March 16, 1965 A. J. CAMPOS 3,173,406

ROTARY INTERNAL COMBUSTION ENGINE

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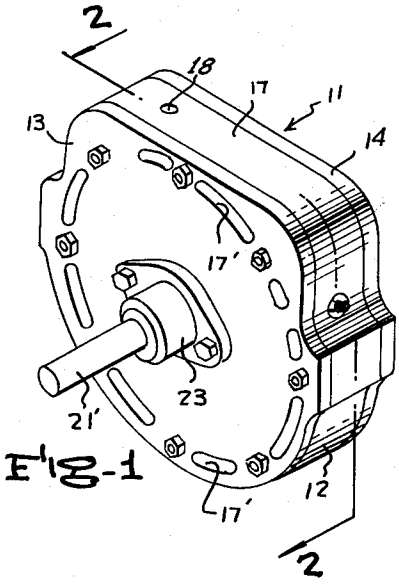

Fig-1

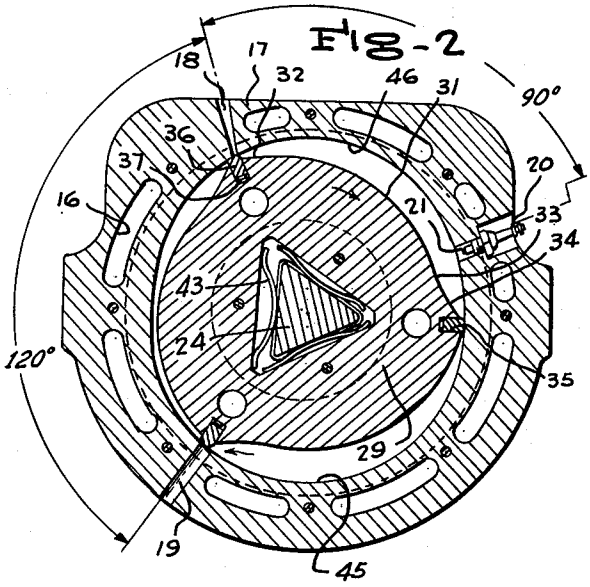

Fig-2

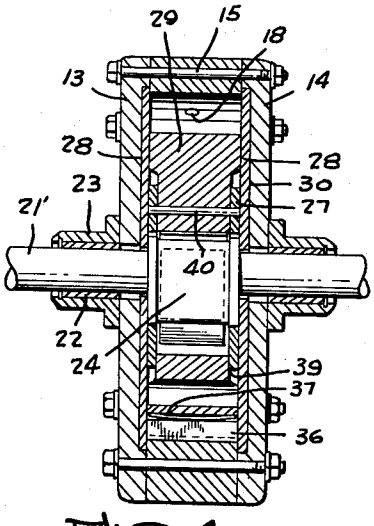

Fig-4

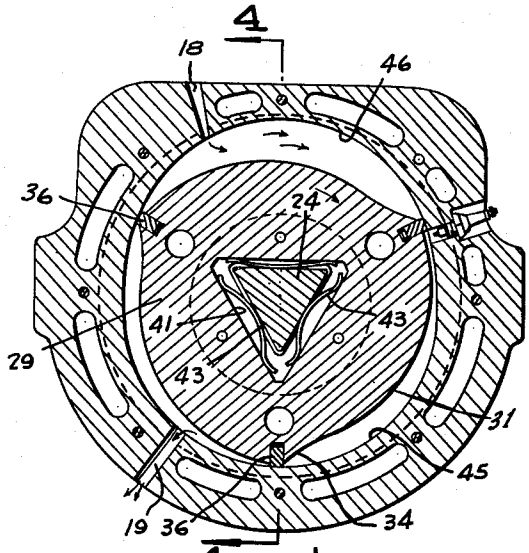

Fig-3

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FIG. 5

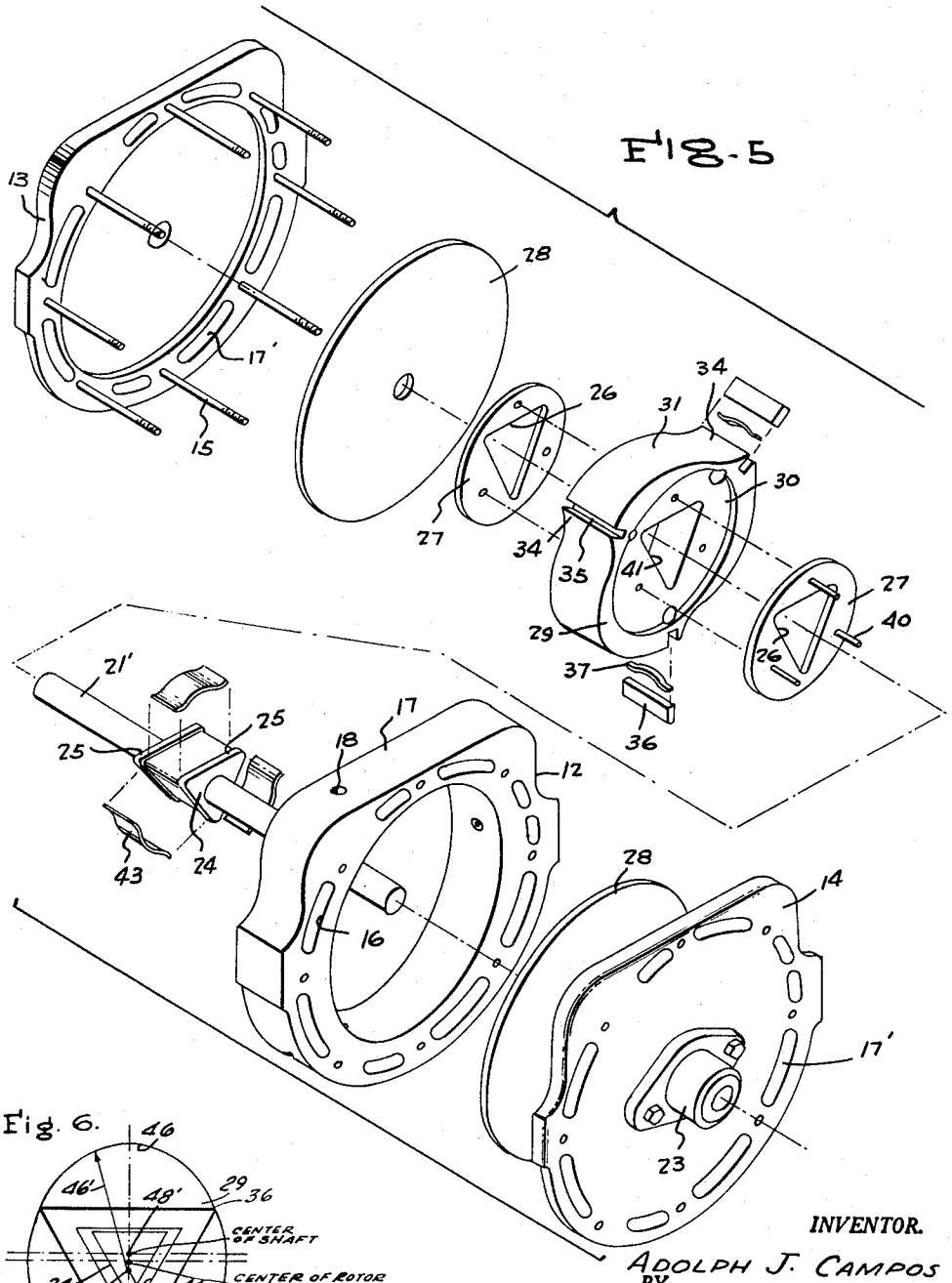

Fig. 6.

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ROTARY INTERNAL COMBUSTION ENGINE

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4 Claims. (Cl. 123—16)

This invention relates to improvements in internal combustion engines, and more particularly to an improved internal combustion engine which uses a three-sided rotor and which develops three power impulses per revolution, all in the same direction.

A main object of the invention is to provide a novel and improved rotary internal combustion engine which is relatively simple in construction, which is compact in size, which is relatively light in weight and which develops a relatively high power output with minimum consumption of fuel.

A further object of the invention is to provide an improvide rotary internal combustion engine of the type employing a three-sided rotor, the engine being relatively inexpensive to manufacture, being durable in construction, involving only a few parts, and developing a substantial amount of mechanical output.

A still further object of the invention is to provide an improved rotary internal combustion engine which is relatively inexpensive to manufacture, which requires a relatively small amount of maintenance, which is reliable in operation, and which is highly economical in fuel consumption.

A still further object of the invention is to provide an improved rotary internal combustion engine of the type employing a three-sided rotor, the engine developing three power impulses per revolution, all in the same direction, said engine being smooth in operation, developing a minimum amount of vibration, and employing relatively inexpensive materials.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

FIGURE 1 is a perspective view of an improved rotary internal combustion engine constructed in accordance with the present invention.

FIGURE 2 is an enlarged vertical cross sectional view taken substantially on the line 2—2 of FIGURE 1.

FIGURE 3 is a vertical cross sectional view, similar to FIGURE 2, but showing the rotor in a position wherein fuel is being admitted into the compression chamber of the engine, the rotor being in a position advanced relative to the position thereof shown in FIGURE 2.

FIGURE 4 is a vertical cross sectional view taken on the line 4—4 of FIGURE 3.

FIGURE 5 is a perspective view of the elements comprising the engine of FIGURES 1 to 4, said elements being shown in separated positions.

FIGURE 6 is a diagrammatic sketch illustrating the mode of operation of the internal combustion engine of the present invention.

Referring to the drawings, **11** generally designates an improved rotary combustion engine constructed in accordance with the present invention. The engine **11** comprises a main housing consisting of a generally annular main body **12** and a pair of opposite side plates **13** and **14** of similar shape secured to the opposite sides of the main body **12**, as by means of longitudinally extending fastening bolts **15**. The main body **12** is formed with a plurality of circularly arranged cooling slots **16**, and the plates **13** and **14** are provided with similar slots **17'** registering with the cooling slots **16**, whereby to provide continuous channels for the circulation of cooling air through the peripheral portions of the engine.

The engine is substantially flattened at its top portion, as shown at **17**, and the flattened top portion **17** of the

main body **12** of the engine is formed with a downwardly convergent fuel intake port **18** to which may be connected a suitable fuel supply conduit, not shown, which may be connected to a suitable source of a combustible gas mixture. As shown in FIGURE 2, the downwardly convergent fuel intake port **18** is located at one side of the top wall of the engine. The engine is formed at its bottom wall with an exhaust port **19** which is located at the same side thereof as the fuel intake port **18**, being spaced therefrom by an angle of approximately 120° of rotation, as shown in FIGURE 2.

Mounted in the wall of the main body **17** of the engine and angularly spaced from the fuel intake port **18** by an angle of approximately 90° in a clockwise direction, as viewed in FIGURE 2, is a spark plug **20** whose electrodes terminate in an axial bore **21** communicating with the interior of the engine, as shown in FIGURE 2, for igniting fuel mixture in the upper portion of the engine cavity subsequent to compression thereof, as will be presently explained. The spark plug **20** is energized from a suitable ignition system which is suitably synchronized so as to deliver a spark in the ignition space **21** near the end of the compression portion of the cycle of rotation of the engine rotor, as will be presently explained. The details of the distributor and associate ignition system for energizing the spark plug **20** are conventional in themselves and form no part of the present invention.

Axially journaled in the engine is a shaft **21'** which is rotatably supported on suitable sleeve bearings **22** mounted in annular end bushings **23** secured to the central portions of the side plates **13** and **14**, as shown in FIGURE 4. The intermediate portion of the shaft **21'** is integrally formed with, or has rigidly secured thereon, a generally triangular, enlarged body **24**, which has a cross section in the shape of an equilateral triangle, and which is centered so that its axis coincides with the axis of the shaft **21'**. The body **24** is formed with marginal ribs or flanges **25** at its opposite peripheral sides, said ribs or flanges **25** being received within correspondingly shaped triangular openings **26** formed in spacer discs **27**. The spacer discs **27** are interposed between respective opposing wear plates **28** and a rotor body **29**, presently to be described. The wear plates **28** are received in circular recesses **30** formed in the inside walls of the respective side plates **13** and **14**. The rotor **29** is generally three-sided in shape and is formed with the three identically curved peripheral surfaces **31** which have trailing ends **32** of maximum radius and which diminish gradually in radius toward their leading ends. The radius reaches a minimum at a point **33** adjacent the leading end of the side, after which the radius increases rapidly in value, defining an arcuately curved thrust shoulder **34** at the leading end of the side **31** of the rotor.

The rotor **29** is formed at the junction between the leading and trailing ends of its respective sides **31** with radially extending longitudinal slots **35** in which are slidably positioned respective longitudinally extending sealing bars **36** which are biased outwardly into sealing contact with the inside wall of the cavity of body **17** by bowed leaf springs **37** disposed in the bottoms of the grooves or slots **35**. The circular plate members **27, 27** are secured in circular recesses **39** formed in the opposite sides of the rotor **29** concentrically with its axis, the plate members **27** being secured by rivets **40** extending through said plate members and the rotor **29**, as shown in FIGURE 4.

The rotor **29** is formed centrally with a triangular aperture **41** which is in the shape of an equilateral triangle and which is substantially larger in size than the triangular body **24** received therein, but is of such size as to prevent complete rotation of body **24** therein. As shown in FIGURE 3 a substantial amount of clearance is provided between the faces of the body **24** and the inside

faces of the aperture **41**. Bowed leaf springs **43** are provided in the clearance spaces, thus resiliently connecting the rotor **29** to the shaft body **24**, so that a yieldable cushioned coupling exists between the shaft and the rotor, the coupling being however of a positive nature, since the rotor cannot rotate relative to the shaft body **24**, except to a limited degree, as permitted by the flexure of the leaf springs **43**. The rotor is also allowed to move somewhat horizontally and vertically relative to the shaft body **24**, as permitted by the yielding action of the leaf springs **43**.

The lower portion **45** of the cavity defined in the generally annular main body **12** of the engine is of substantially constant radius **45'**, as shown in FIGURE 6. The upper portion **46** of the cavity is at a radial distance **46'** from the center **47'** of said lower portion **45** greater than the radius **45''** of said lower portion, and the arcuate side portions of the cavity converge smoothly toward said upper portion, as is clearly shown in FIGURES 2, 3 and 6. Thus, the cavity is shaped so as to be somewhat vertically elongated, with a generally semi-cylindrical lower portion and an upper portion having upwardly convergent sides. Since there is some play between the triangular shaft portion **24** and the inside faces of aperture **41**, the rotor can assume a position, such as that shown in FIGURES 3 and 6, wherein the center of the rotor is below the center of said triangular shaft portion (the center of said triangular shaft portion being substantially at the intersection **48'** of the major and minor axes of the generally oval cavity) and such that the distance from the center of the shaft to the upper right-hand seal **36** in FIGURES 3 and 6 is slightly less than the distance to the lower seal **36**, the differential in distance providing a differential surface on which combustion pressure in the space immediately below said upper right-hand seal can act to produce rotation of the rotor. Because of the upward convergency of the sides of the upper portion of the cavity, as above noted, and as is clearly shown in FIGURES 3 and 6, the upper seals **36** act as follower members cooperating with said convergent sides to depress the rotor to the position of FIGURES 3 and 6.

In operation, combustible fuel mixture is admitted into the upper space **46** of the engine, assuming the port **18** to be in communication with said upper space, namely, the rotor to be in a position such as that illustrated in FIGURE 3. With the rotor rotating in a clockwise direction, as viewed in FIGURE 3, the upper left sealing bar **36** eventually passes upwardly beyond the sealed intake port **18**, namely, passes the position thereof illustrated in FIGURE 2, after which the gaseous fuel mixture admitted into the space **46** undergoes compression as the volume thereof is reduced, namely, as the rotor rotates clockwise beyond the position thereof illustrated in FIGURE 2. When the rotor reaches the position shown in FIGURE 3, the fuel is in the lower right space and is under maximum compression, at which point ignition takes place, and the fuel is ignited by the spark plug **20**. The expansion of the ignited fuel develops a power stroke on the aforesaid differential surface. As above mentioned, the rotor is urged to the depressed position of FIGURES 3 and 6 by the cooperation of the upper seals **36** with the upwardly convergent sides of the cavity. Therefore, the rotor will receive a power impulse tending to rotate said rotor clockwise with each ignition of the compressed fuel by the spark plug **20**. Said power impulse will be furnished by the expanding gaseous products of combustion acting against the aforesaid differential surface.

Subsequent to the delivery of said power impulse to the rotor, the gaseous products of combustion are placed in communication with the exhaust port **19**, through which they discharge to the atmosphere. Thus, in the position of the rotor shown in FIGURE 2, the gaseous products of combustion in the lower space of the engine cavity are placed in communication with the discharge port **19**, and are allowed to escape, after delivery of the thrust impulse to the rotor. The above described cycle is repeated three times for every revolution of the rotor, so that three power impulses are developed for each revolution thereof.

Following impulses applied to the rotor are transmitted to the shaft **21'** through the resilient coupling defined between the triangular shaft portion **24** and the triangular aperture **41** in the rotor, by means of the leaf springs **43**, which permit relative movements between rotor **29** and the portion **24** in the manner above described.

It will be noted that the peripheral ribs **25, 25** on the enlarged intermediate portion of the shaft **21'** serve as positioning means to retain the leaf springs **43** in centered positions relative to the member **24**, the curved portion of each leaf spring **43** being received between the ribs **25, 25** of the adjacent side of member **24**, as illustrated in FIGURE 3, or alternatively, being reversed so as to be disposed adjacent to the associated side of the rotor aperture **41**, as illustrated, for example in FIGURE 5. In either case, a cushioned resilient coupling will be defined between the rotor and the shaft, providing smooth transmission of torque from the rotor to the shaft over a wide range of loading of the engine.

It will be noted that the respective sides of the triangular aperture **41** in the rotor **29** are substantially parallel to the sides of the rotor, namely, to the surfaces defined between respective pairs of contact bars **36, 36**. Thus, when the gas mixture is ignited in the space **45**, the resultant explosion develops a force which may be resolved in a direction perpendicular to the adjacent straight side of aperture **41** of the rotor, causing the rotor to be urged inwardly toward the corresponding straight side of the triangular member **24**, thus tending to flatten the intervening arcuate leaf spring **43**. The leaf spring thus directly cushions the explosion and prevents direct impact between rotor **29** and shaft portion **24**. Further cushioning is provided by the resiliency of the biasing springs **37** acting outwardly on the sealing bars **36**, and it will be noted that because of the parallel location of the sides of aperture **41** with respect to the sides of the rotor, the cushioning effects provided by the springs **37** are symmetrically arranged relative to the cushioning effects provided by the leaf springs **43**.

While a specific embodiment of an improved rotary combustion engine has been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. A rotary combustion engine comprising a main housing formed with a generally oval vertically elongated rotor cavity comprising a substantially semi-cylindrical lower portion, an arcuate top portion at a radial distance from the center of said lower portion greater than the radius of said lower portion, and arcuate upwardly convergent side portions smoothly connecting said arcuate top portion and substantially semi-cylindrical lower portion, said cavity having a fuel intake port communicating with the cavity at one side of said top portion, fuel ignition means in the cavity adjacent the opposite side of said top portion, said cavity being provided with a peripheral exhaust port in said lower portion at the same side of the cavity as said intake port, a shaft journaled in the housing with its axis displaced from said center toward said arcuate top portion and having a polygonally shaped intermediate portion, a rotor having a periphery comprising three successive sides of similar shape, said rotor having a central polygonal aperture loosely receiving said intermediate portion of the shaft, said intermediate shaft portion being sufficiently large in size so that it cannot rotate in said polygonal aperture, means resiliently supporting said rotor on said intermediate shaft portion, and respective sealing members on the periphery of said rotor between its successive sides sealingly engaging the peripheral sur-

face of said rotor cavity and cooperating with said convergent side portions to cause the rotor to at times assume a depressed position providing a differential of radial distance between the center of the shaft and the portions of said peripheral surface at opposite sides of the ignition means engaged by two successive sealing members, whereby to define a differential thrust surface on the rotor.

2. The structure of claim 1, and wherein each side of the rotor has an outwardly concave portion defining a thrust shoulder.

3. The structure of claim 1, and wherein said resilient supporting means comprises leaf springs between the sides of said aperture and said intermediate shaft portion.

4. The structure of claim 1, and wherein said polygonal aperture and shaft intermediate portion are shaped in the form of equilateral triangles.

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