R. E. MILLER.

ROTARY INTERNAL COMBUSTION ENGINE.

APPLICATION FILED APR. 10, 1919.

1,380,404.

Patented June 7, 1921.

4 SHEETS—SHEET 1.

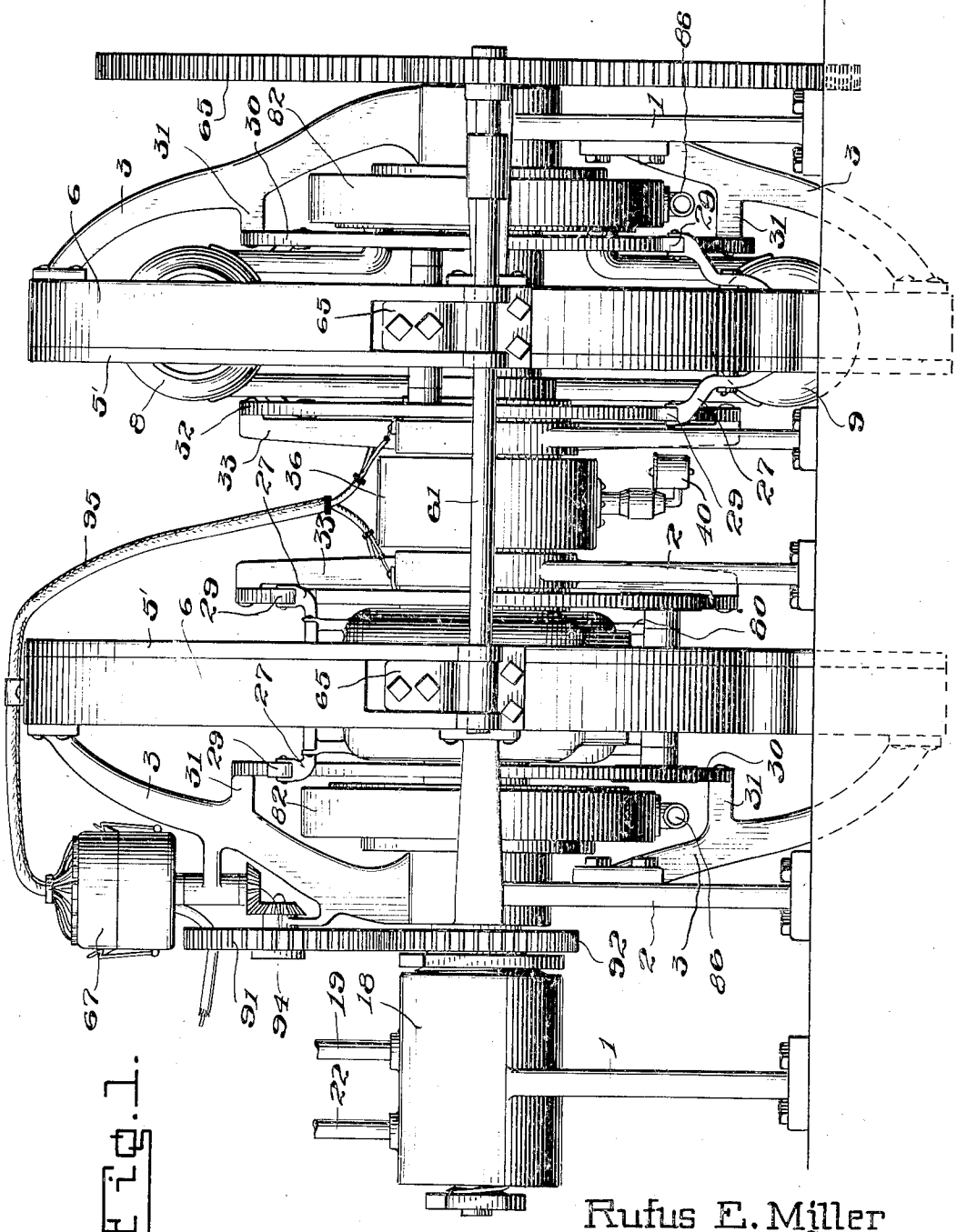


Fig. 1.

Rufus E. Miller
Inventor

By Lancaster & Allwine
Attorneys

R. E. MILLER.

ROTARY INTERNAL COMBUSTION ENGINE.

APPLICATION FILED APR. 10, 1919.

1,380,404.

Patented June 7, 1921.

4 SHEETS—SHEET 2.

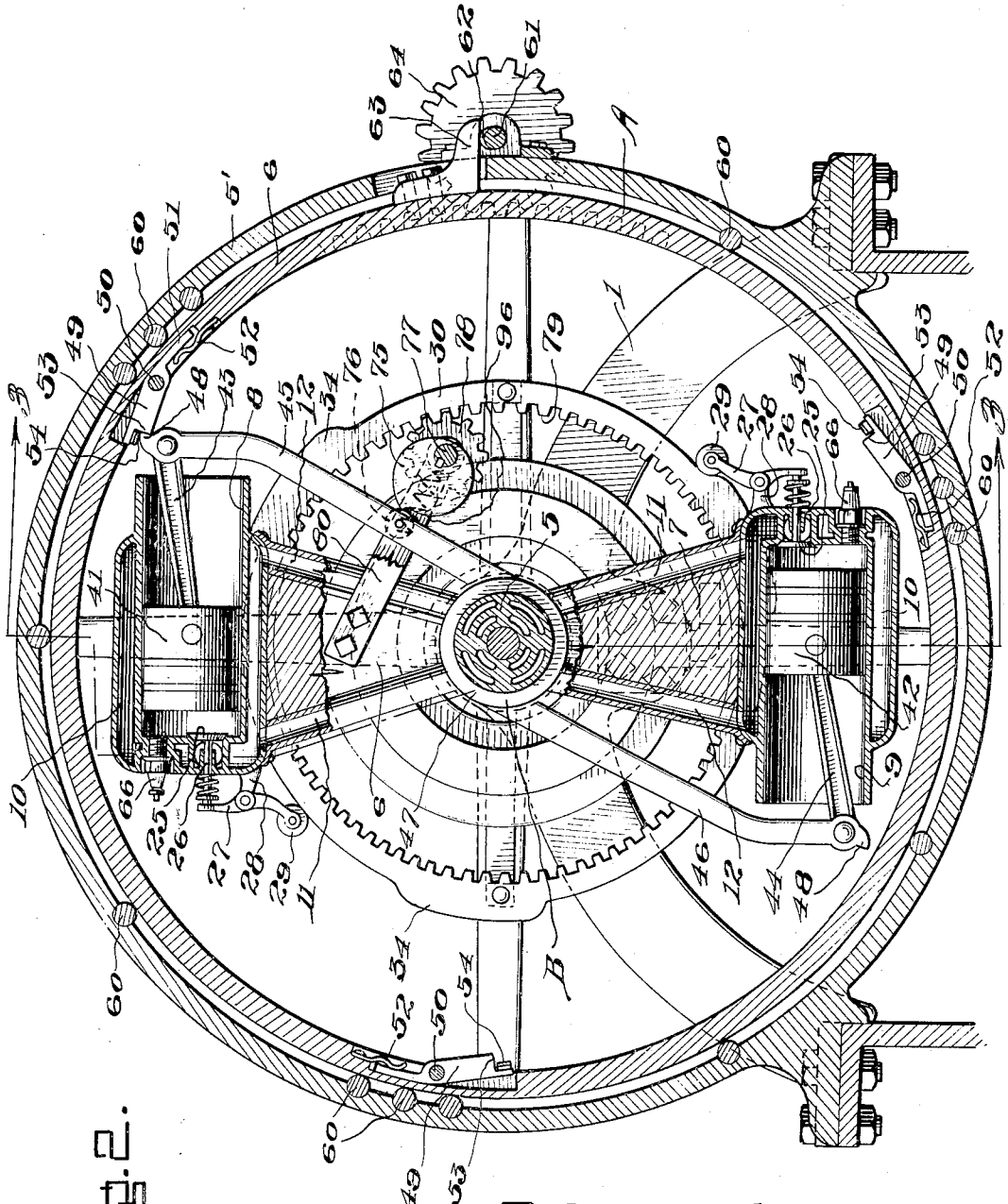


Fig. 2.

Rufus E. Miller

Inventor

By Lancaster and Allwine

his Attorneys

R. E. MILLER.

ROTARY INTERNAL COMBUSTION ENGINE.

APPLICATION FILED APR. 10, 1919.

1,380,404.

Patented June 7, 1921.

4 SHEETS—SHEET 3.

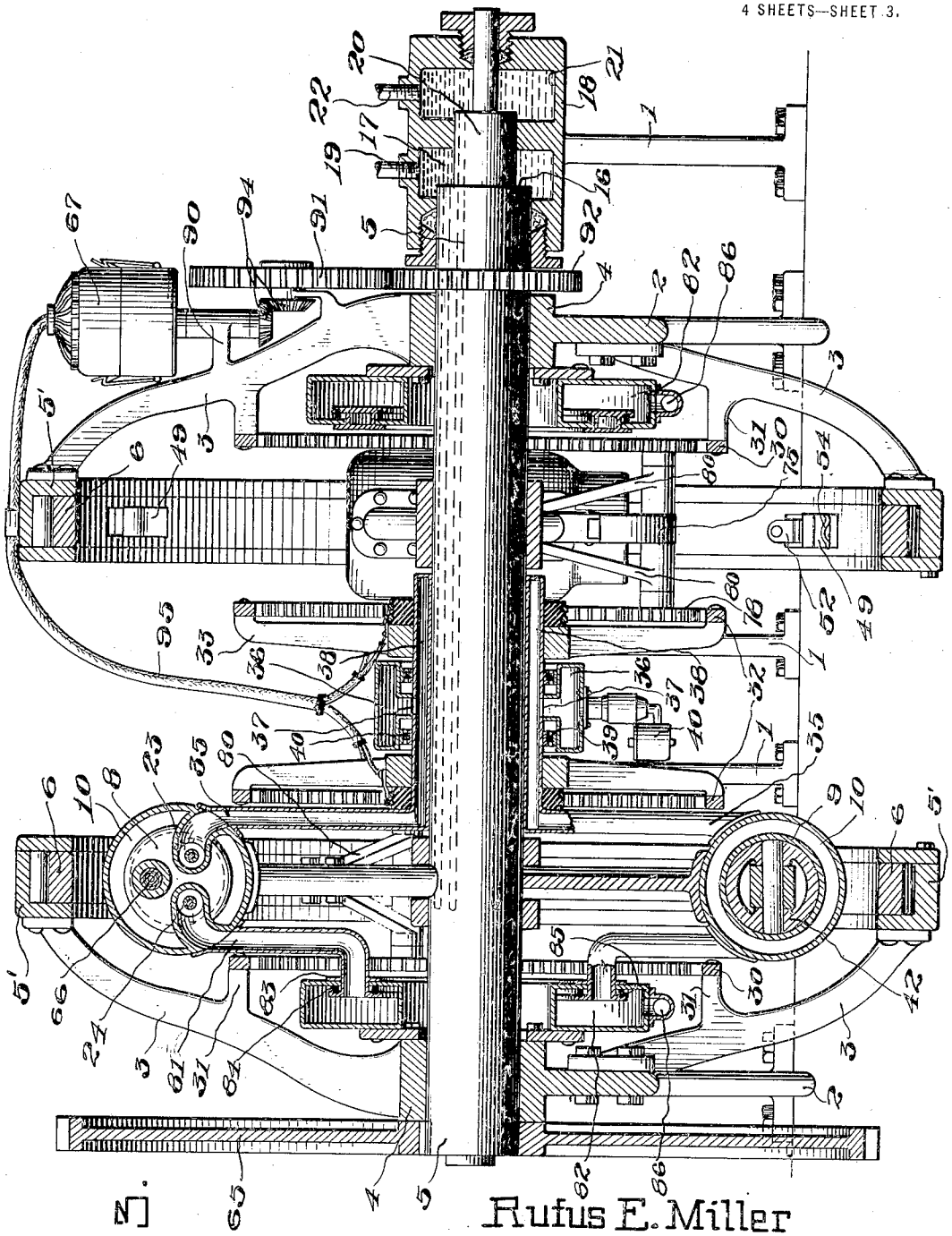


Fig. 3.

Rufus E. Miller

Inventor

By Lancaster and Allwine

Attorneys

R. E. MILLER.

ROTARY INTERNAL COMBUSTION ENGINE.

APPLICATION FILED APR. 10, 1919.

1,380,404.

Patented June 7, 1921.

4 SHEETS—SHEET 4.

Fig. 4.

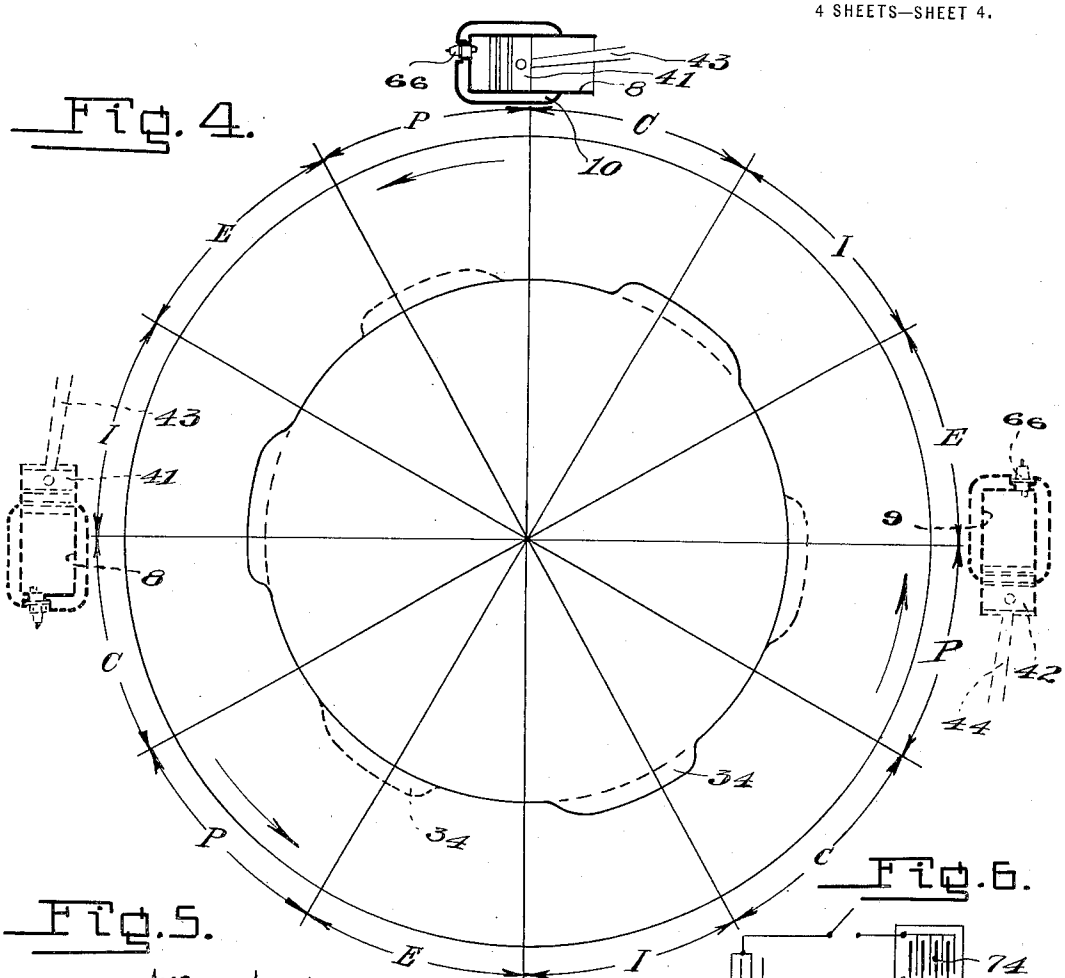


Fig. 5.

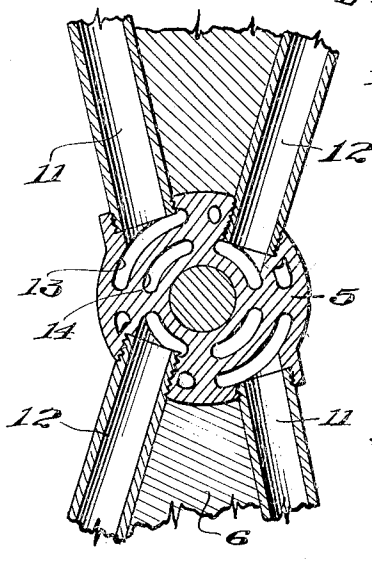
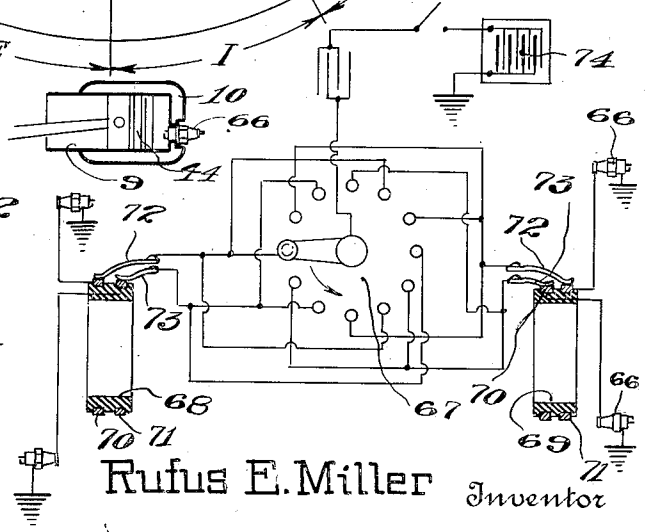


Fig. 6.



Rufus E. Miller Inventor

By Lancaster and Allwine

Attorneys

UNITED STATES PATENT OFFICE.

RUFUS E. MILLER, OF POCONO PINES, PENNSYLVANIA.

ROTARY INTERNAL-COMBUSTION ENGINE.

1,380,404. Specification of Letters Patent. Patented June 7, 1921.

Application filed April 10, 1919. Serial No. 288,997.

To all whom it may concern:

Be it known that I, RUFUS E. MILLER, a citizen of the United States, residing at Pocono Pines, in the county of Monroe and State of Pennsylvania, have invented certain new and useful Improvements in Rotary Internal-Combustion Engines, of which the following is a specification.

This invention relates to internal combustion engines of the rotary type, and an object of the invention is to provide a rotary engine wherein there will be substantially a continuous application of power to the power or operating shaft thereof, during operation of the engine, resulting in the obtaining of a maximum efficiency of the engine and eliminating the momentum or idle, revolutions or partial revolutions, of the power shaft.

Another object of the invention is to provide a rotary engine which will accomplish the above object by the employment of a minimum number of cylinders, the engine comprising four cylinders rotatable about a fixed axis and connected to the power shaft of the engine, each of said cylinders having three power or explosion cycles upon each revolution of the power shaft, the power cycles of the cylinders being successive, whereby one of the cylinders will always be on a power stroke or cycle.

A further object of the invention is to provide a rotary internal combustion engine as specified wherein the cylinders are connected directly to the power shaft, and are movable relative to the piston during the power cycle, the said piston being supported from the power shaft and held against backward motion during explosion of the explosion or power cycle by movable spring actuated abutments which are carried by the stator of the engine and spring behind the connecting rods of the pistons at the proper predetermined times during each revolution of the cylinder about the axis of the power shaft; and also to provide cams which engage the supporting arms of the pistons and force the pistons into their respective cylinders during the compression and exhaust cycle, the said pistons and cylinders being coupled in opposed pairs, whereby when one cylinder is moving under explosion of fuel therein, it will move the other cylinder of the pair to draw a charge of fuel therein.

Further objects of the invention are: to provide a novel valve actuating mechanism for the engine, comprising an annulus or ring carried by the stator of the engine and having cam enlargements at circumferentially spaced intervals, which enlargements operate pivotally mounted valve operated levers at predetermined times during each revolution of the rotor of the engine to control the inlet and exhaust of fuel into and from the cylinder and also to provide a plurality of passageways in the power shaft and cylinder supporting arm, having communication with a suitable supply source and the interior of the water jackets of the cylinders, to permit circulation of water or an analogous cooling medium about the cylinders.

Other objects of the invention will appear in the following detailed description taken in connection with the accompanying drawings, forming a part of this specification and in which drawings:

Figure 1 is a side elevation of the improved rotary engine.

Fig. 2 is a vertical section through the engine.

Fig. 3 is a longitudinal vertical section through the engine, taken on the line 3—3 of Fig. 2.

Fig. 4 is a diagrammatic view illustrating the cycle of operation of the respective cylinders and pistons of the engine.

Fig. 5 is a fragmentary cross section through the power shaft of the engine illustrating the water inlet and outlet ports or passageways therein, and

Fig. 6 is a diagrammatic view of the ignition system of the engine.

Referring more particularly to the drawings, A generically indicates stator structures of the engine, while the rotor structure is generically indicated by the letter B. The stator structure includes a plurality of bearing members 1 which may be attached to any suitable permanent support and also bearings 2, attached to the permanent support, and which latter bearings have supporting arms 3 formed thereon, and radiating from the bearing boxes 4 of the said bearing structures 2. The arms 3 are attached at their outer ends to the outer circular shells 5 of the stator structure, in which are mounted the rings or annuli 6′. As shown in Figs. 1 and 3 of the drawings, there are two of the annuli 6′ and circular or ring cas-

ings 5, one being provided for each unit of the engine and in specifically describing the engine structure only one unit will be referred to, but it is to be understood that both the units are identical in construction.

The bearing boxes of the bearings 1 and 2 rotatably support the power shaft 5 which forms a part of the rotor structure B. A shaft 5 has webs 6 and 7 radiating therefrom, at diametrically opposed points and these webs 6 and 7 have cylinders 8 and 9 attached to their outer ends, respectively, the cylinders 8 and 9 are provided with the usual form of water jackets 10, the inlet and outlet of the cooling liquid thereto being through passageways 11 and 12 formed in the edge portions of the webs 6 and 7. These passageways 11 and 12 may be formed by pipes, which are attached to the outer surfaces of the water jackets 10 and are threaded or otherwise suitably connected to the shaft 5. The shaft 5 is provided with longitudinally extending passageways, arranged in an outer circle 13, and an inner circle 14. The passages 13 have communication with the inlet pipe 11 of the cooling liquid circulating system of the cylinders 8 and they open out through the shouldered end 16 of the shaft 5 into a compartment 17 formed in a suitable passage 18 supported by one of the bearing structures 1. This compartment 17 has communication, through a pipe 19 with a suitable supply source, which may be an ordinary radiator, pump, or other approved structure for supplying water or an analogous cooling fluid to the compartment 17 for passage through the cooling system of the cylinder. The reduced portion 20 of the shaft 5 which extends outwardly of the shoulder 16 thereon projects into a compartment 21 formed in the casting 18 and the passageways 14 open into this compartment 21, having outlet from the compartment through a suitable outlet pipe 22. Thus the water or analogous cooling fluid circulating the motor is separated after its passage through the cooling system from the cooling fluid just entering the cooling system, permitting of the efficient cooling of the cylinders 8 during operation of the engine.

Each of the cylinders 8 and 9 are provided with the usual inlet ports 23 and exhaust ports 24, the passage of fuel through the said ports being controlled by the valves 25, the stems 26 of which are projected outwardly through the cylinder and are connected to levers 27. The levers 27 are pivotally supported, by arms 28, formed upon the cylinder structure, and they have rollers 29 rotatably supported by their free ends, the said rollers riding over the periphery of a ring 30, which is supported by lateral projections or extensions 31 formed upon the radial bracing arms 3. The ring 30, and a ring 32 which is supported by radiating arms 33 carried by one of the bearing structures 1. The rings 30 and 32 have cam enlargements 34 formed upon their peripheries, which when the rollers 29 engage and ride thereover, operate the exhaust valve 24 and inlet valve 23 respectively for controlling the exhaust from and inlet into of fuel.

The inlet openings 23 of the cylinders 8 and 9 have communication, through manifolds 35 with an annular or ring-like manifold 36 which is mounted about the shaft 5. The ring-like manifold 36 has communication through a plurality of openings 37 with the angularly disposed portions of the manifold 35, to permit the flow of the combustible fuel from the ring-like manifold 36 into the manifold 35 for transmission into the cylinder when the valves 25 of the inlet openings 23 are forced open by the engagement of the rollers 29 with the cam extensions 34 of the ring 32. The angular extensions 38 of the manifold 35 are carried by the shaft 5 and are rotatable therewith, and bearing rings 39 are provided between the manifold extensions 38 and the circular manifold 36, the said bearing rings including the gaskets indicated at 40 to prevent the escape of any of the fuel between the extensions 38 and manifolds 36 during operation of the engine. A carbureter 40 of any approved construction is connected to the manifold 36 and is adapted to have connection with any suitable fuel supply source.

Pistons 41 and 42 are mounted for reciprocatory movement in the cylinders 8 and 9 respectively, and the coupling rods 43 and 44 of the said pistons are pivotally connected at their outer ends to arms 45 and 46. These arms 45 and 46 have their inner ends connected to a ring 47 which is rotatably mounted upon the shaft 5, thereby mounting the pistons for relative movement with respect to the cylinders, while the cylinders are mounted for movement with respect to the pistons, through their direct connection with the power shafts 5. The arms 45 and 46 have abutment extensions 48 formed upon their ends outwardly of their pivotal connection with the connecting rod or arm 43 and 44 of the pistons. These abutment extensions 48 are adapted for engagement against movable abutment members 49 carried by the ring 6 of the stator structure. The movable abutment members 49 are substantially in the form of pawls, being pivotally supported by the stator rings 6 as shown at 50 and having extensions 51 which are engaged by springs 52, that are carried by the ring 6, the action of which springs are to force the head or shouldered end of the abutment members inwardly of the inner circumference of the ring 6, as clearly shown in Fig. 2 of the drawings. The ends of the movable abutment 49 which are urged outwardly by the springs 72 are

provided with shoulders 53 adapted to be engaged by the flat sides of the abutment extension 48, and if it is so desired, cushioning springs 54 may be provided to cushion the engagement of the said abutment extension with the movable abutment 49.

The ring 6 is mounted for limited rotary movement with respect to the shell 5, and is supported within the said shell by suitable bearing rollers 16. A shaft 61 is supported by the shell 5 of the stator A, and it has a cam enlargement 62 formed thereon which engages a pawl or radial extension 63 carried by the ring 6. A pinion 64 is carried by the shaft 61 which meshes with a gear 65 mounted upon the shaft 5. This connection between the ring 6 and the shaft 5 is established to cause a slight rotary movement of the shell 5 at predetermined times during the rotation of the main drive shaft 5, to move the shoulder 53 of one of the pivoted abutments 49 into engagement with the flat surface of the abutment extension 48 adjacent thereto, to prevent this abutment extension from being forced sharply and quickly against the shoulder 53 upon the explosion of the fuel within the cylinder.

The cylinders 8 and 9 are coupled in an opposed pair as are also the pistons 41 and 42, and in the operation of the engine, when the cylinder 8 is in a power or explosion cycle, the cylinder 9 is in its intake cycle, which positions are shown in Fig. 2 of the drawings, and in solid lines in Fig. 4 of the drawings. The movable or pivotal abutments 49 are positioned at predetermined places about the inner circumference of the ring 6, so that the shoulders 53 thereof will be engaged by the extensions 48 on either of the arms 45 or 46 immediately prior to the explosion of the gas or fuel within the cylinders, and thus the pistons will be held against backward motion at both the power or explosive cycle and the intake cycle of each of the cylinder structures. Upon the explosion of fuel within the cylinder 8, which is shown in Fig. 2 in its position for the exploding of the fuel, the force thereof will move the cylinder 8 toward the left, the pistons 41 acting as a cylinder head or abutment, it being held stationary by the engagement of the abutment extension 48 with the shoulder 53, and this forcing to the left of the cylinder 8 will force a companion cylinder 9 of the pair upwardly or to the right, creating a suction for drawing a new supply of the volatile fuel into this cylinder 9, wherein it is compressed by the pistons 42. The fuel, after compressed, is ignited through the medium of an ordinary spark plug 66, as employed in internal combustion engines, and the sparking or passing of the current through the said spark plug is controlled through the medium of a distributer 67, and distributer rings 68 and 69. The distributer ring 68 is constructed of insulating material and is mounted about the extension 38 of the manifolds 35 as clearly shown in Fig. 3 of the drawings, and it carries a pair of spaced rings 70 and 71, of conductive material with which springs 72 and 73 respectively engage. These rings 70 and 71 have connection, through suitable conductors, with the spark plug 66 of the cylinder structures 8 and 9. The distributing mechanism 67 is interposed in a circuit between the brushes 72 and 73 and any suitable supply source such as a storage battery 74 indicated in the diagram in Fig. 6. The distributer 67 is arranged to control the passage of currents to the respective spark plugs 66 to properly time the explosion of the gases therein, as is ordinary in internal combustion engine structures.

The movement of the cylinder 8, under the force of the explosive fuel therein moves this cylinder off its piston 41. However, the said piston is moved relative to the cylinder and toward the head of the said cylinder immediately after the completing of the power or explosion cycle, of the cylinder structure 8, to exhaust the burnt or used gases therefrom. This movement of the piston 41 into the cylinder 8 is provided by a cam 75, which engages a roller 76 carried by the supporting arm 45. The cam 75 is keyed upon a sub shaft 77, which shaft has a pinion 78 mounted thereon which meshes with the internal gear teeth 79 formed upon the rings 30. The shaft 77 is supported by arms 80 which are in turn connected to the web 6, thereby connecting the shaft 77 and cam 75 for rotation about the power shaft 5 as an axis, and with rotation of the cylinders about the axis of the power shaft.

The cam 75 is timed or shaped, so that upon the completing of the power or explosion cycle of the cylinder 8 it will force the arm 45 forwardly rotating it about the shaft 5 and force the piston 41 into the cylinder 8, forcing the spent gases or fuel out through the exhaust port 24 of the cylinder, the valves 25 which control said ports being opened by engagement of the rollers 29 with one of the cam enlargements 34 upon the ring 30. The spent gases exhaust through the exhaust manifold 81 into an exhaust drum 82. The drum 82 is supported from one of the bearings 2 and is stationary, it being provided with a circular slot or opening through which the exhaust manifolds 81 of the cylinders 8 and 9 extend. These exhaust manifolds have inner and outer rings 82 and 83 formed thereon, which outer rings engage against the outer surfaces of the inner sides of the drum 82 while the inner rings 84 are spaced from the inner surfaces of the inner sides of the drum 82. Stuffing box rings or gaskets 85

are positioned between the facing surfaces of the inner rings 84 and the inner surface of the inner side of the drum 82, as clearly shown in Fig. 3 of the drawings, to prevent the escape of the exhaust gases out of the drum through the circular slots therein. The gas exhausts from the drum 82 through a suitable exhaust pipe 86.

The cam 75 forcing the piston 41 into the cylinder 8 during the exhaust cycle of the cylinder 8 will, owing to the fact that the arms 45 and 46 are connected, to the rings 47 force the piston 42 into the cylinder 9 for compressing the fuel which has been previously admitted into the cylinder 9 upon suction or intake movement or cycle of the said cylinder.

Thus it will be seen that during the explosion and intake cycles of each of the cylinder or engine structures of the opposed pairs, the pistons will be held stationary while the cylinders will move relative thereto, and during the exhaust and compression cycles, the pistons will be moved into the cylinders and relative thereto.

The entire mechanism is timed, so that there will be three explosions in each cylinder during each revolution of the power shafts 5 as shown diagrammatically in Fig. 4 of the drawings, and thus, with four cylinders, there will be twelve explosion strokes upon each revolution of the power shaft and since there will be twelve distinct cycles of operation of the cylinders, upon each revolution it will be seen that there is a power stroke upon or within one of the cylinder structures at all times, resulting in substantially the continuous exertion of power and transmission thereof to the shaft 5.

The distributer 67, may be supported, from one of the radial brace bars 3 by a suitable supporting and bearing structure 90, as shown in Fig. 3 of the drawings, and it may be operated from the shaft 5 through the medium of the gears 91 and 92 and beveled or miter gears 94, the necessary conductor, indicated at 95, which extends from the distributer 67 through the rings 68 and 69 being supported upon the stator rings 5′ of one of the units of the engine.

The periphery of the cam 75 is cut away slightly as shown at 96, so that the force or impact of the exploding fuel within the cylinders will not affect the cams, or in other words, so that the said force of impact will be borne by the abutment extension 48 and movable abutment 49, and will not be transmitted to the cam and its shaft 77.

Summing up, generically the operation of the improved rotary engine is as follows:

The cylinders are coupled in opposed pairs for rotation with the power shaft 5 while the pistons are also connected in opposed pairs for relative movement with respect to the cylinders and upon the explosion of a charge of fuel or gas in one cylinder, the cylinder is forced away from the piston, the piston acting as an abutment for the impact of the exploding force, and being held stationary by the engagement of the abutment extension 48 with the shoulder 53 and the movable abutment 49. During the movement of one piston of each pair under the explosive force, it will move the other piston for snuffing a charge of fuel thereinto, the cam extension 34 being arranged to operate the inlet valve of the said piston at such times. Upon the completing of the explosion or power cycle or stroke of the cylinder, the cam 75 will come into operative or active relation with the piston carrying arm and force the same pistons into the cylinders during the exhausting cycle or stroke of the pistons for forcing the spent gas or fuel out of the cylinders through the exhaust and preparing it for the inlet of fuel upon the inlet or suction movement of the cylinder under action by the exploding of a charge of fuel in the companion cylinder of the pair. The movable abutments 49 are pivotally mounted and have their portions which project inwardly of the inner periphery 6 inclined so as to allow the abutment 48, to ride thereover until they have passed the shoulders 53 thereon, at which time the movable abutment will swing outwardly under action of the springs 52, to present the shoulders 53 for engagement with the abutment extension 48. To prevent separating movement of the abutment extension 48 and the shoulder 53 prior to the exerting of the explosive force, of the gas against the piston 41, the cam extension or enlargement 62 on the shaft 61 is provided, which enlargement engages the member 63 will move the ring 6 of the stator structure 8 a very short distance, compensating for the short space of time between the passing of the abutment 48 over the shoulder 53 and the exerting of the force of the exploding gas against the piston, thereby eliminating the backward movement of the abutment 48 against the movable abutment 49.

Changes in details may be made without departing from the spirit of the invention, but;

I claim:

1. In a rotary engine, the combination, of a power shaft, cylinders connected to said power shaft for rotation therewith, pistons supported from the power shaft for relative movement with respect to the cylinder, and stationary means for holding the piston from backward motion.

2. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, means controlling the inlet and exhaust into

and from said cylinders, and stationary means for holding the piston from backward motion.

3. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, a stator, and movable abutments carried by said stator for arresting the backward motion of the pistons during the explosion of fuel in the cylinders.

4. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, a stator, movable abutments carried by said stator for arresting the backward motion of the pistons during the explosion of fuel in the cylinders, and stationary means for controlling the inlet and exhaust of fuel to and from said cylinders.

5. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with said power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, a stator, movable abutments carried by said stator for arresting movement of the pistons during the explosion of fuel in the cylinders, and means for moving said stator a limited distance upon active participation of one of said abutments in the piston.

6. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with said power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, and spaced means for arresting backward motion of the pistons during the inlet of fuel into the cylinders.

7. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, a stator, movable abutments carried by said stator for arresting movement of the pistons during the explosion of fuel in the cylinders, and spaced means for arresting backward motion of the pistons during the inlet of fuel into the cylinders.

8. In a rotary engine, the combination, of a rotor comprising a power shaft, cylinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, spaced apart one way operating means for arresting backward motion of the pistons during the explosion of fuel in the cylinders, and means for arresting movement of the pistons during the inlet of fuel into the cylinders.

9. In a rotary engine, the combination, of a rotor comprising a power shaft, cylinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, spaced apart one way operating means for arresting backward motion of the pistons during the explosion of fuel in the cylinders, means for arresting movement of the pistons during the inlet of fuel into the cylinders, and means for moving said pistons relative to said cylinders for compressing fuel into the cylinders.

10. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, a stator, movable abutments carried by said stator for arresting movement of the pistons during the explosion of fuel in the cylinders, spaced apart one way operating means for arresting backward motion of the pistons during the inlet of fuel into the cylinders, and means for moving said pistons relative to the cylinders for compressing fuel in the cylinders.

11. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, a stator, movable abutments carried by said stator for arresting movement of the pistons during the explosion of fuel in the cylinders, means for arresting movement of the pistons during the inlet of fuel into the cylinders, means for moving said pistons relative to the cylinders for compressing fuel in the cylinders, means for controlling the inlet and exhaust of fuel into and from said cylinders, and means for moving said stator a limited distance, upon active participation of one of said abutments with a piston.

12. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, a stator, movable abutments carried by said stator for arresting movement of the pistons during the explosion of fuel in the cylinders, means for moving said pistons relative to said cylinders for compressing fuel in the cylinders, and means for moving said stator a limited distance upon active participation of one of said abutments with a piston.

13. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, a stator, movable abutments carried by said stator for arresting backward motion of the pistons during the explosion of fuel in the cylinders, means for moving said pistons

relative to said cylinders for compressing fuel in the cylinders, valve controlling the inlet and exhaust of fuel into the cylinders, a stationary ring, cam enlargements on said ring, and pivoted operating levers for said valve operated by engagement with said cam extensions.

14. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with said power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, means for arresting movement of the pistons during the explosion of fuel in the cylinders, means for moving said pistons relative to said cylinders for compressing fuel in the cylinders, valves controlling the inlet and exhaust of fuel into and from the cylinders, a stationary ring, cam enlargements on said rings, and pivoted operating levers for said valve operated by engagement with said cam enlargements.

15. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, means for arresting movement of the pistons during the explosion of fuel in the cylinders, said cylinders and pistons connected in opposed pairs, whereby when one cylinder is moving under the explosive force of fuel therein, the opposed cylinder will be moved for drawing the charge of fuel therein, valves controlling the inlet and exhaust of fuel into the cylinders, a stationary ring, cam enlargements on said ring, and pivoted operating levers for said valve operated by engagement with the cam enlargements.

16. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with said power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, a stator, movable abutments carried by said stator for arresting backward motion of the pistons during the explosion of fuel in the cylinders, cams engaging the supports of said pistons, for forcing the pistons into said cylinders to compress fuel therein, means for rotating said cam, and means for moving said stator a limited distance upon active participation of one of said abutments with a piston.

17. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with said power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, a stator, movable abutments carried by said stator for arresting backward motion of the pistons during the explosion of fuel in the cylinders, cams engaging the supports of said pistons, for forcing the pistons into said cylinders to compress the fuel therein, means for rotating said cam, means for moving said stator a limited distance upon active participation of one of said abutments with a piston, and cushioning means carried by said movable abutment for cushioning the engagement between the movable abutments and the piston support.

18. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, cams movable with the cylinders and engaging the support of said pistons for forcing the pistons into said cylinders to compress fuel therein, and means for rotating said cams.

19. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, cams movable with the cylinders and engaging the support of said pistons for forcing the pistons into said cylinders to compress fuel therein, means for rotating said cams, and stationary means for controlling the inlet and exhaust of fuel into and from said cylinders.

20. In a rotary engine, a rotor comprising a power shaft, clyinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movements, a stator, movable abutments carried by said stator, for arresting backward motion of the pistons during the explosion of fuel in the cylinders, cams movable with the cylinders and engaging the supports of said pistons for forcing the pistons into the cylinders to compress fuel therein, valves controlling the inlet and exhaust of fuel into said cylinders, a stationary ring, cam enlargements on said ring, and pivoted operating levers for said valves operated by engagement with said cam enlargements.

21. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movements, a stator, movable abutments carried by said stator for arresting backward motion of the pistons during the explosion of fuel in the cylinders, cams movable with the cylinders and engaging the supports of said pistons for forcing the pistons into the cylinders to compress fuel therein, valves controlling the inlet and exhaust of fuel into said cylinders, a stationary ring, cam enlargements on said ring, pivoted operating levers for said valves operated by engagement with said cam enlargements, and means movable with said ring to rotate said cams.

22. In a rotary engine, a rotor comprising

a power shaft, cylinders connected for rotation with the power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movements, a stator, movable abutments carried by said stator for arresting backward motion of the pistons during the explosion of fuel in the cylinders, cams movable with the cylinders and engaging the supports of said pistons for forcing the pistons into the cylinders to compress fuel therein, valves controlling the inlet and exhaust of fuel into said cylinders, a stationary ring, cam enlargements on said ring, pivoted operating levers for said valves operated by engagement with said cam enlargements, means movable with said ring to rotate said cams, water jackets surrounding said cylinders, said power shaft provided with passageways, pipes communicating with said passageways and said water jackets to permit circulation of a cooling fluid through said shaft, pipes and water jackets.

23. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with said power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, means for arresting backward motion of the pistons during the explosion of fuel in the cylinders, cams movable with the cylinders and engaging the supports of said pistons for forcing said pistons into said cylinders to compress fuel therein, and means for rotating said cam.

24. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with said power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, means for arresting backward motion of said pistons during the explosion of fuel in the cylinders, cams engaging the supports of said pistons for forcing the pistons into the cylinders to compress fuel therein, valves controlling the inlet and exhaust of fuel into the cylinders, a stationary ring, cam enlargements on said ring, pivoted operating levers for said valves operated by engagement with said cam enlargements, and means engageable with said ring to rotate said cam.

25. In a rotary engine, a rotor comprising a power shaft, cylinders connected for rotation with said power shaft, pistons supported from said power shaft, said cylinders and pistons mounted for relative movement, water jackets surrounding said cylinders, said power shaft provided with a plurality of longitudinally extending passageways, pipes communicating with said passageways and said water jackets, a pair of separate compartments, certain of said longitudinal passageways communicating with one of said compartments, and the remaining passageways communicating with the other of said compartments to permit a complete regulation of the cooling fluid through said shaft and water jackets.

RUFUS E. MILLER.