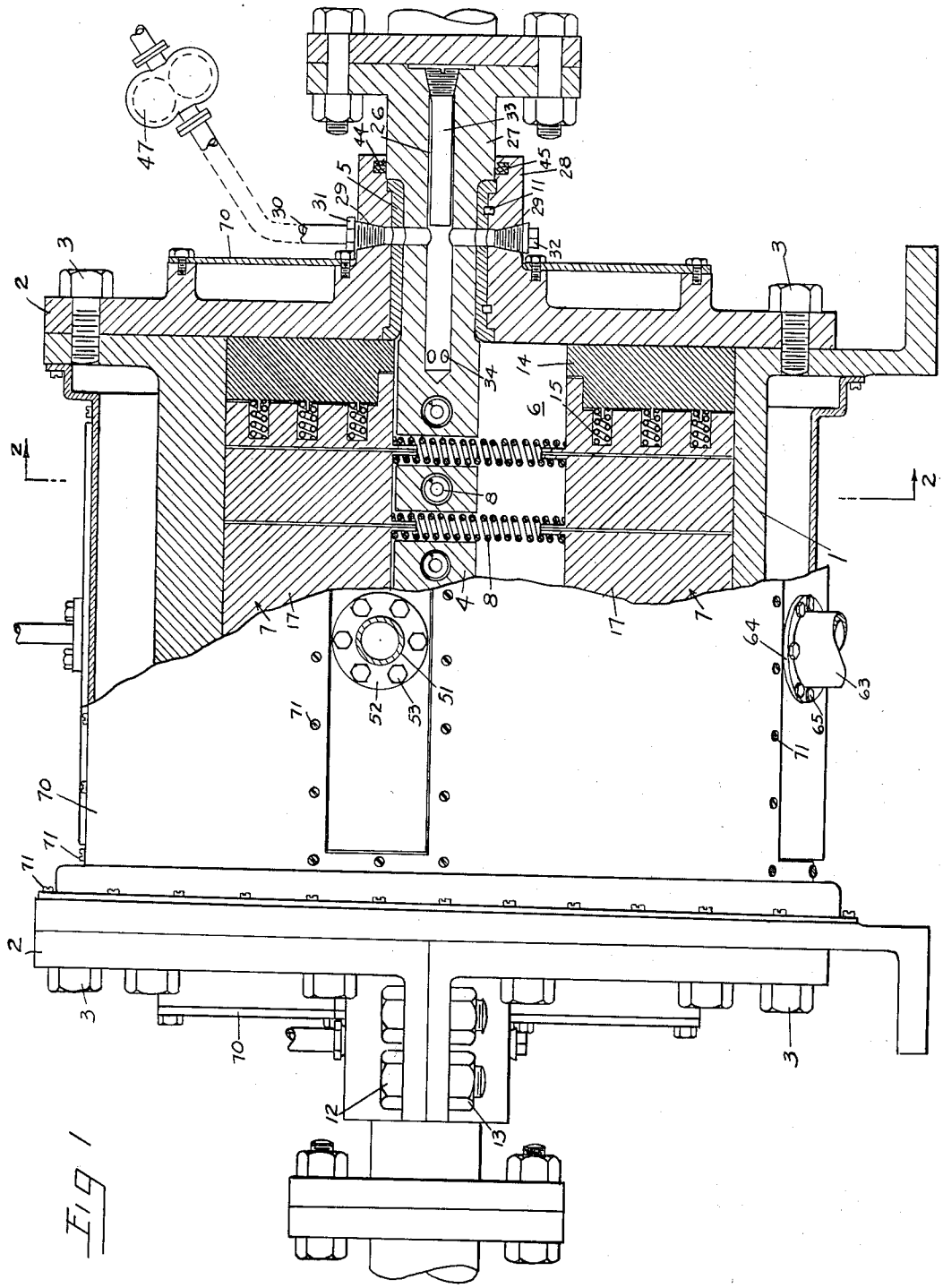


Fig 1

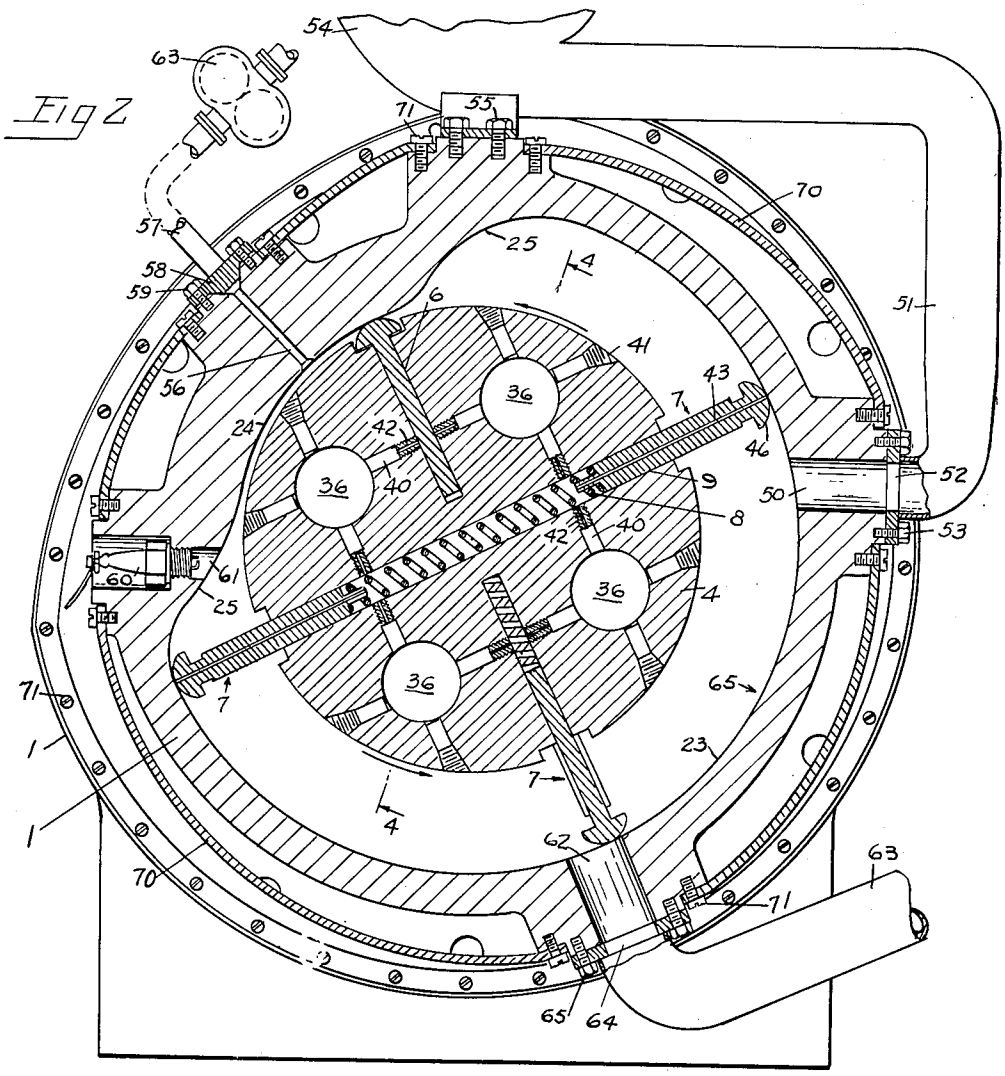
INVENTOR
HANS M. PETERSEN.
BY Boyken, Molden & Beckley
ATTORNEYS

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Fig 2



INVENTOR
HANS M. PETERSEN
BY Boyken, Mohler & Beckley
ATTORNEYS

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Fig 3

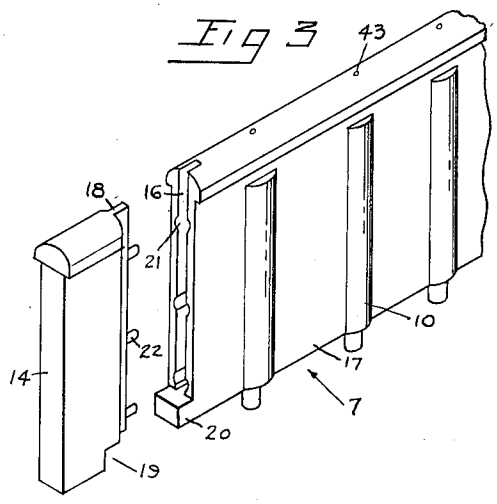
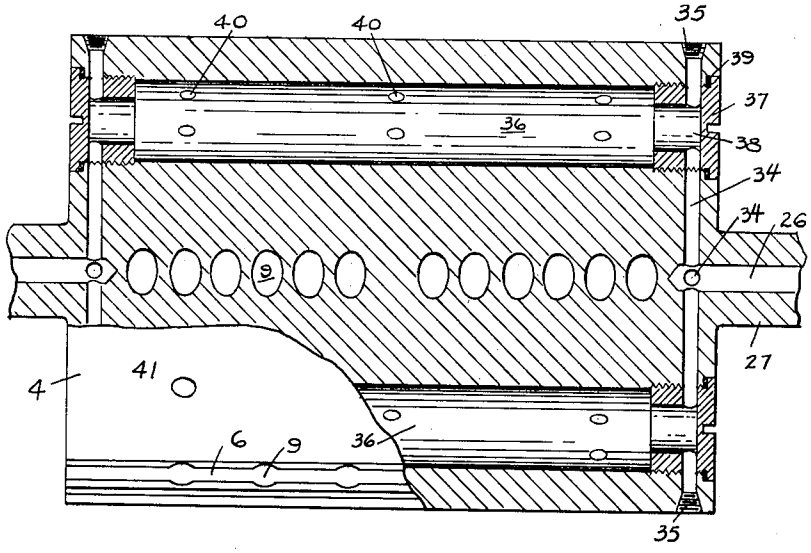


Fig 4



INVENTOR.

HANS M. PETERSEN

BY

Boyken, Mohler & Beckley

ATTORNEYS

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Fig 5

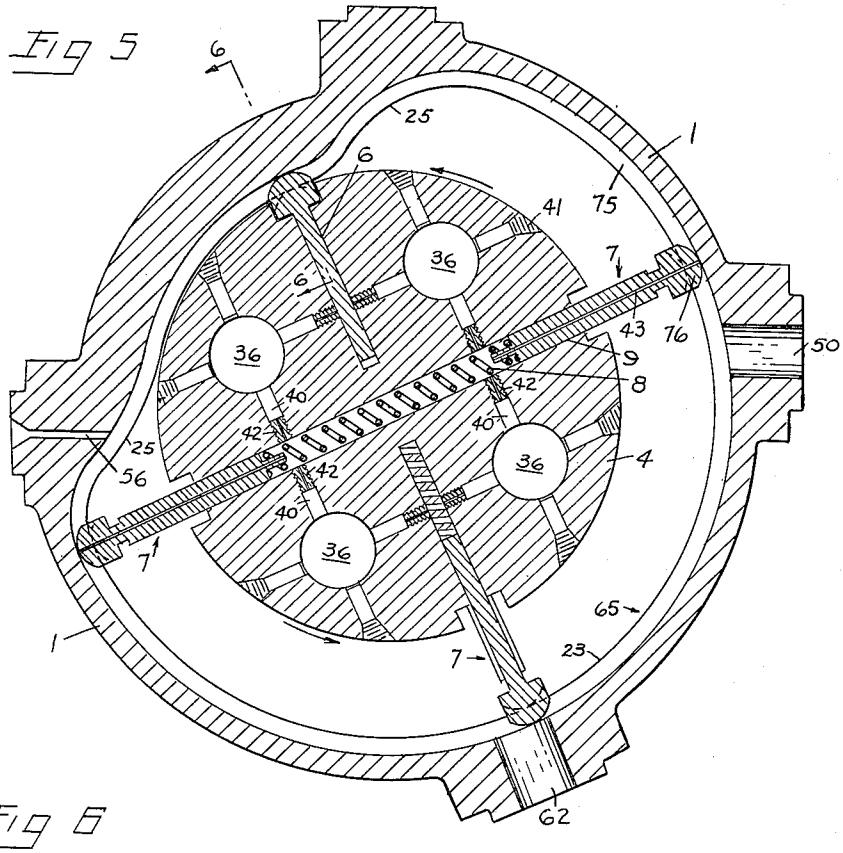
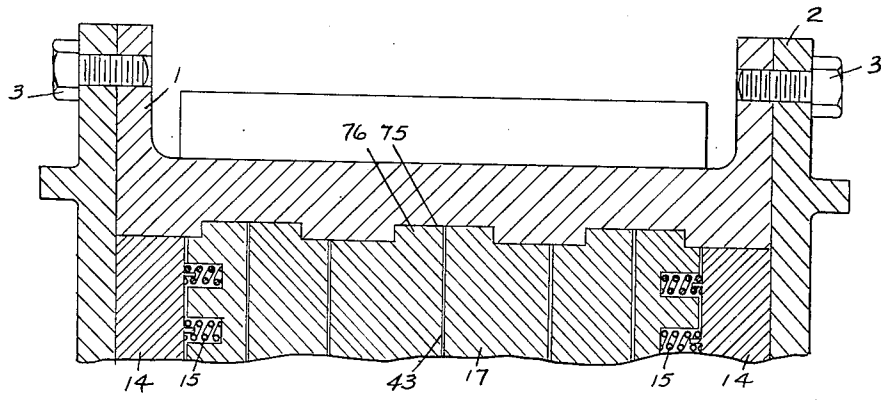


Fig 6



INVENTOR.
HANS M. PETERSEN
BY
Boyken, Mobley & Beckley
ATTORNEYS

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ROTARY INTERNAL COMBUSTION ENGINE

Hans M. Petersen, San Francisco, Calif., assignor to H. M. Petersen & Associates, Inc., a corporation of California

Application September 13, 1948, Serial No. 49,068

9 Claims. (Cl. 123—16)

This invention relates to rotary internal combustion engines and more particularly to that type in which the rotor is substantially concentric with the housing.

Heretofore rotary internal combustion engines designed to produce their own suction have generally failed to develop adequate power output, have operated at a low efficiency and have been characterized by excessive wear in their moving parts. One of the objects of this invention is to provide an engine of high horsepower output per unit weight.

Another object of the invention is the provision of a rotary internal combustion engine of extremely simple construction and few moving parts.

A still further object of the invention is the provision of an internal combustion engine in which wear due to friction is minimized and automatically compensated for without loss in efficiency.

An additional object is the provision of a rotary internal combustion engine having a simple and effective lubrication system.

Other objects and advantages will appear in the specifications and drawings.

In the drawings,

Fig. 1 is an elevation of the engine partly broken away and in section.

Fig. 2 is a cross-sectional view through the engine taken along lines 2—2 of Fig. 1.

Fig. 3 is a perspective view of one of the vanes with one of its separate end portions detached from the vane but positioned in its normal position relative to the vane.

Fig. 4 is a longitudinal sectional view (partly in elevation) of the rotor taken along lines 4—4 of Fig. 2 and showing the lubrication passages.

Fig. 5 is a cross-sectional view of a modified form of the invention.

Fig. 6 is a partial longitudinal sectional view of the form shown in Fig. 5.

The engine comprises a housing 1 closed at each end by end plates 2 (Fig. 1) which are bolted to the housing by bolts 3. Disposed within the housing is a rotor 4 mounted in journal bearings 5 which are in turn releasably secured within the end plates by means of pins 11. To facilitate assembly, the end plates are preferably made in two parts which are bolted together by means of bolts 12 and nuts 13. Bearing housing 28 may be cast integrally with the two portions of the end plates 2, thus providing a split housing.

As best seen in Fig. 1 a plurality of slots 6 preferably four in number, extend radially and longitudinally within the rotor 4. Slidably disposed within slots 6 are vanes generally designated 7 which are urged radially outwardly against the inner wall of housing 1 by helical springs 8.

The width of slots 6 is increased at intervals along the length of the slots as by drilling holes 9 (Fig. 4). The axes of holes 9 are radial and preferably coincide with the longitudinal center line plane of slot 6. The width of vanes 7 is correspondingly increased at intervals along the length of the vanes as at 10 (Fig. 3). The widened portions 10 of vanes 7 register with the holes 9 drilled in the rotor, thus insuring only radial movement of the vanes 7 with respect to rotor 4. Holes 9 continue radially through the rotor 4 and serve as guides for springs 8.

In order to effectively seal the vanes 7 with the end plates 2, I provide end portions 14 which coact with the major portion 17 of the vanes and which are urged longitudinally outwardly of the vanes against the end plates 2 by helical springs 15. The major portions of the vanes 17 may be slotted along their ends as at 16 to receive extensions 18 in the end portions 14 (Fig. 3). The end portions 14 are recessed as at 19 at their inner edge to register with longitudinal extensions 20 on the major portions 17 of the vanes 7. Thus the end portions 14 are slidably secured to the major portion 17 of the vane and may move longitudinally and radially but not tangentially with respect to the rotor 4. The width of slot 16 may be increased at intervals along its length to provide recesses 21 for springs 15. Cylindrical extensions 22 may be provided on end portions 14 to register with recesses 21 and to act as keepers for springs 15.

As best seen in Fig. 2, the inner wall of the housing 1 generally designated 65 is concentric with the axis of the rotor and spaced a substantial distance from the rotor for a major portion of its length around the rotor as at 23. For a minor portion of its length around the rotor, the wall is concentric with the axis of the rotor as at 24, but at a slight distance from the rotor 4. Between the two concentric portions the inner wall curves radially inwardly as at junctures 25 from the major portion to the minor portion so as to provide a gradual change in the radial velocity of the vane 7 when the rotor is rotating at a constant angular velocity. Thus the contour of the wall between the concentric portions is preferably such that the vane 7 has a constant radial acceleration between the concentric portions when the rotor is rotating at a constant angular velocity. The width of vane 7 is preferably increased as at 46 to permit cutting the outer edge to a large radius, thereby providing smooth contact between vane 7 and inner wall of housing 65, and particularly at the sloping wall 25.

Lubricant for the engine is introduced under pressure through pipe 30 and bushing 31 into the bearing housing 28 through hole 29. Hole 29 may be drilled through housing 28 and bearing 5 and the hole sealed at one end by plug 32. Hole 26 is drilled axially of the rotor so as to intersect perpendicularly hole 29. The rotor journal 27 extends a substantial distance longitudinally outwardly from end plates 2 to provide clearance for coupling the rotor to the driven shaft. For this reason hole 26 is relatively long. To prevent air pockets within hole 26, I provide a relatively long shanked plug 33 having a diameter slightly less than the diameter of hole 26 to seal the hole.

As best seen in Fig. 4, each hole 26 extends from the journal 27 into rotor 4 a slight distance and is intersected by radial holes 34 preferably two in number drilled through the rotor and sealed at the periphery of the rotor by long shanked plugs 35. To provide a conduit for longitudinal movement of the lubricant through the rotor, relatively large holes 36 are drilled preferably midway between slots 6 a substantial distance from the axis of the rotor and parallel thereto. Plugs 37 seal holes 36 and are threadedly secured therein. An effective seal may be insured by use of gasket 39 between plug 37 and rotor 4. The shank of plug 37 is recessed as at 38 to provide space for the lubricant. Hole 34 is drilled through plug 37 after the plug is in place, thus providing a continuous conduit for the lubricant running radially

and longitudinally of the rotor. Thus it is apparent that lubricant under pressure may be introduced at one end of the rotor and removed from the other end. Felt packing 44 disposed within circumferential groove 45 in bearing housing 28 creates a seal between journal 27 and bearing housing 28, thereby preventing escape of lubricant. Any conventional means such as pump 47 may be employed to supply oil under pressure to the lubrication system.

As best seen in Fig. 2, lubricant is conveyed from holes 36 into slots 6 and holes 9 through holes 40. Holes 40 are drilled perpendicular to slots 6 through holes 36 from the periphery of the rotor. The ends of holes 40 are sealed in a similar manner to the ends of holes 26, 34 by plug 41 having a relatively long shank to prevent air pockets. Plugs 35 must be cut off flush with the rotor after the lubrication passages are drilled.

Needle valves 42 are provided in holes 40 adjacent slots 6 to provide a predeterminate amount of lubricant to the vanes 7. To provide lubrication between the vanes and the inner wall of the housing 65, holes 43 are provided through vanes 7 drilled radially of the rotor. Thus lubricant in holes 9 and slots 6 will be pumped radially outwardly against the inner wall of the housing by reciprocations of vanes 7 caused by the variations in radius of the inner wall of the housing. It should be noted that lubrication between vane 7 and wall 65 is supplied in greatest quantity when vane 7 leaves the concentric section of the inner wall and engages the juncture 25, at which point the need for lubrication is greatest because of the increased pressure between the vane and the wall.

A continuous air supply to the engine is effected through inlet opening 50 in the housing 2. Pipe 51 containing air under pressure is connected to the housing 2 by means of flange 52 rigidly secured to pipe 51 and connected to the housing in registration with opening 50 by means of bolts 53. The air pressure may be obtained from any conventional blower 54 which may be conveniently mounted on top of housing 2 by means of bolts 55, and driven by any suitable source.

Fuel is injected into the housing through hole 56 which is preferably located where the clearance between the rotor and the inner wall of the housing is a minimum. Fuel may be supplied by any conventional pump 63 through pipe 57 which is secured to the housing by means of flange 58 and bolts 59.

Spark plug 60 is threadedly mounted in hole 61 in the side of the housing and is preferably positioned where the inner wall of the housing curves radially inwardly as at one of junctures 25.

An exhaust port 62 in the housing wall conducts the exploded gases to the atmosphere. Exhaust pipe 63 is secured to housing 2 in registration with hole 62 by means of flange 64 and bolts 65.

Assuming counter-clockwise rotation in Fig. 2, fresh air is forced into the engine through inlet opening 50 which is preferably located with respect to exhaust port 62 so that exploded gases are blown out through port 62 during a short period of the rotation of rotor 4. Thus the conventional scavenging cycle of a two cycle engine is simulated.

Fresh air confined between two vanes will be compressed upon continued counter-clockwise rotation due to the decreasing volume of the space between vanes.

Thus it is apparent that the four vanes shown in the preferred form divide the space between the rotor 4 and the inside wall of the housing into four combustion chambers. The number of vanes is of course not critical and may be any number depending on the size of the engine and the power to be developed.

Fuel may be injected into each combustion chamber prior to firing at any time consistent with good combustion chamber design. The location of the fuel injection is preferably as shown in Fig. 2 to obtain maximum vaporization of the fuel. Spark plug 60 fires when the leading vane of a combustion chamber is at point 23' of the major concentric portion 23 of the housing 2. It should be noted that when an explosion takes place within a combustion chamber, the leading vane (assuming counter-clockwise rotation) does not move radially thereafter until the pressure attending the explosion is dissipated. Thus wear on the vanes is minimized.

The engine may be cooled by circulating water around the outer wall of the housing within a water jacket 70 made of sheet metal or the like and bolted to the housing by bolts 71 as shown in Figs. 1 and 2.

It will be apparent that the invention herein described may with slight modification be converted into a diesel engine by eliminating the spark plug, relocating the fuel injection opening and increasing the compression ratio. In order to develop high compression ratios of say ten or twelve to one it has been found necessary to make the clearance between the rotor and the inside of the housing very slight, say .002 inch and also to provide slots 75 in the inner wall of the housing, and corresponding projections 76 on the radially outwardly projecting edge of the vanes 7 as may be seen in Figs. 5, 6 which figures disclose a modified form of the invention. Those elements in Figs. 5, 6 that are identical with the elements shown and described in the other views will bear the same numbers. Since the clearance between the rotor and the inner wall of the housing is so slight, substantially all of the fluid carried past the inner wall of the housing at the short concentric portion of said wall designated 24 must pass through said slots. Thus the frictional force resisting the flow of fluid past the inner wall of housing 65 is diminished by decreasing the periphery of the area through which the fluid flows.

The engine develops its power in all forms of the invention by virtue of the difference in area subjected to pressure between the leading vane and the trailing vane of any combustion chamber.

Various modifications may be made of the invention disclosed without departing from the spirit of my invention. For example, fuel may be mixed with the fresh air instead of injecting the fuel separately and the spark plug may be omitted as explained above.

I claim:

1. In a rotary internal combustion engine, a housing having coaxial cylindrical inner sides in two sections of different radii, the section of smaller radius being relatively short with respect to the other section in direction circumferentially of the same and disposed between the ends of said other section, the inner sides of said housing at the junctures between the adjacent ends of said sections being gradually curved to provide a gradual merging of said section at said junctures, a rotor supported within said housing for rotation about the common axis of said sections, spaced vanes carried by said rotor and extending radially therefrom into sliding engagement with said sections and movable radially relative to said axis for passing over said junctures in engagement therewith, an inlet in said housing for supplying air under pressure to the space between said rotor and said inner sides of said housing, and an outlet for exhausting the products of combustion from said space, said inlet and outlet being spaced apart in said other section a distance relative to the spacing of said vanes to permit said inlet to communicate with said outlet through said space for an interval during said rotation for scavenging said products from said space.

2. In a rotary internal combustion engine, a housing having coaxial cylindrical inner sides in two sections of different radii, the section of smaller radius being relatively short with respect to the other section in direction circumferentially of the same and disposed between the ends of said other section, the inner sides of said housing at the junctures between the adjacent ends of said sections being gradually curved to provide a gradual merging of said sections at said junctures, a rotor supported within

said housing for rotation about the common axis of said sections, spaced vanes carried by said rotor and extending radially therefrom into sliding engagement with said sections and movable radially relative to said axis for passing over said junctures in engagement therewith, an inlet in said housing for supplying air under pressure to the space between said rotor and said inner sides of said housing, and an outlet for exhausting the products of combustion from said space, said inlet and outlet being spaced apart in said other section a distance relative to the spacing of said vanes to permit said inlet to communicate with said outlet through said space for an interval during said rotation for scavenging said products from said space, said inlet being spaced from the adjacent juncture of said sections a distance substantially equal to the spacing between said vanes at said inner sides, and said rotor being rotated in a direction for carrying a charge of air from said inlet toward said last mentioned juncture for compressing such charge adjacent said short section.

3. In a rotary internal combustion engine, a housing having coaxial cylindrical inner sides in two sections of different radii, the section of smaller radius being relatively short with respect to the other section in direction circumferentially of the same and disposed between the ends of said other section, the inner sides of said housing at the junctures between the adjacent ends of said sections being gradually curved to provide a gradual merging of said sections at said junctures, a rotor supported within said housing for rotation about the common axis of said sections, spaced vanes carried by said rotor and extending radially therefrom into sliding engagement with said sections and movable radially relative to said axis for passing over said junctures in engagement therewith, an inlet in said housing for supplying air under pressure to the space between said rotor and said inner sides of said housing, and an outlet for exhausting the products of combustion from said space, said inlet and outlet being spaced apart in said other sections a distance relative to the spacing of said vanes to permit said inlet to communicate with said outlet through said space for an interval during said rotation of scavenging said products from said space, said inlet being spaced from the adjacent juncture of said sections a distance substantially equal to the spacing between said vanes at said inner sides, and said rotor being rotated in a direction for carrying a charge of air from said inlet toward said last-mentioned juncture for compressing such charge adjacent said short section and means for injecting fuel into said space at said short section.

4. In a rotary internal combustion engine, a housing having coaxial cylindrical inner sides in two sections of different radii, the section of smaller radius being relatively short with respect to the other section in direction circumferentially of the same and disposed between the ends of said other section, the inner sides of said housing at the junctures between the adjacent ends of said sections being gradually curved to provide a gradual merging of said sections at said junctures, a rotor supported within said housing for rotation about the common axis of said sections, spaced vanes carried by said rotor and extending radially therefrom into sliding engagement with said sections and movable radially relative to said axis for passing over said junctures in engagement therewith, a firing chamber adjacent one of said junctures defined by a pair of adjacent vanes and said rotor and said inner sides, a spark plug positioned in said chamber for exploding a combustible gas in the same, said spark plug being adapted to be fired when the leading vane relative to the direction of rotation of said pair is engaging said other section and the trailing vane of said pair is engaging said short section whereby said leading vane will traverse said other section between said junctures after said explosion without undergoing radial movement relative to said axis.

5. In a rotary internal combustion engine, a housing having coaxial cylindrical inner sides in two sections of different radii, the section of smaller radius being relatively short with respect to the other section in direction circumferentially of the same and disposed between the ends of said other section, the inner sides of said housing at the junctures between the adjacent ends of said sections being gradually curved to provide a gradual merging of said sections at said junctures, a rotor supported within said housing for rotation about the common axis of said sections, spaced vanes carried by said rotor and extending radially therefrom into sliding engagement with said sections and movable radially relative to said axis for passing over said junctures in engagement therewith, a firing chamber adjacent one of said junctures defined by a pair of adjacent vanes and said rotor and said inner sides, a spark plug positioned in said chamber for exploding a combustible gas in the same, said spark plug being adapted to be fired when the leading vane relative to the direction of rotation of said pair is engaging said other section and the trailing vane of said pair is engaging said short section whereby said leading vane will traverse said other section between said junctures after said explosion without undergoing radial movement relative to said axis, an outlet for exhausting the products of combustion from said space and an inlet for supplying air under pressure to said space, said outlet being spaced from said one juncture a distance substantially equal to the spacing between vanes at said sides, and said inlet being spaced from said outlet a distance less than the spacing between said vanes for scavenging said products through said outlet by the pressure of said air.

6. In a rotary internal combustion engine, a housing having coaxial cylindrical inner sides in two sections of different radii, the section of smaller radius being relatively short with respect to the other section in direction circumferentially of the same and disposed between the ends of said other section, the inner sides of said housing at the junctures between the adjacent ends of said section being gradually curved to provide a gradual merging of said sections at said junctures, a rotor supported within said housing for rotation about the common axis of said sections, spaced vanes carried by said rotor and extending radially therefrom into sliding engagement with said sections and movable radially relative to said axis for passing over said junctures in engagement therewith, a firing chamber adjacent one of said junctures defined by a pair of adjacent vanes and said rotor and said inner sides, a spark plug positioned in said chamber for exploding a combustible gas in the same, said spark plug being adapted to be fired when the leading vane relative to the direction of rotation of said pair is engaging said other section and the trailing vane of said pair is engaging said short section, whereby said leading vane will traverse said other section between said junctures after said explosion without undergoing radial movement relative to said axis, an outlet for exhausting the products of combustion from said space and an inlet for supplying air under pressure to said space, said outlet being spaced from said one juncture a distance substantially equal to the spacing between vanes at said sides and said inlet being spaced from said outlet a distance less than the spacing between said vanes for scavenging said products through said outlet by the pressure of said air and means for injecting fuel through said short section under pressure into said firing chamber.

7. In a rotary internal combustion engine, a housing having coaxial cylindrical inner sides in two sections of different radii, the section of smaller radius being relatively short with respect to the other section in direction circumferentially of the same and disposed between the ends of said other section, the inner sides of said housing at the junctures between the adjacent ends of said sections being gradually curved to provide a gradual merging of said sections at said junctures, a rotor supported within said

housing for rotation about the common axis of said sections, spaced vanes carried by said rotor and extending radially therefrom into sliding engagement with said sections and movable radially relative to said axis for passing over said junctures in engagement therewith, an inlet in said housing for supplying air under pressure to the space between said rotor and said inner sides of said housing, and an outlet for exhausting the products of combustion from said space, said inlet and outlet being spaced apart in said other section a distance relative to the spacing of said vanes to permit said inlet to communicate with said outlet through said space for an interval during said rotation for scavenging said products from said space, said inner sides having a plurality of circumferentially extending parallel grooves therein, said vanes having a plurality of extensions intermediate their ends extending radially outwardly of the outer edges of said vanes and slidable in said grooves.

8. In a rotary internal combustion engine, a housing having coaxial cylindrical inner sides in two sections of different radii, the section of smaller radius being relatively short with respect to the other section in direction circumferentially of the same and disposed between the ends of said other section, the inner sides of said housing at the junctures between the adjacent ends of said sections being gradually curved to provide a gradual merging of said sections at said junctures, a rotor supported within said housing for rotation about the common axis of said sections, spaced vanes carried by said rotor and extending radially therefrom into sliding engagement with said sections and movable radially relative to said axis for passing over said junctures in engagement therewith, an inlet for air and an outlet for exhaust gas communicating with the inside of said housing at spaced points therearound, said sides and said rotor defining a continuous space surrounding the latter and divided into a plurality of chambers each extending between a pair of adjacent vanes, said rotor being spaced a relatively short distance from said short section, whereby a charge of gas in a chamber between a pair of vanes engaging said other section will be compressed upon movement of such pair to a position with the leading vanes of said pair in engagement with said short section.

9. In a rotary internal combustion engine, a housing having coaxial cylindrical inner sides in two sections of different radii, the section of smaller radius being relatively short with respect to the other section in direction circumferentially of the same and disposed between the ends of said other section, the inner sides of said

housing at the junctures between the adjacent ends of said sections being gradually curved to provide a gradual merging of said sections at said junctures, a rotor supported within said housing for rotation about the common axis of said sections, spaced vanes carried by said rotor and extending radially therefrom into sliding engagement with said sections and movable radially relative to said axis for passing over said juncture in engagement therewith, an inlet for air and an outlet for exhaust gas communicating with the inside of said housing at spaced points therearound, said sides and said rotor defining a continuous space surrounding the latter and divided into a plurality of chambers each extending between a pair of adjacent vanes, said rotor being spaced a relatively short distance from said short section, whereby a charge of gas in a chamber between a pair of vanes engaging said other section will be compressed upon movement of such pair to a position with the leading vane of said pair in engagement with said short section, the circumferential length of said short section being less than the distance between adjacent vanes at said sides whereby air will be driven in a relatively narrow stream at a relatively high velocity between said rotor and said short section in the direction of rotation of said rotor upon movement of said pair from said last mentioned position to a position with said leading vane in engagement with said other section, an inlet in said short section for introducing fuel into said stream.

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