No. 649,122. Patented May 8, 1900.

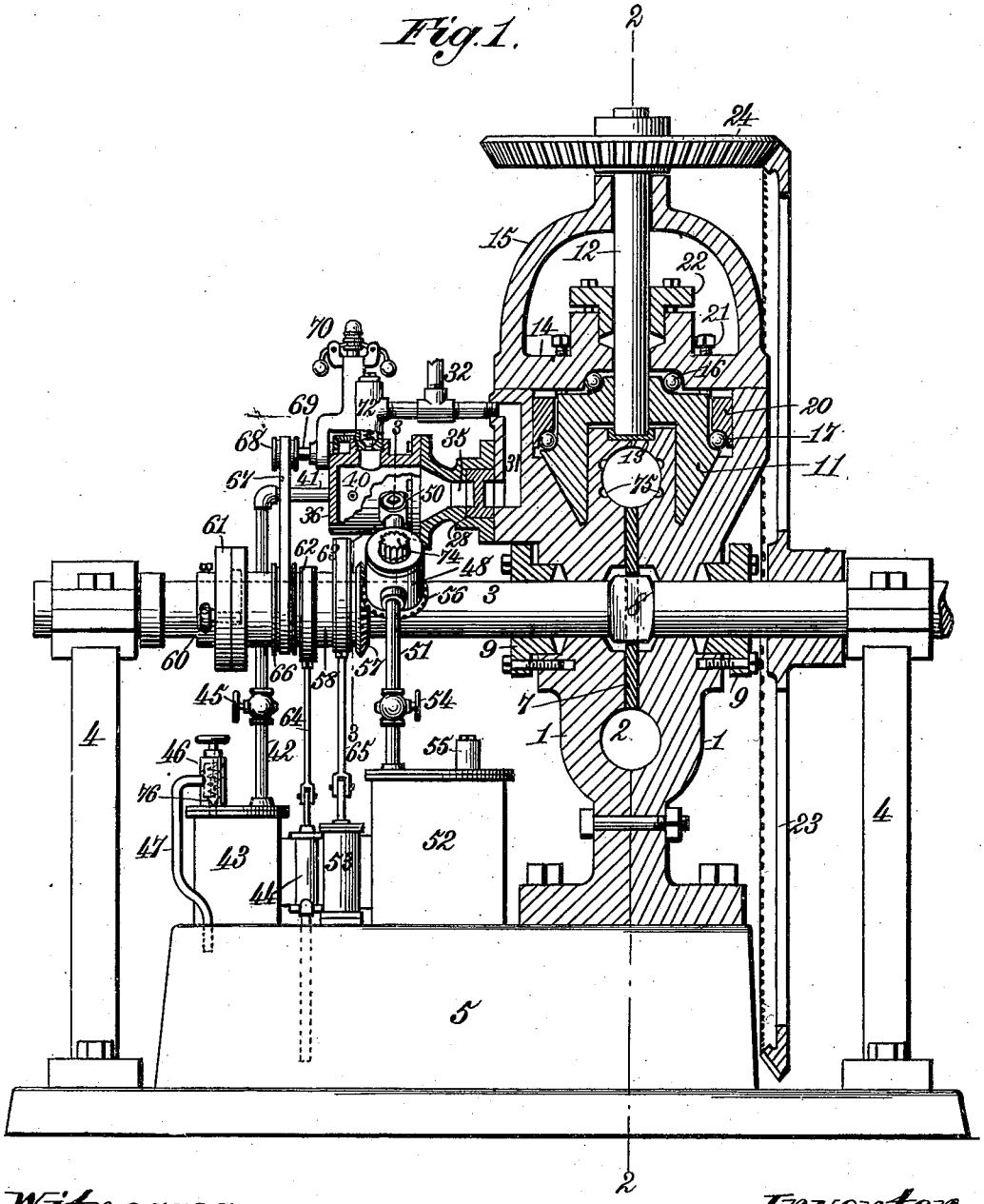
D. F. ALLEN.

ROTARY ENGINE.

(Application filed Apr. 27, 1898.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



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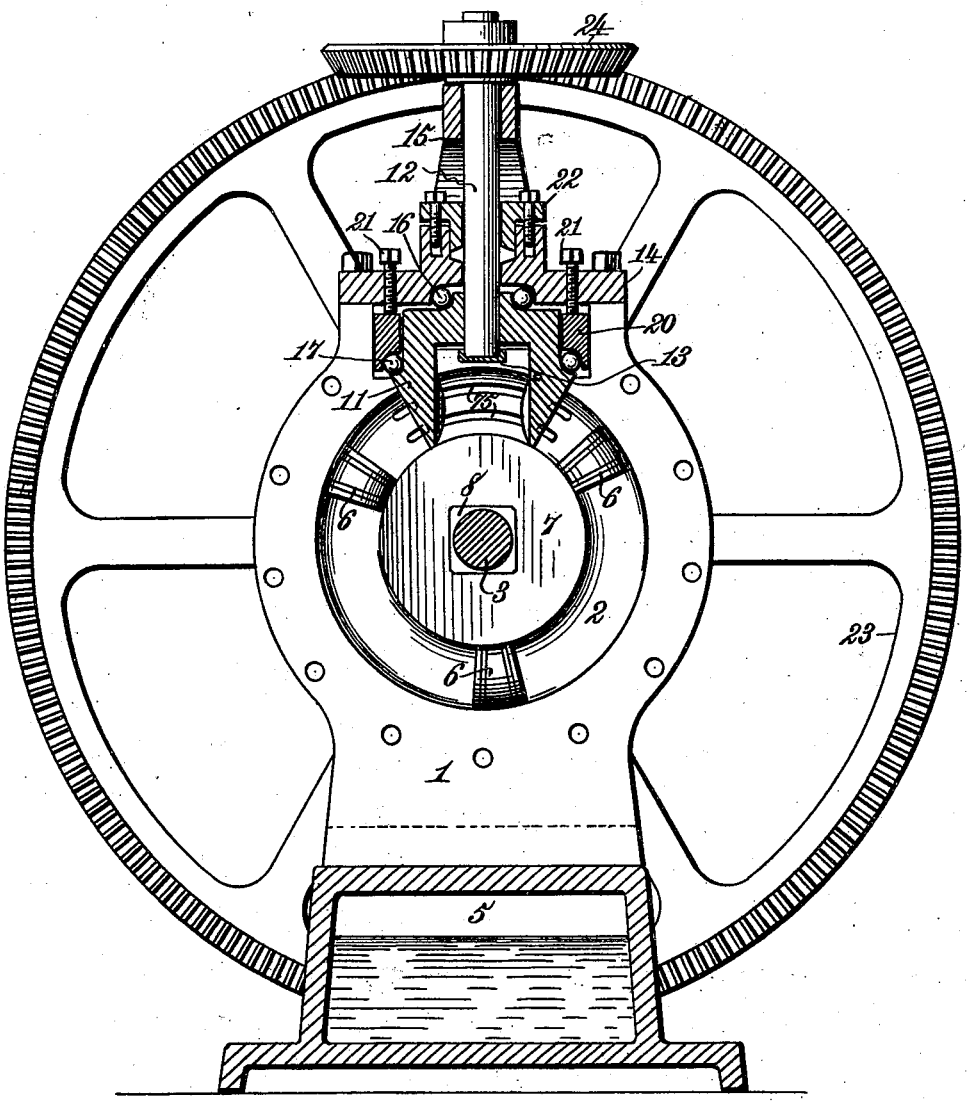
(No Model.) 3 Sheets—Sheet 2.

Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

Fig. 3.

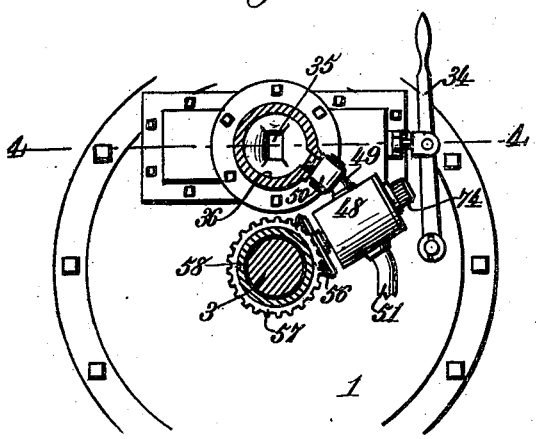


Fig. 4.

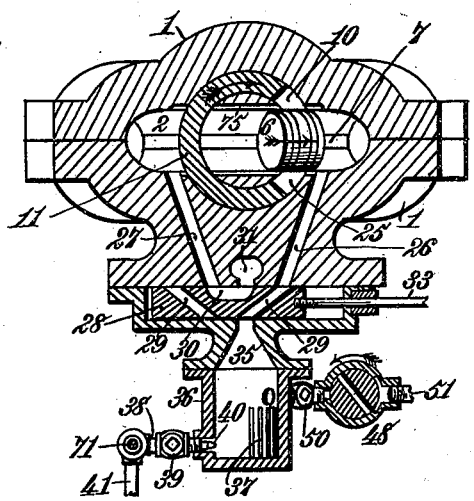


Fig. 5.

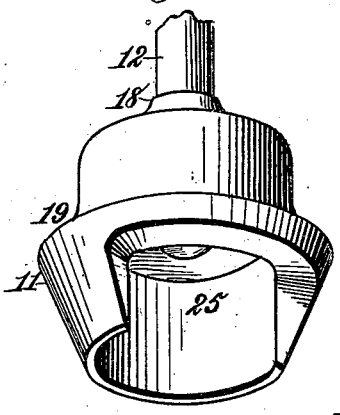


Fig. 6.

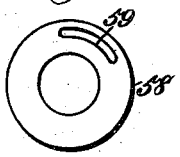
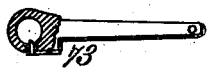


Fig. 7.



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UNITED STATES PATENT OFFICE.

DAVID F. ALLEN, OF RICHBURG, NEW YORK.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 649,122, dated May 8, 1900.

Application filed April 27, 1898. Serial No. 679,008. (No model.)

To all whom it may concern:

Be it known that I, DAVID F. ALLEN, a citizen of the United States, residing at Richburg, in the county of Allegany and State of New York, have invented new and useful Improvements in Rotary Engines, of which the following is a specification.

My invention relates to rotary engines, and has for its objects to provide an improved rotary abutment for taking the pressure of the working fluid and improved mechanism for the operation of the engine by energy developed in the explosion of oil and oil-gases with compressed air, though the engine is also capable of operation with steam.

The invention consists in features of construction and novel combinations of parts in a rotary engine, as hereinafter more particularly described and claimed.

In the annexed drawings, illustrating the invention, Figure 1 is a vertical section of my improved rotary engine in a plane that is parallel with the main engine-shaft. Fig. 2 is a vertical section of the same on the line 2 2 of Fig. 1. Fig. 3 is a vertical section on the line 3 3 of Fig. 1. Fig. 4 is a horizontal section on the line 4 4 of Fig. 3. Fig. 5 is a perspective of a rotary cup-shaped abutment. Fig. 6 is an end view of a loose sleeve on the engine-shaft. Fig. 7 is a view of a ratchet-lever for use with the engine.

The engine-cylinder is constructed in two corresponding parallel parts or sections 1, that are securely bolted together and which have an annular passage 2 formed between them. The main engine-shaft 3 is mounted to rotate in bearings supported by standards 4, that may be bolted to the base or pedestal of an oil tank or reservoir 5, on which the engine-cylinder can be mounted. In the annular cylinder-passage 2 there may be mounted a plurality of rotary pistons 6, attached to the periphery of a disk 7, that is slipped onto a square portion 8 of the engine-shaft to impart motion thereto as the pistons and disk are rotated. If desired, stuffing-boxes 9 may be placed around the engine-shaft at each side of the cylinder, as shown in Fig. 1.

In the periphery of the engine-cylinder, preferably at the top, there is an annular groove or recess 10, Fig. 4, that intersects the annular passage 2, in which the pistons 6 revolve. This annular groove or recess 10 has fitted therein a rotary cup-shaped abutment 11, Figs. 1, 2, 4, and 5, that is adapted to operate in unison with the rotary pistons to afford a backing for the working fluid. The rotary cup-shaped abutment 11 is secured to and actuated through a shaft 12, the inner end of which has a step-bearing 13 in the periphery of the engine-cylinder. This shaft 12 has other bearings in a cap 14, Figs. 1 and 2, and in the upper part of a yoke 15, formed on said cap. It is preferable to provide the rotary cup-shaped abutment 11 with two annular series of ball-bearings 16 and 17, as shown in Figs. 1 and 2. One series of balls may be located between the cap 14 and an annular shoulder 18 on the outer portion of the rotary abutment, and the other series of balls may be lodged between a peripheral shoulder 19 of said rotary abutment and a ring 20, for which adjusting-bolts 21 are provided. A stuffing-box 22 may surround the shaft 12 of the rotary cup-shaped abutment. The main engine-shaft 3 carries a bevel gear-wheel 23, meshing with a bevel-pinion 24 on the shaft of the rotary cup-shaped abutment 11 for giving it the required motion at the proper speed to accord with the movements of the rotary pistons. It will be seen by reference to Figs. 4 and 5 that the peripheral skirt of the rotary abutment 11 is provided with an opening 25, which is presented across the annular cylinder-passage 2 at proper time-intervals in such position as will permit the passage of a rotary piston. After the piston has passed the rotary abutment a solid portion of the abutment-skirt is presented in position to afford a backing for the expansion of working fluid to keep the piston in motion. By reference to Figs. 1, 2, and 5 it will be seen that the rotary abutment is cup-shaped, and on its outer side it is beveled toward the rim of the cup, so that its periphery cuts the annular cylinder-passage 2 at substantially a right angle. Thus the pressure of the working fluid is exerted against the rotary abutment with such directness that the shaft of the abutment will carry its load with as much ease as an ordinary wheel-axle. The ball-bearings 16 and 17 greatly facilitate the operation of the rotary

cup-shaped abutment, and, if desired, any suitable provision may be made for supplying the step-bearing 13 with a lubricant.

It will be observed by reference to Figs. 1, 2, and 4 that the rotary cup-shaped abutment 11 is located wholly within the shell of the engine-cylinder to operate in an annular groove or recess 10, Fig. 4, that intersects the annular piston-passage 2 at two points or on opposite sides of the axis or shaft 12 of said rotary abutment 11, the abutment-shaft 12 being arranged radially with relation to the engine-shaft 3, on which the rotary pistons 6 are mounted. By this arrangement of parts great steadiness of movement is imparted to the rotary cup-shaped abutment. Besides, the said rotary abutment is thus completely housed in the engine-cylinder. This construction is simple, compact, thoroughly effective, and relieves the rotary abutment from all strain, so that it will be capable of moving as easily as a wheel. In passing the rotary cup-shaped abutment 11 each piston 6 enters the hollow or cup of said abutment through the opening 25 in the skirt or wall of the cup while the said opening is in proper position with relation to the annular passage 2 of the engine-cylinder, and then on further rotation of said abutment, whereby its opening 25 is presented across an advanced portion of the annular cylinder-passage 2, the piston 6 will pass out through said opening, as shown in Fig. 4, where the arrows indicate the direction of movement for the rotary abutment 11 and piston 6 in one direction of engine movement. Thus the construction and arrangement of this rotary cup-shaped abutment 11 is such that after the piston has passed through the skirt-opening 25 a solid portion of said skirt is presented across the cylinder-passage 2 in position to provide a backing for the expansion or working fluid to keep the piston in continuous rotation.

Working pressure is admitted to the annular cylinder-passage 2 through either one of two passages or ports 26 and 27, Fig. 4, according to the direction in which the pistons are to move, the other one of said ports being employed for the exhaust. These ports 26 and 27 are controlled by a reversing slide-valve 28, Figs. 1 and 4, having two inlet-ports 29 for alternate use and an exhaust-port 30, which may connect either port 26 or 27 with an exhaust-passage 31, with which an exhaust-pipe 32 connects. The reversing-valve 28 is provided with a stem 33, to which a hand-lever 34, Fig. 3, is connected for reversing the engine when desired.

It will be obvious that, if desired, the engine may be operated by steam supplied from any convenient generator. In the drawings, however, I have shown the engine constructed and arranged to be run as an explosive gas or oil motor.

The reversing-valve 28 communicates through a port 35 with an explosion-chamber 36, Figs. 1, 3, and 4, that is connected with the casing of said valve. In this chamber 36 there may be placed a grating 37 of any suitable character to provide extended surfaces for retaining the heat of successive explosion, and thereby facilitate the vaporizing of oil sprayed into said explosion-chamber. One side of the explosion-chamber has connected therewith a pipe 38, provided with a check-valve 39 and having an injector-nozzle 40, projecting into the chamber 36 at a point opposite the grating 37 therein. The pipe 38 receives oil through a pipe 41, connecting with a pipe 42, that in turn connects with the discharge-chamber 43 of a pump 44, that takes oil from the reservoir 5 at the base of the engine. The oil-pipe 42 may be provided with a throttle 45, as shown in Fig. 1. On the discharge-chamber of the oil-pump and communicating therewith there may be placed a pressure-regulator 46, having an overflow-pipe 47, leading back to the oil-reservoir, so that the pressure of oil delivered to the explosion-chamber 36 will not exceed that for which the regulator is set. The pump 44 delivers oil to the explosion-chamber 36 continuously during the operation of the engine, and the required explosions are effected at proper time-intervals by the admission of compressed air intermittently into the explosion-chamber to combine with the heated oil and oil-gases. An air-controlling valve 48, Figs. 1, 3, and 4, is connected to the explosion-chamber 36 by a pipe 49, in which a check-valve 50 is located. This air-controlling valve 48 communicates through a pipe 51 with a compressed-air chamber 52, with which an air-pump 53 is connected. A throttle-valve 54 is provided for the air-supply pipe 51 and a relief-valve 55 is connected with the compressed-air chamber. The air-controlling valve 48 is geared by means of bevel-wheels 56 and 57 with a sleeve 58, Figs. 1 and 6, loosely placed on the engine-shaft. In one end of this sleeve 58 there is a slot 59 for engagement with a set-screw 60 carried by a collar 61, that is secured to the main engine-shaft 3 to revolve therewith and through which the said sleeve is caused to revolve with the shaft when the said collar and sleeve are engaged or clutched. The sleeve 58 carries eccentrics 62 and 63 for attachment of connecting-rods 64 and 65, through which the pumps 44 and 53 are actuated. On the sleeve 58 there is a pulley 66, that connects by a belt 67 with a pulley 68 on a shaft 69, that is geared with a governor 70, Fig. 1, for controlling a valve 71, Fig. 4, in the oil-supply pipe to the explosion-chamber. There is mounted on the explosion-chamber 36 a safety-valve 72, Fig. 1, communicating with the exhaust.

In starting the engine the set-screw 60 will be withdrawn to unclutch the sleeve 58 and shaft-collar 61, so that the sleeve will be free to rotate on said shaft. The throttles 45 and 54 will first be closed. A ratchet-lever 73, Fig. 7, may then be engaged with a ratchet 74, Fig.

1, on the air-controlling valve 48, so that through the gears 56 and 57, loose sleeve 58, and eccentric 63 the air-pump 53 may be operated to accumulate a supply of compressed air, while at the same time the oil-pump 44 will be operated through the eccentric 62, so as to draw a supply of oil to the chamber 43, connected with said pump. After this the explosion-chamber 36 will be heated by means of a lamp, the oil-throttle 45 will be opened to permit the passage of oil to the explosion-chamber, the sleeve 58 will be clutched with the engine-shaft by engaging the screw 60 of the shaft-collar 61 into the slot 59 of said sleeve, and then the air-throttle 54 will be opened, the use of the ratchet-lever 73 being continued until the engine is started by the explosion induced through the injection of compressed air into the heated oil and oil-gases. The gases from the explosion-chamber 36 pass through the port 35 to an inlet-port 29 of the reversing-valve 28 and thence through a port, as 26, Fig. 4, into the annular cylinder-passage 2 at the rear of one of the rotary pistons. The explosions are so timed that the expanding gases enter the annular cylinder-passage 2 just as a piston passes the inlet-port and in time to expand against the skirt of the rotary cup-shaped abutment 11, which moves in a path intersecting the annular cylinder-passage 2 and is so timed as to permit the successive pistons 6 to pass into and out of said rotating cup-shaped abutment through the abutment-opening 25 without hindrance or any risk of collision. It is preferable to provide the annular cylinder-passage 2 with series of curved grooves 75, Figs. 1, 2, and 4, located at each side of the rotary cup-shaped abutment 11, thus permitting a partial balancing of working pressure, so that any gases or working fluid entering the cylinder just before the piston passes the inlet-port will have a vent to the rear of the piston and find a backing within the rotary abutment. The exhaust escapes through passages or ports 27, 30, and 31 to the exhaust-pipe 32, as before mentioned. By means of the lever 34 the valve 28 can be shifted to reverse the engine, if required. Should it be desired to run the engine by steam, a suitable steam-chest can be provided, and the attachments for actuating the oil-pump and air-pump can be disconnected. The rotary cup-shaped abutment 11 is operated in such unison with the several pistons that there is no danger of obstruction or collision, there is no dead-center to overcome, and the abutment is so mounted and carried as to secure all the advantages of a steady rotary motion. In starting the engine after a temporary stoppage the pressure exerted by the spring-plunger 76 of the regulator 46 will be sufficient to force an initial supply of oil to the explosion-chamber 36 as soon as the oil-throttle 45 is opened, and then by opening the air-throttle 54 the engine will be started under the immediate expansion of compressed air and its entrance to the explosion-chamber through the air-controlling valve 48, which is readily set by means of the ratchet-lever 73, so that the valve-passage will be in proper position. The length of the slot 59 of the sleeve 58 is such that the sleeve can be turned the proper distance in either direction to bring the valve-passage into operative position. The manner in which the rotary pistons are mounted on the engine-shaft, through a disk slipped onto a squared portion of said shaft, obviates any liability to binding in case of any slight distortions.

The spring-plunger 76 in the regulator 46 provides for giving such pressure in the oil-discharge chamber 43 that when the engine is reversed or started after a temporary stoppage the oil will feed at once into the explosion-chamber 36 and cause the engine to start as readily as a steam-engine, making it a complete automatic engine in every way and one that will start with its load without assistance, the same as an ordinary steam-engine, there being always a reserve of compressed air in the chamber 52 to feed in conjunction with the oil.

It will be obvious that various modifications may be made in the construction of the rotary cup-shaped abutment without affecting the principal object of my invention, which is to provide for mounting said abutment wholly within the shell or casing of the engine-cylinder on a shaft that is arranged radially with relation to the main engine-shaft and so that the skirt of the rotary abutment will intersect the annular cylinder-passage at two points and take the pressure of working fluid in such manner that the friction of said abutment will be greatly reduced.

What I claim as my invention is—

1. In a rotary engine, the combination of a cylinder provided with an annular piston-passage and an annular groove or recess intersecting said piston-passage at two points, the main engine-shaft, a rotary piston connected with said shaft, the rotary cup-shaped abutment mounted wholly in the cylinder-shell to rotate in said annular groove or recess and having a circular skirt beveled on its exterior toward the rim of the cup to take the pressure of working fluid and an opening in said skirt for passage of the rotary piston into and out of the cup portion of said rotary abutment, a shaft for said rotary cup-shaped abutment mounted radially with relation to the main engine-shaft, and bevel-gears connecting the outer end of said abutment-shaft with the main engine-shaft, substantially as described.

2. In a rotary engine, the combination of a cylinder provided with an annular piston-passage having oppositely-arranged series of grooves therein and an annular recess intersecting the said piston-passage and its said grooves at two points, a main engine-shaft having a rotary piston thereon, a rotary cup-shaped abutment mounted wholly in the cyl-

inder-shell to rotate in said annular recess intersecting said annular piston-passage and having a skirt to take the pressure of working fluid and an opening in said skirt for passage of the rotary piston into and out of the cup portion of said rotary abutment, a shaft for said rotary cup-shaped abutment mounted radially with relation to the main engine-shaft, and bevel-gears connecting said engine-shaft and abutment-shaft, substantially as described.

3. In a rotary engine, the combination of a cylinder having an annular piston-passage therein and provided in the periphery with an annular recess intersecting the said annular piston-passage at two points, a plurality of rotary pistons, a main engine-shaft with which said pistons are connected, the rotary cup-shaped abutment mounted to rotate in said annular recess and wholly inclosed within the cylinder-shell, the circular skirt of said abutment being beveled on its exterior toward the rim of said cup to take the pressure of working fluid and having an opening for passage of the rotary pistons into and out of the cup portion of said rotary abutment, a shaft for said rotary cup-shaped abutment mounted radially with relation to the main engine-shaft, bevel-gearing directly connecting said main engine-shaft with the outer end of the abutment-shaft, and valve mechanism for controlling the inlet and exhaust of working fluid, substantially as described.

4. In a rotary engine, the combination with the cylinder and its ports, the main engine-shaft, and a rotary piston, of an explosion-chamber, an oil-reservoir, an oil-pump having a discharge-chamber, a pressure-regulator communicating with said discharge-chamber of the oil-pump and having a spring-pressed valve and an overflow-pipe, a pipe leading from the discharge-chamber of the oil-pump to the explosion-chamber and provided with a throttle, a governor-controlled valve in the oil-supply pipe, a compressed-air reservoir having a pipe leading to the explosion-chamber and provided with a throttle, an air-controlling valve in said air-pipe, an air-pump, and means for operating the oil-pump, air-pump and air-controlling valve from the engine-shaft, substantially as described.

5. In a rotary engine, the combination with the cylinder and its ports, the main engine-shaft, and a rotary piston, of an explosion-chamber, an oil-pump having a discharge-chamber provided with a pipe leading to the oil-inlet of the explosion-chamber, an air-pump, a compressed-air reservoir having a pipe leading to the air-inlet of the explosion-chamber, an air-controlling valve located in said pipe intermediate the compressed-air reservoir and explosion-chamber, a sleeve having clutch connection with the engine-shaft and carrying eccentric mechanism for operating the oil-pump and air-pump, and gearing between said sleeve and the air-controlling valve, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

DAVID F. ALLEN.

Witnesses:
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BRUCE S. ELLIOTT.