F. E. GLAZE.

ROTARY ENGINE.

APPLICATION FILED SEPT. 23, 1918.

1,337,218.

Patented Apr. 20, 1920.

4 SHEETS—SHEET 1.

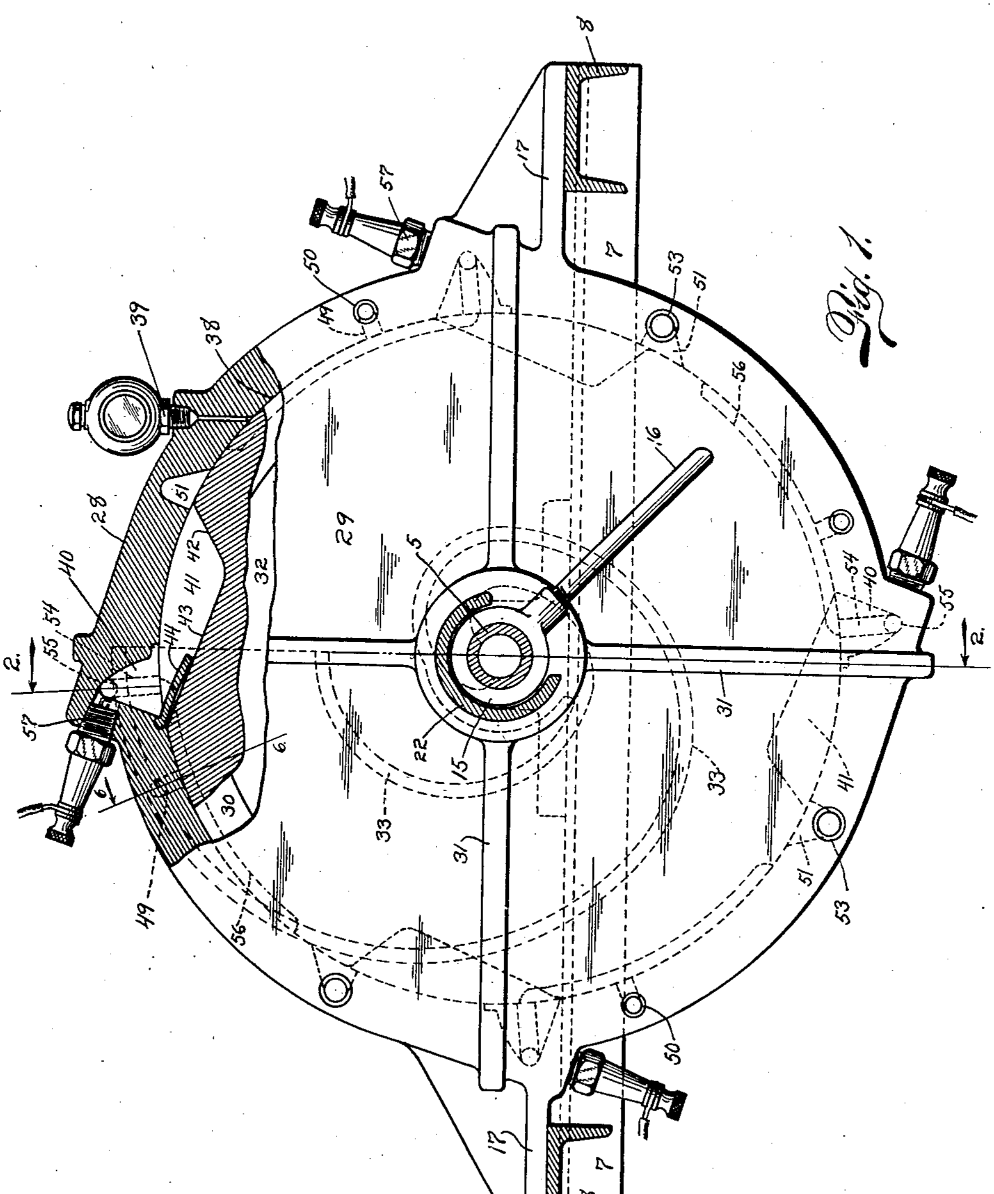

Fig. 1.

Witnesses

John B. Wade.

Inventor

Frederick E. Glaze.

by Wilkinson & Giusta

his Attorneys

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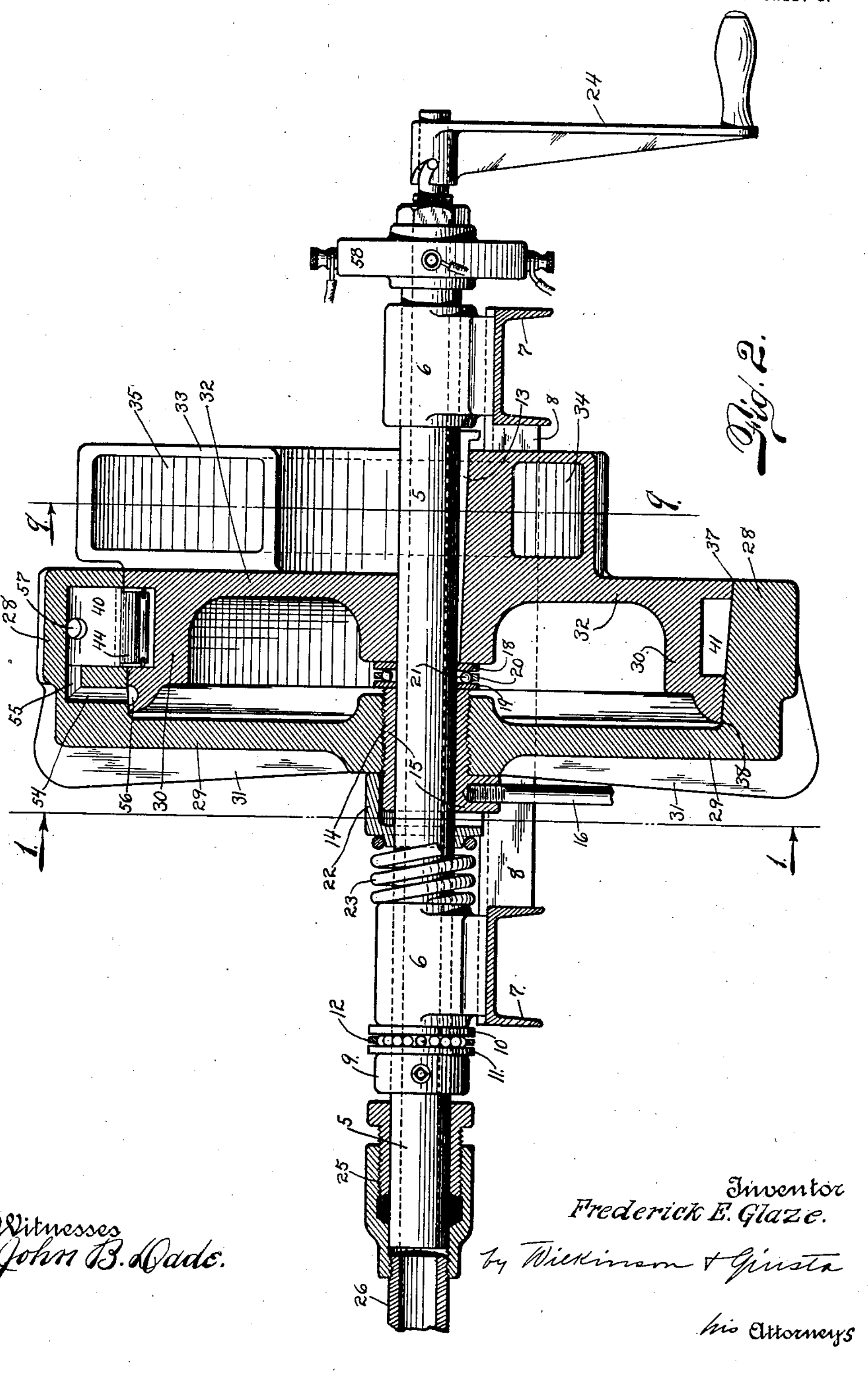

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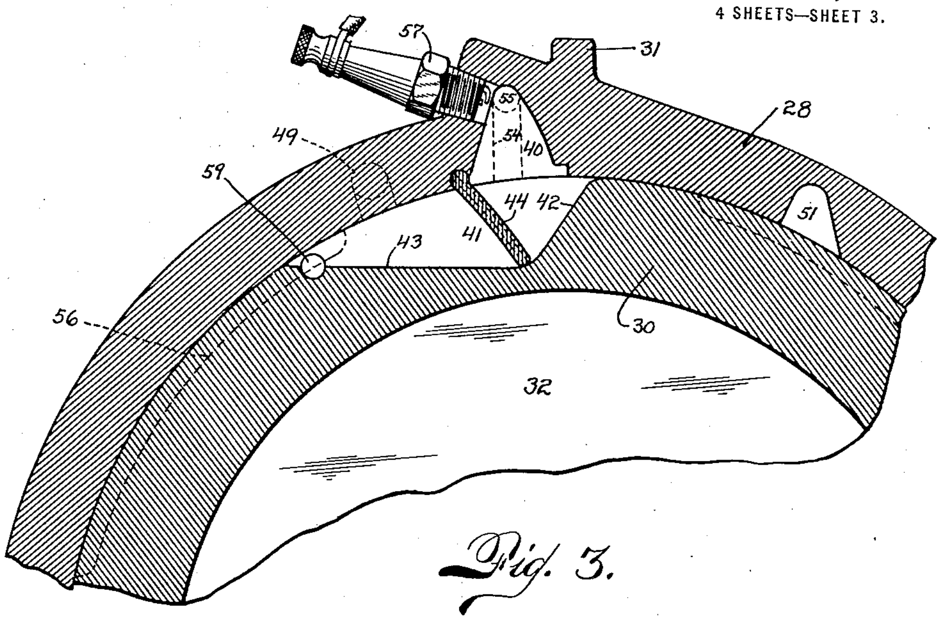

Fig. 3.

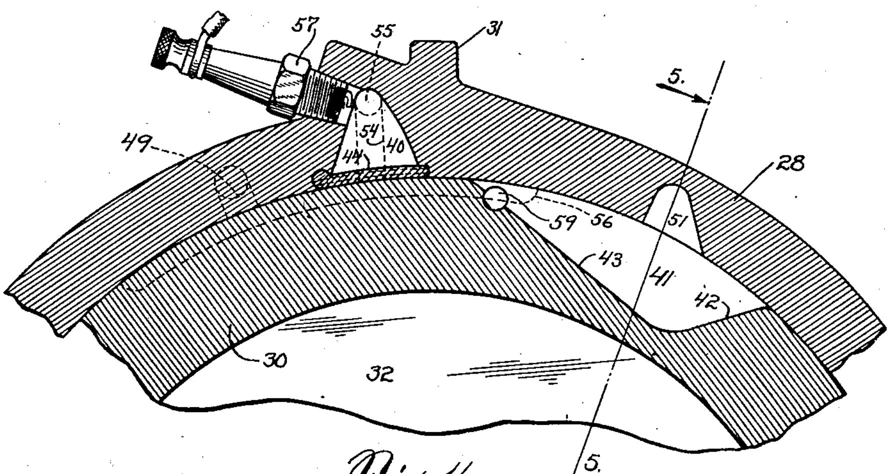

Fig. 4.

Witnesses
John B. Dade

Inventor
Frederick E. Glaze.
by Wilkinson & Giusta
his Attorneys

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4 SHEETS—SHEET 4.

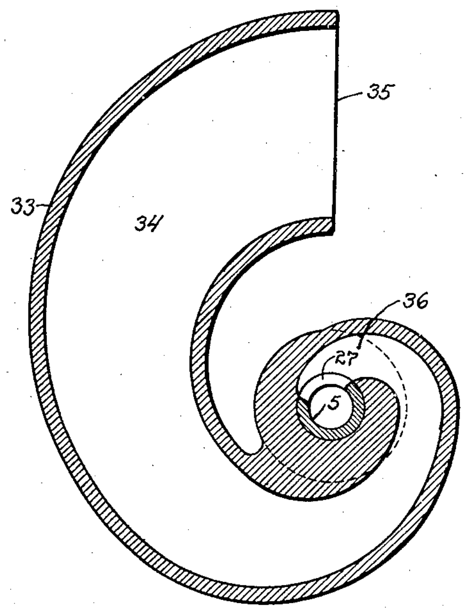

Fig. 9.

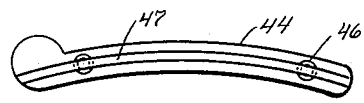

Fig. 7.

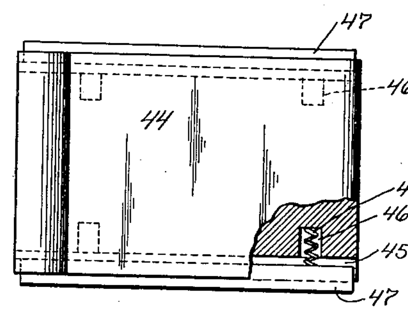

Fig. 8.

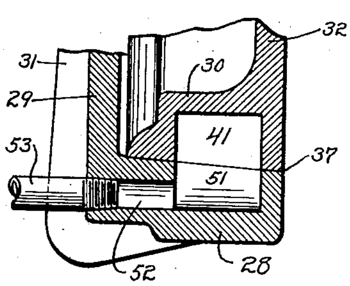

Fig. 5

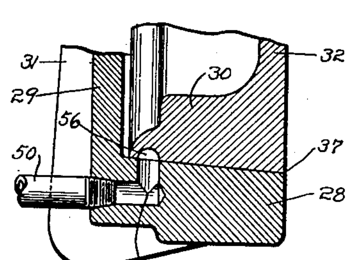

Fig. 6.

Witnesses
John B. Wade.

Inventor
Frederick E. Glaze.
by Wilkinson & Giusta
his Attorneys

UNITED STATES PATENT OFFICE.

FREDERICK E. GLAZE, OF DENVER, COLORADO.

ROTARY ENGINE.

1,337,218. Specification of Letters Patent. Patented Apr. 20, 1920.

Application filed September 23, 1918. Serial No. 255,259.

To all whom it may concern:

Be it known that I, FREDERICK E. GLAZE, a citizen of the United States, residing in the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

This invention relates to improvements in rotary engines of the type in which a rotor element is so mounted relatively to a stator element that the two are annularly alined in substantially self-contained association.

In these types of engines, it is well known that, by slightly modified constructions, either the outer or the inner member may be the rotor or vice versa. Likewise, it is generally accepted that, by the omission of ignition means, such machines may utilize, as the motive power, expansive fluids other than the exploded or slow burning charges of a combustible mixture.

Therefore, while for the purpose of simplicity of illustration and brevity of description I shall disclose my invention as applied only to a rotary engine of the internal combustion type, employing the inner member as the rotor, I wish it to be distinctly understood at the outset that I am not necessarily restricted to such identical use or structural arrangement.

In my novelly combined structure as a whole, the primary objects are to avoid the employment of piston contained cylinders, spring controlled valves, and some of the other general elements heretofore used, in the production of an engine having a minor number of working parts, but with a maximum of energy, durability, and efficiency.

Other objects and advantages will be so clearly apparent, as incidental to the following disclosure, that it would only be superfluous to initially refer to the same more particularly, and, with these prefacing remarks, reference will now be had to the accompanying drawings, illustrating a practical embodiment of the improvements, in which drawings—

Figure 1, is a sectional view on the line 1—1 of Fig. 2, showing the major portion of the stator in side elevation, and the upper portions of the stator and rotor in circumferential section; Fig. 2, is a vertical cross-sectional view, taken substantially along the line 2—2 of Fig. 1; Figs. 3 and 4, are fragmentary circumferential sectional views in enlarged detail, showing the initial opening and full exhaust positions of the rotor relatively to that shown in Fig. 1; Fig. 5, is a fragmentary detail sectional view, taken along the line 5—5 of Fig. 4, but in inverted position, or through the diametrically opposed exhaust port to that shown in Fig. 4; Fig. 6, is a view analogous to that of Fig. 5, but taken through the inlet port, as indicated by the line 6—6 of Fig. 1; Figs. 7 and 8, are detail views, illustrating in side elevation and top plan, respectively, one of the foldable abutments for the rotor's expansion pockets; and Fig. 9, is a circumferential sectional view through the spiral air compressor passage, taken along the plane of the line 9—9 of Fig. 2.

5 designates a driving shaft, journaled in bearings 6 (Fig. 2) mounted on side channel bars 7 forming a part of a supporting frame, of which 8 designates the end channel bars or beams.

9 designates an adjustably secured collar on the shaft, between which and the adjacent face of the bearing 6 are disposed end thrust bearing elements, comprising the washers 10 and 11, and interposed ball containing ring 12.

The hub of the rotor is suitably fixed to the shaft 5, as by a key 13, while the hub of the stator is centrally apertured and threaded, as at 14, to engage an externally threaded adjusting sleeve 15, freely encompassing the shaft 5 and rotatable by means of an operating lever 16. This arrangement will permit of the bodily adjustment of the stator toward the rotor, while the stator is fixed against rotation, owing to a pair of projecting supports 17, seating on the end cross beams 8, where they may be adjustably secured, if desired, in any suitable manner not shown.

The abutting ends of the two hubs are slightly spaced apart to permit of the mounting of central thrust bearing elements between the inner face of the rotor hub and the opposed end face of the sleeve 15, the said bearing elements being substantially similar in arrangement to the end thrust bearing elements before mentioned, and comprising the washers 18 and 19, and the interposed ring 20 having a series of circularly spaced apertures for seating bearing balls 21, contacting the faces of the washers 18 and 19. The functioning of both central and end thrust bearings will hereinafter more fully appear.

A cylindrical cap member 22 encompasses the other end of the adjustment sleeve 15, and the inner end face of this cap member bears up against the abutting face of the hub of the stator, being always held in that position by the pressure of a highly tensioned stout coil spring 23, encircling the shaft 5 and interposed between the outer end face of the cap member and the adjacent shaft bearing 6 or other abutment. The lower portion of this cylindrical cap may be cut-away, as shown, to permit of the play of the lever 16.

24 is simply a conventional form of crank, associated with one end of the shaft 5 in the usual manner, for starting up the engine.

This end of the shaft is formed solid or otherwise closed up, but the remaining portion is hollow to the opposite end, where it is incased by a stuffing box arrangement, indicated at 25, which latter also encompasses the end of a compressed air conduit pipe 26, fed with the air from a spiral air compressor passage, communicating with the hollow shaft 5 through an inlet opening 27, Fig. 9, all of which is hereinafter more fully referred to.

28 designates the substantially solid annular rim of the stator, which is offset from its supporting disk 29 to provide a housing for the oppositely offset substantially solid annular rim 30 of the rotor, with which it is functionally associated.

Obviously, the rim of the stator may be supported by spokes instead of the end disk 29, but where the latter is employed I prefer to cast the same with radial integral strengthening ribs 31, while the end disk 32, for supporting the rotor rim, is provided on its outside face with a casing 33, forming a spirally disposed air compressing passageway 34, converging from its enlarged intake or outer open end 35 to a restricted neck space 36 at its inner delivery end, where it discharges to the interior of the hollow shaft 5 through the inlet opening 27 before referred to.

The inner periphery of the stator rim is beveled, the outer edge of its inclined face being designated at 37 and its inner edge at 38, while the outer periphery of the rotor rim is likewise beveled to provide a complementary inclined face, and 39 shows conventional oiling means for lubricating these contiguous beveled surfaces.

The stator rim is formed with one or more, but preferably a plurality of equidistant, fixed chambers 40, which may be conveniently and interchangeably termed either ignition or compression pockets, dependent upon whether an explosive or a slowly combustible mixture is utilized or a fluid of other expansive character employed, inasmuch as the pockets are adapted, in either instance, to receive compressed charges of the operating fluid; and in the usage of the term ignition pockets, while more properly employed in describing the form of engine illustrated, it is used in the other sense as well where applicable. These pockets are sunk in the stator rim and have open ends lying in the inner periphery thereof.

The rotor rim is also formed preferably with a like number of equidistantly arranged expansion pockets 41, likewise sunk in the rotor rim and opening to the outer periphery thereof, being adapted to synchronously uncover said ignition pockets successively during the revolutions of the rotor. Each of the expansion pockets 41 is of elongated formation, relatively to the more restricted ignition pockets 40, the forward wall 42 thereof sloping downwardly and rearwardly with steep declivity, to provide a substantial operating abutment face, while the bottom wall 43 recedes upwardly to the periphery of the rim at a much longer incline.

As each expansion chamber uncovers and traverses its complementary ignition chamber, an automatically operating abutment is caused to be projected into the former and ride along inside thereof as a partitioning member to provide for a constantly increasing volume or space between the forward wall 42 and the automatically operating abutment element, thus allowing for the expansion of the motive charge to impart motion to the rotor.

This may be accomplished with any suitable retractile gate, illustrated by the foldable or hinged abutment 44, shown in different positions in Figs. 1, 3 and 4, and in detail in Figs. 7 and 8. Its side edge faces are longitudinally recessed, as at 45, for receiving compensating side wear-strips 47 adapted to be forced outwardly in any suitable way, conveniently shown by the coil springs 48, contained in sockets 46 and pressing outwardly on said wear-strips.

For each ignition pocket, the stator rim is formed with an inlet port 49, connected with an inlet pipe 50, and also with an exhaust chamber 51 communicating, through the outlet port 52, with a discharge pipe 53, the said exhaust chambers 51 and said inlet ports 49 opening out on the inner peripheral surface of the stator rim, as shown in detail in Figs. 5 and 6, and the exhaust chambers being disposed in alined positions relatively to said revoluble expansion pockets 41. Also, each ignition pocket is supplied by a suitable intake port, shown as being L-shaped, the radial branch 54 of which opens out on the inner periphery of the stator rim, while the horizontal branch 55 thereof communicates with its ignition chamber 40. 56 designates a corresponding number of intake passages, comprising elongated grooves disposed around the outer periphery of the rotor rim, which are sufficiently long to substantially over-span, in open communication therewith, a complementary pair of said inlet and intake ports, at proper intervals, during the revolutions of the rotor; it being understood that the inlet ports 49, intake ports 54—55 and the coöperating peripheral grooves 56 are arranged in circumferential alinement, but to one side of, or out of alinement with, the positions of the exhaust chambers 51 and the expansion pockets 41, so that the delivery of the combustible mixture to the ignition pockets is direct and never through the revoluble expansion pockets.

Means may be provided for relieving any cushioning air that might form behind the abutments 44, and such means may be suitably represented by restricted outlets 59 leading to the atmosphere, directly or otherwise, from the rear of each of said ignition pockets.

57 designates an electric spark plug, or analogous means, associated with each of the revoluble pockets 40 for igniting the combustible compressed charges therein at the most advantageous predetermined time, proper ignition being attained by means of any suitable timing mechanism, shown conventionally at 58 as being mounted on the closed end of the driving shaft 5.

It may not be amiss, at this point, to state that theoretically and technically my engine will successfully operate, whether there be only one ignition pocket in the stator rim and either one or more expansion pockets in the rotor rim, or vice versa. Therefore, I do not wish to necessarily restrict myself in this respect, although the maximum of practical efficiency would doubtless require the employment of a plurality of both ignition and expansion pockets, equidistantly disposed as illustrated and previously described.

Having thus generally set forth the details of the invention, a description of the operation of the engine, as a whole, will now follow, which will more distinctly state the functioning of the several elements and features encompassed by the present improvements.

Operation.

It is to be understood that, in the construction illustrated, charges of a highly compressed combustible mixture, from a properly controlled source of supply, are caused to be delivered to one or more of the ignition pockets 40, as desired, by way of the inlet pipes 50, intake branches 54—55, and the coöperating interposed inlet ports 49 and passages 56. As any suitable controlled supply means may be employed, such as substantially shown in my former application Serial No. 198,624, it is not believed to be necessary or desirable to encumber the drawings with an illustration of any specific fuel connection, the showing of the inlet pipes 50, adapted to receive this fuel supply under pressure, being deemed sufficient for present purposes.

If only one inlet pipe 50 be opened, it will be apparent that the combustible mixture will be conducted to but one of the ignition pockets 40 of the engine, so that four of such charges will be ignited, burned, and expanded successively, as the four expansion pockets 41 of the rotor come around into registration with that particular ignition pocket, causing four impulses upon each cycle of revolution. Under such circumstances, the engine would be turning over at its lowest speed and developing the least power.

However, it is desirable to equalize the force of the impulses, relatively to the engine structure, so that at least dual impulses will occur at the same time from diametrically opposite positions. Thus with two opposite inlet pipes 50 open, the compressed fuel mixture is fed to diametrically opposed ignition pockets 40 of the stator, not only balancing the engine but also developing greater power and speed, with eight impulses for each cycle of revolution of the rotor. Likewise is this effect proportionately increased with all four inlet pipes 50 maintained open, leading to as many ignition pockets, in which latter case there would be sixteen impulses per revolution, and so on as the number of sets of coöperating elements are increased, although only four of such sets have been shown.

With this understanding, for simplicity of statement, I will now refer more especially to only one set of coöperating elements, with but one inlet pipe 50 opened up, as it will be understood that with all of the inlet pipes open there will be a synchronous coöperation of the complementary elements of the other sets accordingly.

Viewing Fig. 3, a compressed charge of the combustible mixture, in the ignition pocket 40, will have been ignited before the parts have assumed the relative positions shown, or while the hinged abutment 44 is in closed position, (dependent upon how far the sparking point has been advanced or retarded) still the movement of the rotor has been so rapid that complete combustion is substantially effected as the forward wall 42, of the expansion pocket, passes beyond the hinged abutment, the swinging end of which latter immediately rides down said forward inclined wall (being positively forced downwardly by the pressure above) to the position shown in the expansion pocket 41, preventing leakage therearound to the rear of said abutment member.

If the ignition creates an explosive force, there will be an initial impact against the forward face 42 of the expansion pocket, or where only a slower burning of the combustible mixture is desired (to avoid shocks and noise as in later developed types of engines) the increased temperature, in either instance, will tend to expand the burning gases, raised to a very high pressure, which will impart rotary motion to the rotor member, free expansion being permitted by the increasing volume of the expansion pocket, or the lengthening of the space between the forward wall 42 thereof and the hinged abutment 44, as the latter rides up the much longer upwardly receding bottom wall 43, until the hinged abutment assumes the position, shown in Fig. 1, where it is being completely folded to close the ignition pocket.

At this moment, approximately, the forward wall 42 starts to uncover the exhaust chamber 51, while the peripheral groove 56 opens communication between the inlet port 49 and the intake branches 54—55, the incoming fresh charge initially functioning as a scavenging means for the pocket 40, just prior to the closing up of the hinged abutment.

As the expansion pocket 41 thus starts initially uncovering the exhaust chamber, there is a further expansive force or continuing impulsion pressure against the forwardly moving inclined abutment face 42, owing to the release of the now rushing out gases and products of combustion, until after the lowest portion of the expansion chamber has substantially passed beyond the exhaust chamber.

In the position shown in Fig. 4, full exhaust from the expansion pocket is being completed, after the ignition pocket has been closed and while the fresh charge is still being fed into the ignition pocket under heavy pressure, the restricted outlet 59, previously functioning to relieve any cushioning air from behind the hinged abutment, now further assisting in perfecting the exhaust additionally from the rear portion of the unobstructed revolving expansion chamber.

The automatic opening and closing movements of the hinged abutment 44 will be obvious from Figs. 3, 1 and 4.

The object of beveling the contiguous faces of the stator and rotor rims is manifestly to avoid release of pressure by lateral leakage therebetween, and the substantially stout and strong spring 23 will exert a firm inward pressure on the cap member 22 and hence the stator, thus tending to force the beveled rims of the stator and rotor into the closest contact. This, however, would cause frictional binding thereof, which is equalizingly offset by the minute nicety of adjustment afforded by the rotatable adjustment sleeve 15, the inner end face of which engages the washer 19 of the central thrust bearing; so that in tightening up the adjustment sleeve 15, by operating the lever 16 one way, the stator is threaded outwardly against the tension of the spring 23, whereas upon easing up on the adjustment sleeve, the stator is correspondingly moved inwardly to the desired extent. In this way the beveled faces of the rims are maintained in the closest proximate degree to provide a leak-proof closure between the same and still permit the rotor to freely revolve.

The functioning of the central thrust bearing elements, 18 to 21, will be fully apparent from the foregoing, and the end thrust bearing elements, 10 to 12, interposed between the shaft collar 9 and the proximate shaft bearing 6, will prevent the strong coil spring 23 from forcing the rotor and the driving shaft, to which it is keyed, to the right, in conjunction with the stator, when the latter is moved inwardly for adjustment.

As the rotor turns over to the right, the enlarged open or intake end 35 of the air compressor casing 33 will provide for outside air being forced inwardly along the converging spiral passageway 34 to the restricted neck portion 36 (Fig. 9) where it is delivered into the hollow shaft 5, through the inlet opening 27, in a highly compressed state. It is then conveyed away, through the shaft 5 and conduit pipe 26, for further utilization as desired. One expedient usage of this compressed air, more particularly germane to the present invention, is to furnish a proper supply of pressure air for admixture with a hydrocarbon fuel, such as gasolene or equivalent fluid, which is to be delivered through the inlet pipes 50 of the engine, under pressure and proper control as before stated, in the form of a thoroughly carbureted combustible mixture.

In thus fully disclosing a practical embodiment of the invention, it will be apparent that certain general features of arrangement and construction might be varied without departing from the spirit of the invention. It will be understood, therefore, that I do not restrict myself to the exact details as shown and described, otherwise than coming within the purview of the ensuing claims and a reasonable construction of the scope thereof, as viewed in the light of the specification, a fair range of expedient equivalents being contemplated in actual practice, if found desirable.

What I do claim, as new and patentable, is:—

1. In a rotary engine, the combination of a stator and a rotor, annularly constructed

and mounted in self-contained relation, the said stator and rotor being respectively provided with a compression pocket and an expansion pocket, disposed and functioning as set forth, and the said expansion pocket being formed with a forward confining wall, of steep declivity, merging into a receding substantially elongated bottom wall, and with a restricted outlet discharging from the rear thereof; intermittently controlled inlet means for delivering operating charges to said compression pocket; exhausting means for said expansion pocket; and a retractile abutment automatically coöperating with said expansion pocket, to ride along therein and function as a variable partition therefor, substantially as described.

2. In a rotary engine, the combination with a suitably journaled shaft; of a stator slidingly encompassing same; a rotor fixed on said shaft, the said stator and said rotor being annularly constructed with beveled peripheries contiguously associated in self-contained relation, and being also respectively provided with a compression pocket and an expansion pocket, disposed and functioning as set forth; means for bodily adjusting said stator along said shaft, to regulate the space between said beveled peripheries; intermittently controlled inlet means for delivering operating charges to said compression pocket; exhausting means for said expansion pocket; and a retractile abutment automatically coöperating with said expansion pocket, to ride along therein and function as a variable partition therefor, substantially as described.

3. In a rotary engine, the combination with a suitably journaled shaft; of a rotor fixed thereon; a stator associated therewith, the said stator and the said rotor being annularly constructed with beveled peripheries contiguously associated in self-contained relation, and being also provided with a compression pocket and an expansion pocket, respectively, disposed and functioning as set forth; an externally threaded adjustment sleeve loosely encompassing said shaft, adjacent said rotor, and supporting said stator in movable threaded relation; means for rotating said adjustment sleeve; central thrust bearing elements interposed between said rotor and the adjacent end of said adjustment sleeve; end thrust bearing elements for said shaft; means exerting a strong pressure on said stator toward said rotor; intermittently controlled inlet means for delivering operating charges to said compression pocket; exhausting means for said expansion pocket; and means providing for the continuous enlargement of the total working space of said pockets, from the time of opening communication therebetween until the period of initial exhaust, substantially as described.

4. In a rotary engine, the combination of a stator and a rotor, annularly constructed and mounted in self-contained relation, the said stator and rotor being respectively provided with a compression pocket and an expansion pocket, disposed and functioning as set forth; an intake port, for said compression pocket, opening peripherally of said stator; an inlet port for the operating fluid, also opening peripherally of said stator, at the rear of and in line with said intake opening; a pair of peripherally cut ports, comprising elongated grooves, disposed around said rotor, one in advance of and the other to the rear of said expansion pocket, and in line with said intake and inlet openings; an exhaust chamber, opening peripherally of said stator, forwardly of said compression pocket and in line with said revoluble expansion pocket; and means providing for the continuous enlargement of the total working space of said compression and expansion pockets, when in communication, from the time of opening communication therebetween until the period of initial exhaust, substantially as described.

5. In a rotary engine, the combination with a suitably journaled hollow shaft, closed at one end, and coupled with an outlet pipe conduit at the other end; of a stator and a rotor, annularly constructed and mounted in self-contained relation, the said stator and rotor being respectively provided with a compression pocket and an expansion pocket, disposed and functioning as set forth; an air compressor casing eccentrically mounted relatively to said shaft, being rotatable therewith, and providing a spirally converging passageway opening to the atmosphere at its larger outer end, and communicating, at its inner restricted end, with said hollow shaft; intermittently controlled inlet means for delivering operating charges to said compression pocket; exhausting means for said expansion pocket; and means providing for the continuous enlargement of the total working space of said compression and expansion pockets, when in communication, from the time of opening communication therebetween until the period of initial exhaust, substantially as described.

In testimony whereof I affix my signature.

FREDERICK E. GLAZE.