

Nov. 19, 1940.

C. F. ROCHEVILLE
COMBUSTION GAS TURBINE

2,222,183

Filed July 12, 1937

4 Sheets-Sheet 1

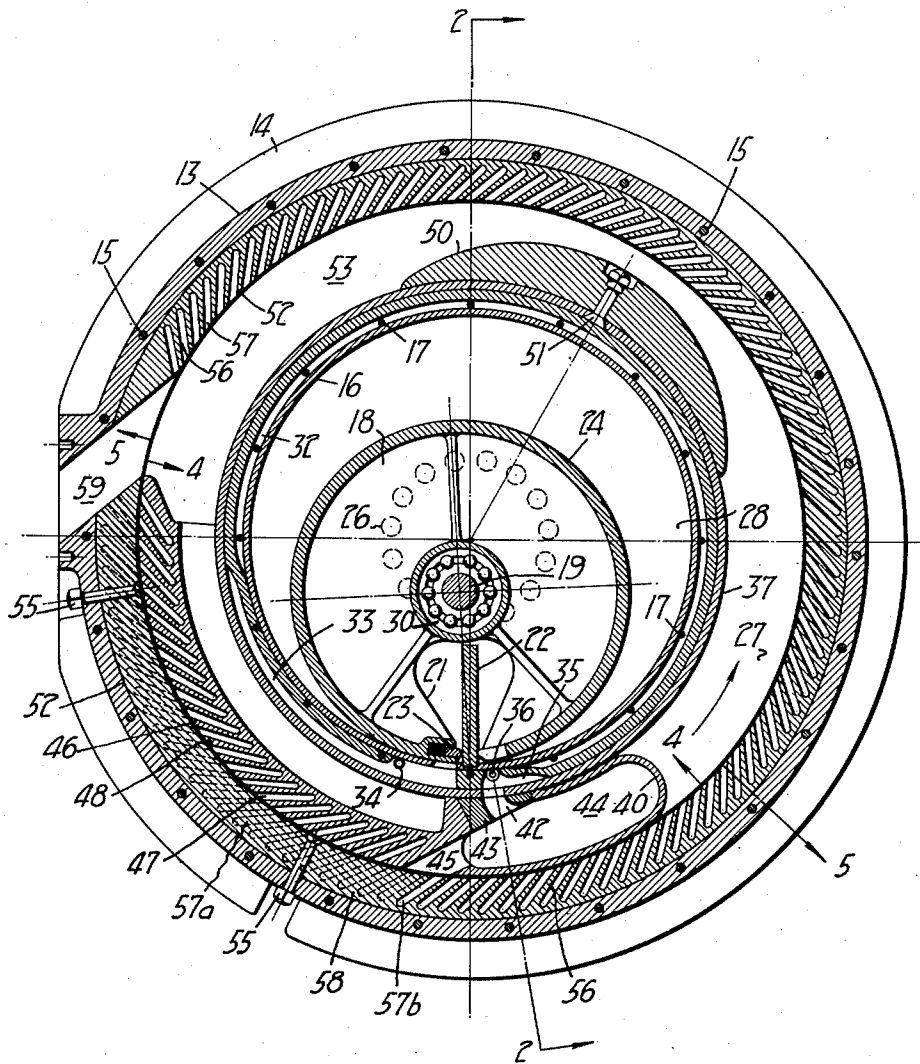


FIG. 1

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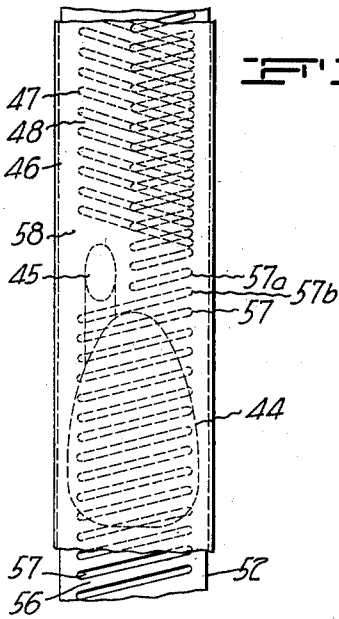


FIG. 1.

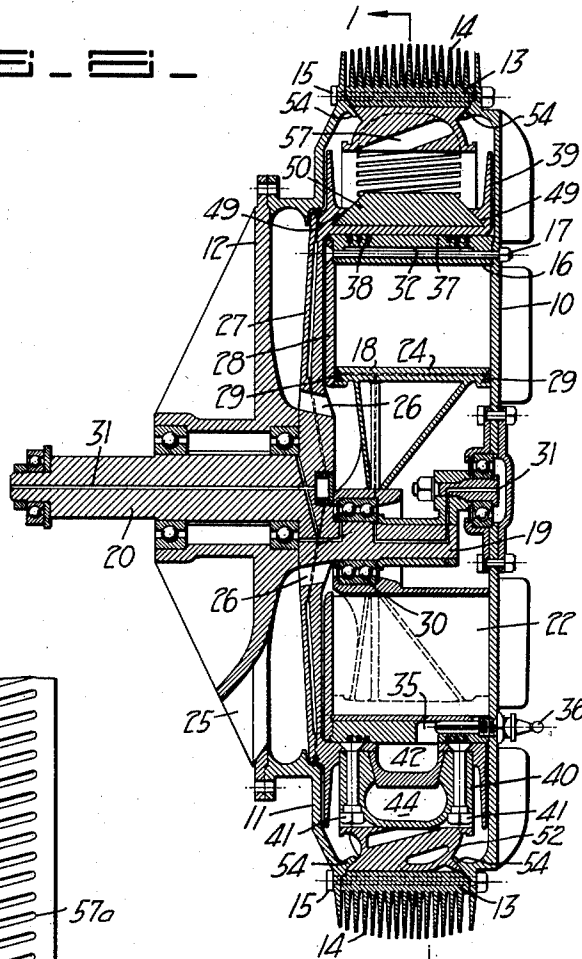


FIG. 2.

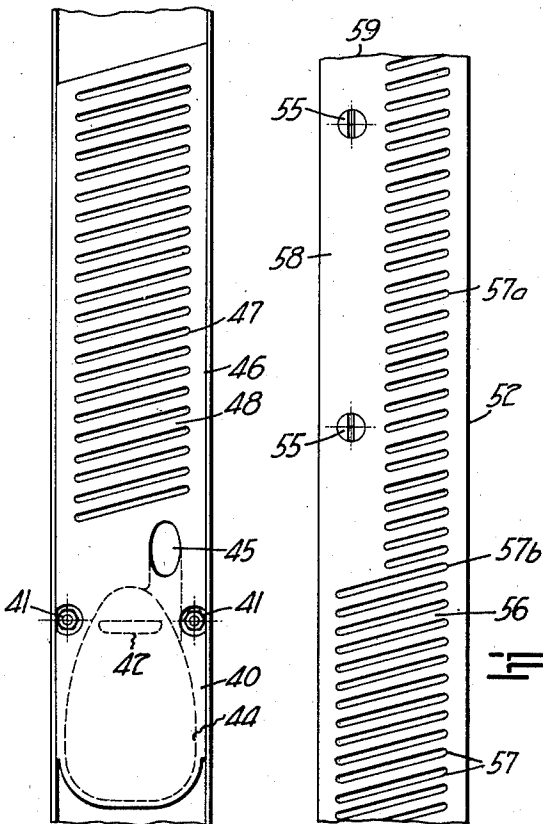


FIG. 3.

FIG. 4.

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4 Sheets-Sheet 3

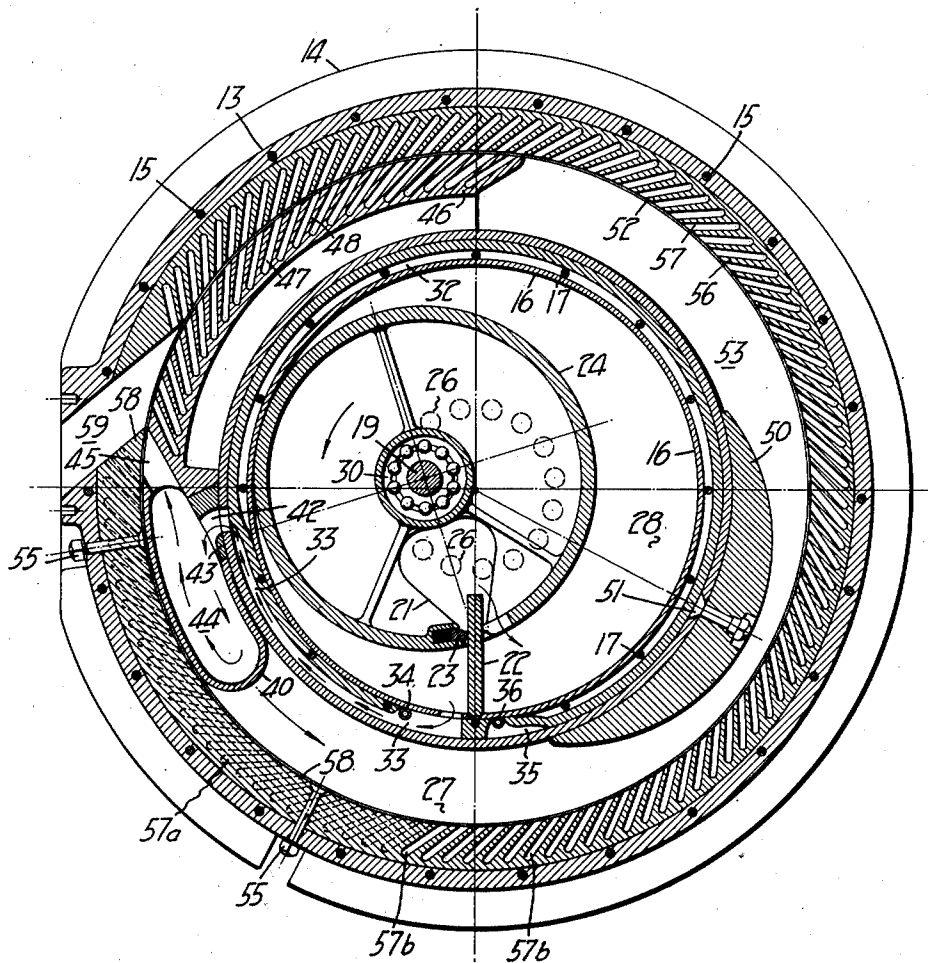


FIG. 3.

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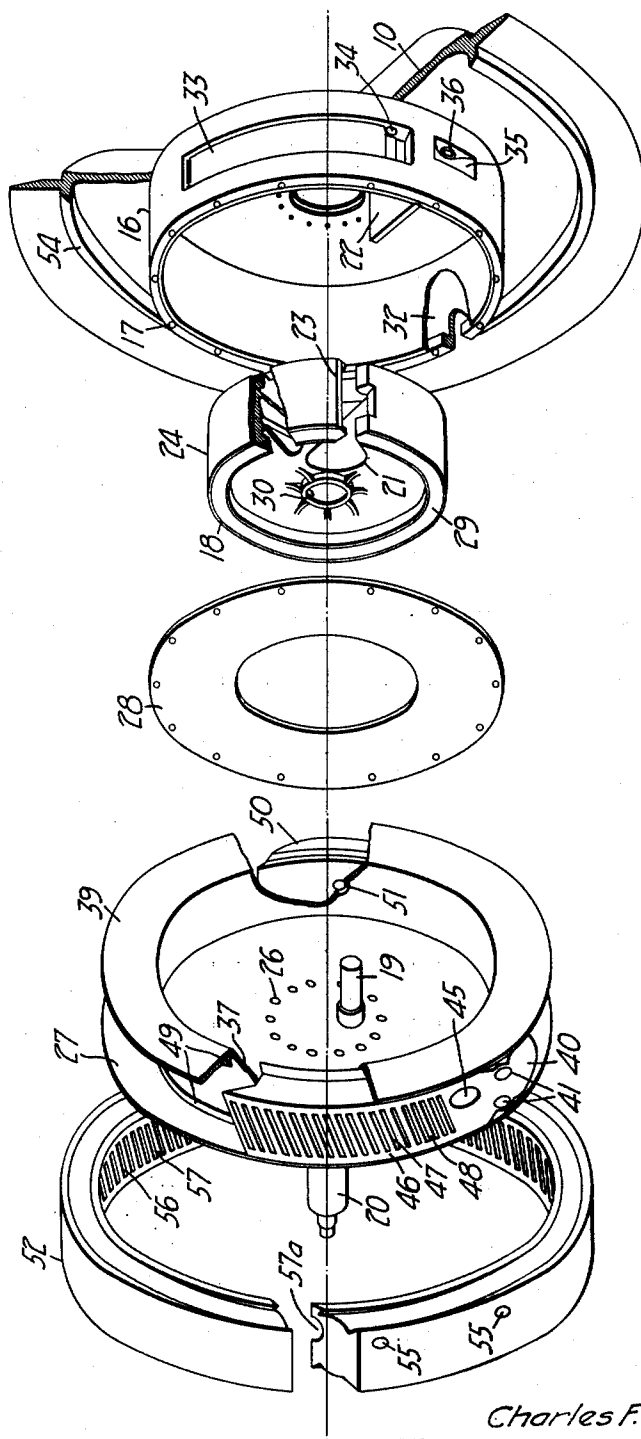
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2,222,183

COMBUSTION GAS TURBINE

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Application July 12, 1937, Serial No. 153,147

6 Claims. (Cl. 60-41)

This invention relates to an internal combustion engine or motor and particularly refers to a rotary or turbine type of prime mover in which a combustible mixture is ignited in a rotating combustion chamber and expands therefrom to impinge against a plurality of vanes and drive forwardly the combustion chamber and its supporting shaft to generate power. The apparatus disclosed and claimed herein is an improvement over that of my copending application Serial No. 18,340, filed April 26, 1935, now abandoned.

Heretofore, combustion gas turbines of this general type have employed elaborate and complicated compressors for the air or combustible mixtures, as well as slide or poppet valves for control of intake, compression, firing and exhaust stages. Those nozzle and vane arrangements for utilizing the expansive effect of the hot combustion gases have been unsatisfactory and of inefficient design and arrangement.

This invention broadly comprehends a body forming an inner and an outer chamber, both stationary and both concentric with the engine axis, the inner chamber forming a housing for a compressor rotor, and the outer chamber forming an annular passage in which moves a rotatably supported combustion chamber. A combustible mixture is compressed in the inner chamber, passes through a suitable port in the wall separating the chambers into the combustion chamber and is there ignited, the products of combustion escaping through a suitable nozzle into a series of intercommunicating expansion pockets and doing work by reaction and impulsion, urging forward the combustion chamber and turning the shaft on which it is supported. The ported combustion chamber cooperates with the ported stationary wall separating the outer and inner chambers, as well as with the stationary outer wall surrounding the outer chamber to form valve means acting automatically to control the compression, intake, firing and exhaust stages of the cycle of operation.

An alternative mode of arrangement and operation comprehends the compression of air and its admission, together with a metered quantity of atomized liquid fuel, into the combustion chamber, the remainder of the structure and operations being otherwise as just described, and the ignition being accomplished by the heated combustion chamber.

It is an object of this invention to provide a combustion gas turbine with a minimum of moving parts and without timing gears, poppet valves

and the like to control the various stages of operation.

Another object is to provide a combustion gas turbine with no reciprocating parts, all motion being rotary or at most oscillatory about a central shaft.

Another object is to provide a combustion gas turbine in which primary rubbing surfaces move progressively forwardly, facilitating sealing and reducing the wear and leakage caused by reversal of direction.

Another object is to provide a combustion gas turbine in which expansion due to temperature differential is so directed that clearances between closely fitting moving parts will not be adversely affected or altered.

Still another object is to provide a combustion gas turbine in which all parts are readily accessible for inspection or replacement with a minimum of disassembling.

Another object is to provide a combustion gas turbine in which those parts which attain the highest temperature are in such a location that heat is readily, uniformly and controllably dissipated.

Another object is to provide an arrangement of cooperating pockets that will receive and direct the expanding gas and thus serve to smooth out and extend the power impulse throughout the greater part of the cycle of rotation.

These and other objects and advantages will become further apparent from the following description and from the accompanying drawings, which from a part of this specification and illustrate a preferred embodiment of this invention.

In the drawings:

Figure 1 is a vertical sectional view on line 1-1 of Figure 2, and at right angles to the axis of a combustion gas turbine embodying this invention, showing in section the inner and outer chambers, the compressor, combustion chamber, and expansion vanes, at the time of ignition of a combustible charge.

Figure 2 is a vertical sectional view on line 2-2 of the turbine shown in Figure 1, and illustrates the arrangement of the shaft, the air or combustible mixture inlet, the crank or eccentric for the compressor rotor and a preferred means for securing the combustion chamber to the rotor plate.

Figure 3 is a vertical sectional view of the turbine of this example, similar to Figure 1, but with the compressor impeller and combustion chamber at the end of the exhaust and the beginning of

the intake and compression stage of the engine cycle.

Figure 4 is a developed view on line 4—4 of the turbine of Figure 1, showing a preferred arrangement of the combustion chamber and its following vanes and expansion pockets.

Figure 5 is a developed view on line 5—5 of the turbine of Figure 1, showing a preferred arrangement of the stationary vanes and expansion pockets.

Figure 6 is a developed view of the combustion chamber and following vanes of Figure 4 superimposed on the stationary vanes and expansion pockets of Figure 5 illustrating their true positions in the turbine.

Figure 7 is an exploded perspective view, partially in section, of the stationary vane and expansion pocket element, the rotor and combustion chamber, the cover plate for the compressor chamber, the compressor impeller and one side of the stationary body or frame of the turbine.

Referring to the drawings, and particularly to Figures 1 and 2, the reference numeral 10 designates a generally circular stationary plate member forming one side of the turbine casing, and 11 designates a complementary annular flanged side member, which together with a base member 12 forms the opposite side of the turbine casing. The ring member 13, preferably provided with cooling flanges 14, completes the casing and is clamped between side members 10 and 11 as by bolts 15. A hollow cylindrical element 16 is secured to the inner face of the outer side member 10 as by a plurality of bolts 17, and forms the circumferential wall of the housing within which an oscillating compressor rotor generally designated 18 is adapted to be moved by crank 19 of shaft 20.

The compressor rotor 18 is shown in some detail in Figures 2 and 7 and, in this example, is of conventional cylindrical type, with a longitudinal slot 21 sliding on a stationary abutment plate 22 secured to plate 10, and sealed to plate 22 as by a spring pressed element 23. The periphery 24 of compressor rotor 18 contacts the inner surface of the hollow cylindrical housing 16 and, as the compressor rotor is oscillated in a counterclockwise direction by crank 19, compresses gas or air between the mutually advancing surfaces in the well known manner. Gas or air is admitted to the interior of compressor rotor 18 through passage 25 in base member 12 and thence through the circularly spaced openings 26 in the main rotor support plate 27 (Figure 2). The sides of the compressor housing are formed, respectively, by the inner face of side plate 10 and by a compressor inlet cover plate 28 (Figures 2 and 7) secured to the face of the cylindrical compressor housing ring 16 by bolts 17. Sealing of the end faces of compressor rotor 18 is provided by V rings 29. Rotor 18 is rotatably supported on crank 19 as by bearing 30, which is lubricated by oil passages generally designated 31 leading through crank 19 and supplied by lubricant from a suitable source.

The cylindrical ring member 16 forming the compressor rotor housing is preferably of hollow construction as shown at 32 (Figures 3 and 7) and lubricant from 31 is circulated through a passage (not shown) in stationary side plate 10 to cool the ring 16 and, in turn, to cool compressor rotor 18. Such cooling means are conventional and need no further explanation to one skilled in this art. A compressor discharge port 33 passes through ring member 16 adjacent

abutment 22, and extends circumferentially throughout a portion of the outer surface of ring 16 for a purpose which will be described below. Terminating intermediate the ends of port 33 is a fuel injection port 34, used to inject or atomize a liquid fuel from any suitable metering source when the turbine is being operated on hot-bulb instead of spark ignition. A recess 35 is provided in the outer face of ring 16 to receive a spark plug 36 used for ignition when starting or operating the turbine on a gaseous fuel-air mixture.

The power rotor element (Figures 2 and 7) comprises rotor support plate 27, integral with or at least secured concentrically to the axis of shaft 20. Plate 27 is flanged axially at 37, forming a cylindrical ring which encircles the periphery of the cylindrical rotor housing 16. Circumferential sealing rings 38 are effective to prevent gas leakage inwardly to the interior of the compressor housing. A complementary radial flange 39 at the outer edge of ring 37 completes the basic portion of the rotor support plate 27 and is immediately adjacent the inner face of outer side plate 10.

Combustion chamber 40, preferably of heat resisting alloy, is secured to the outer face of the axial flange or ring 37 of rotor plate 27 (Figures 2, 3 and 7) as by bolts 41. A port or passage 42, which may be lined with a higher heat resisting alloy material 43 connects the interior 44 of combustion chamber 40 with the interior of ring portion 37, so that communication is successively effected between interior 44 of chamber 40, compressor discharge port 33 and spark plug recess 35, as rotor plate 27 advances counterclockwise in the housing. While passage 42 is in communication with the circumferentially elongated compressor discharge port 33 the gas which is compressed by the compressor means together with any added fuel which may be injected through port 34 will have ample time to pass into interior 44 of combustion chamber 40. As the rotor plate advances still further the communication just mentioned is cut off by that portion of the periphery of ring 16 lying between the end of port 33 and port 35. Immediately thereafter port 42 is placed in communication with spark plug recess 35 at which time the spark plug 36 may be energized to ignite the combustible mixture in chamber 40. The discharge port 45 of combustion chamber 40 is preferably at one side of the face of the chamber (Figure 4) for a purpose to be explained in detail below.

At the trailing edge of combustion chamber 40 is a vane or expansion pocket member 46 in which angularly directed pockets 47, with intervening vanes 48, are positioned (Figures 1, 4, 6 and 7). This member is preferably supported between inwardly tapering gibs 49 in plate 27 and flange 39, (Figure 7) so that expansion and contraction of member 46 will be circumferentially rather than radially, thereby preserving the clearances between the moving and stationary parts. This effect is facilitated by the single point of attachment, bolts 41, which also secure the combustion chamber 40 and vane member 46 to cylinder 37 of the rotor. A counterweight 50 is preferably secured to cylinder 37 as by bolt 51 at a point opposite to combustion chamber 40 and vane member 46, to balance the latter.

A stationary vane and expansion pocket member generally designated 52 is secured between outer side plate 10 and inner side plate 11, and forms the periphery of the annular chamber generally designated 53 (Figures 1 and 3)

through which the combustion chamber 40 and its following expansion member 46 are adapted to move. In order to maintain accurate radial clearance, tapered gibs 54 (Figure 2) similar to 49 on the rotor plate 27, are provided on side plates 10 and 11 to cooperate with similarly tapered surfaces on member 52, and circumferential rather than radial expansion movement is preferably effected by securing member 52 to ring member 13 at one end of the former by means of bolts 55 (Figure 1). The respective inclination of vanes 56 and slots 57 on stationary ring member 52 is illustrated in Figure 5, and the cooperation of those vanes and slots or pockets with those of the rotor expansion member 46 is illustrated in Figure 6, which shows one superimposed on the other.

Referring now to Figure 3, the compressor rotor 18 is illustrated at substantially the end of its compression cycle, forcing a combustible gaseous mixture through aligned ports 33 and 42 into the interior 44 of combustion chamber 40. As stated above, the discharge port 45 of this chamber 44 is at one side of combustion chamber 40 and, during the fuel intake part of the cycle just described, that port is sealed or covered by a blank section 58 on stationary member 52 (Figures 5, 1 and 3), the slots 57a along this section being shortened and confined to the opposite side of member 52. The arrangement just described maintains the discharge port 45 closed during that part of the rotation of combustion chamber 40 that maintains ports 33 and 42 in communication, so that substantially the full value of the compression of the fuel charge effected by compressor rotor 18 is transferred to the fuel charge in chamber 44.

Referring now to Figure 1, the rotor plate 27 has advanced counter-clockwise so that inlet port 42 is no longer in communication with compressor discharge port 33, but is open to recess 35 and spark plug 36, and the latter is energized by a suitable ignition system to ignite the compressed charge in chamber 44. At this time, discharge port 45 is in communication with the first full length slot or pocket 57b, so that the gas may expand thereinto. The slots or pockets 47 and 57 being oppositely inclined on the rotating and stationary expansion members 46 and 52, respectively, as shown in Figure 6, the heated products of combustion will pass from one to another and expand, doing work, and urging forward the movable member 46, rotor plate 27 and turning shaft 20. This expansion process continues as the discharge port 45 moves counterclockwise and is successively in communication with the rest of full slots 57, and the expanding gases follow through the channels formed by the cooperation and alignment of pockets 47 and 57.

The expansion of these combustion gases continues through about 270 degrees of rotation, or until the rotor 27 and combustion chamber 40 return to the firing position of Figure 1, whereupon the annular passage or chamber 53 is opened to the exhaust passage 59. Just previous to this, however, the interior of combustion chamber 44 has passed exhaust passage 59, giving it a chance to relieve directly the last of the burned gases into the exhaust passage and be ready for the next incoming charge through co-operating ports 33 and 42.

As stated heretofore, the embodiment here disclosed may equally well be operated upon a liquid fuel suitably metered and injected through

port 34 during the admission of compressed air from the compressor rotor 18. Under such circumstances, spark plug 36 is not ordinarily needed for ignition, such being effected by the residual heat contained in combustion chamber 40.

From the outline of operation just described and from the foregoing description it will be appreciated that a very compact, simple and efficient gas turbine has been devised, that embodies no elaborate compressor mechanisms, valves, timing gears and the like. All the parts are susceptible to simple fabrication methods, and are readily accessible by simple disassembling procedure.

Although a specific construction and mode of operation is here shown and described, it is understood that many changes and modifications could be made without departing from the essential features of this invention, and all such modifications as come within the scope of the appended claims are embraced thereby.

I claim:

1. A gas turbine comprising a cylindrical compressor housing, a compressor element operably mounted in said housing, an air inlet for said housing, a discharge port on the periphery of said housing, a rotor surrounding said housing, a combustion chamber carried by said rotor and rotatable about the periphery of said housing, an inlet port for said chamber, a fuel injection port in said housing, each of said ports adapted to be aligned during predetermined portions of the rotation of said combustion chamber, a discharge port for said chamber, a stationary vane member surrounding said compressor housing and spaced therefrom to form an annular passage, an exhaust port for said passage, and a complementary vane member on said rotor adjacent said combustion chamber discharge port, said vane members adapted to receive combustion gases from said last named discharge port and to direct them in a tortuous path to said exhaust port to produce rotation of said motor.

2. A gas turbine according to claim 1 with the addition of a blank sector on said stationary vane member arranged to cover said combustion chamber discharge port during the admission of air and fuel into said combustion chamber.

3. A gas turbine comprising a stationary cylindrical compressor housing, a compressor element movably positioned in said housing, an air inlet for said housing, a discharge port in said housing, a rotor surrounding said housing, a combustion chamber carried by said rotor and rotatable about the periphery of said housing, an inlet port for said chamber, said ports adapted to be aligned to permit compressed air to pass through the stationary wall of said compressor housing into said chamber during a predetermined portion of the rotation of the latter, a fuel injection port in said housing and adapted to communicate with said chamber, a discharge port for said chamber, a series of recesses in said rotor following said discharge port, a stationary housing surrounding said rotor to provide an annular passage for said combustion chamber, an exhaust port for said passage, and complementary recesses in said last named housing for receiving combustion gases from said discharge port and said rotor recesses, said recesses in said rotor and said housing being opposed so that they cooperate to provide a continuous tortuous passage for said combustion gases into said annular passage to produce rotation of said rotor.

4. A gas turbine according to claim 3 in which said recesses are oppositely inclined in said rotor and said housing.

5. A gas turbine comprising an inner cylindrical wall and an outer cylindrical housing concentric therewith, side members connecting said wall and said housing to form a closed annular passage therebetween, a port through said inner cylindrical wall, means for supplying compressed air to said port, a rotor surrounding said inner wall, a combustion chamber on said rotor and rotatable about said inner wall, an inlet port for said combustion chamber adapted to be aligned with said first named port during a predetermined portion of the rotation of said chamber to admit air thereto, a fuel injection port in said inner wall and adapted to communicate with said inlet port to produce a combustible charge in said chamber, a discharge port for said chamber, an exhaust port for said annular passage, a series of spaced recesses in said rotor following said discharge port and a series of complementary recesses in said outer cylindrical housing to provide a tortuous expansion passage for combustion

gases into said annular passage to produce rotation of said rotor.

6. A gas turbine comprising a housing having spaced walls forming an annular passage therein, a rotor in said housing, a combustion chamber carried by said rotor to traverse said annular passage, an air injection port in a wall of said housing, means for supplying compressed air to said port, an inlet port in said combustion chamber adapted to communicate with said first named port during a predetermined portion of the rotation of said chamber to admit compressed air thereto, a fuel injection port in a wall of said housing and adapted to communicate with the inlet port of said combustion chamber to produce a combustible charge in said chamber, a discharge port for said chamber, an exhaust port for said annular passage, a series of spaced recesses in said rotor following said discharge port, and a series of complementary recesses in that wall of said housing facing said discharge port to provide a tortuous expansion passage for combustion gases into said annular passage to produce rotation of said rotor.

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