Jan. 10, 1928. 1,655,541

J. F. GARDNER

INTERNAL COMBUSTION ENGINE

Filed Nov. 13, 1926 2 Sheets-Sheet 1

Fig. 1.

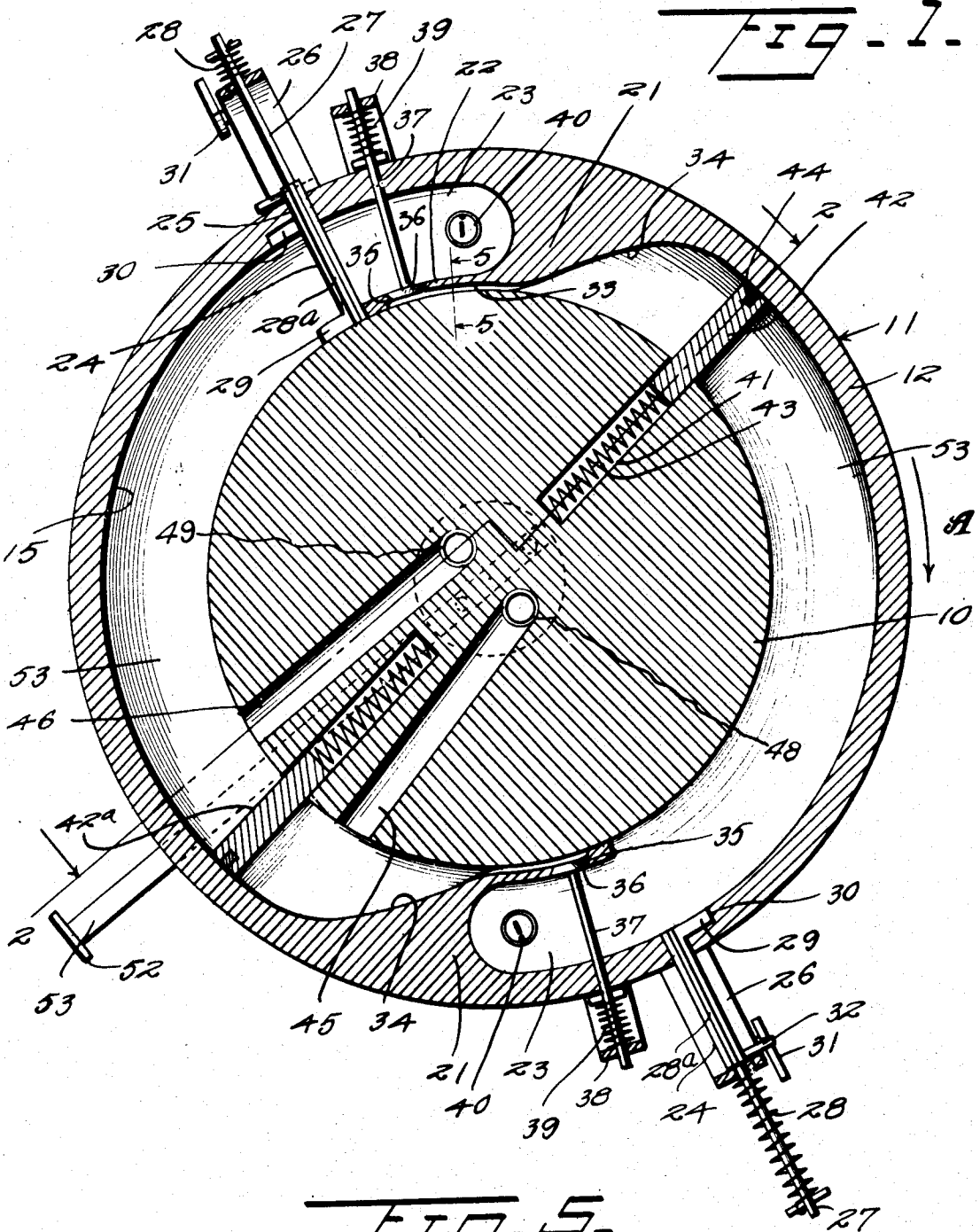
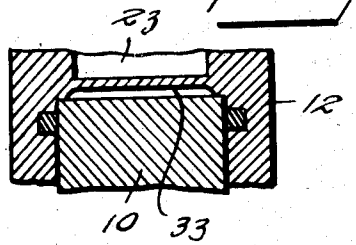


Fig. 5.



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Filed Nov. 13, 1926 2 Sheets-Sheet 2

Fig. 2.

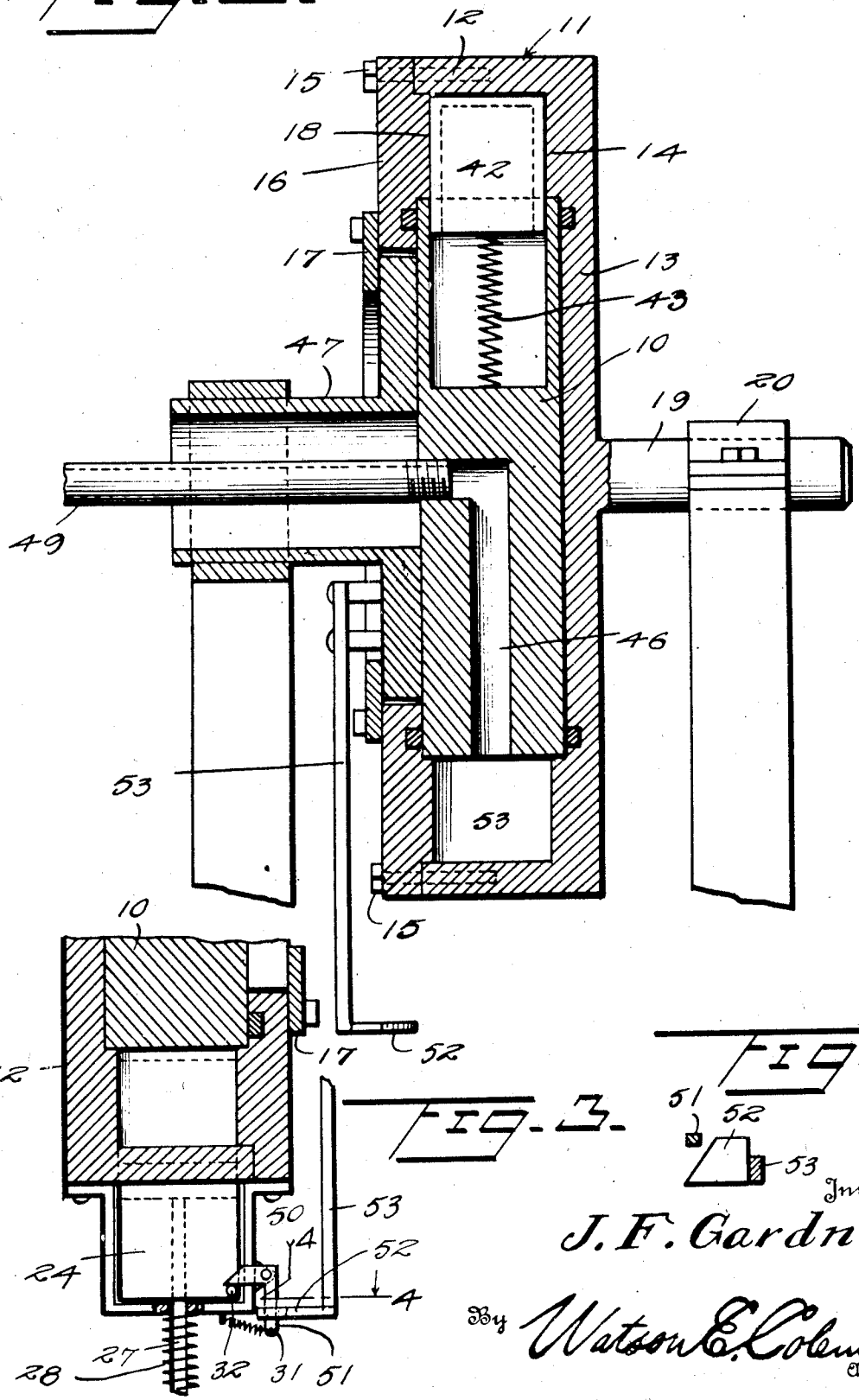


Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE.

JAMES F. GARDNER, OF LONG BEACH, CALIFORNIA.

INTERNAL-COMBUSTION ENGINE.

Application filed November 13, 1926. Serial No. 148,226.

This invention relates to internal combustion engines and more particularly to a rotary internal combustion engine.

An important object of the invention is to provide in a device of this character a structure such that proper scavenging of the cylinders is assured and in which compression of the charge is obtained in much the same manner as it is obtained in the ordinary internal combustion engine.

A further and more specific object of the invention is to provide a device of this character having movable pistons of which alternate pistons function as scavenging and intaking pistons and as compression and explosion pistons.

A further object of the invention is to provide a device of this character wherein chambers are provided within which the charge may be compressed, the intake to the chamber being controlled by a valve, the movement of which is sufficiently resisted to permit the valve to remain closed while the exhausting and intaking piston is moving toward the chamber with which it is associated and which opens to admit a charge when the compression piston is moving theretoward.

A further object of the invention is to provide a device of this character which may be readily and cheaply constructed, which will be durable and efficient in service and a general improvement in the art.

These and other objects I attain by the construction shown in the accompanying drawings, wherein for the purpose of illustration is shown a preferred embodiment of my invention and wherein:—

Figure 1 is a vertical sectional view through an engine constructed in accordance with my invention;

Figure 2 is a section on the line 2—2 of Figure 1;

Figure 3 is a section showing the manner of tripping the gate;

Figure 4 is a section on the line 4—4 of Figure 3;

Figure 5 is a section on the line 5—5 of Figure 1.

Referring now more particularly to the drawings, the numeral 10 designates a disk-like central structure and 11 an annulus mounted upon the periphery of the disk-like structure and held against displacement with relation thereto. Either of these elements may form the stator or rotor of the engine. In the present instance, the central disk-like structure 10 forms the stator and the annulus 11 the rotor. In the present instance, the rotor is shown as comprising an outer rim 12 having integrally connected therewith a disk-like face plate 13 which flatly abuts one side of the rotor. At the periphery of the rotor, this plate is thickened, as at 14, so that it slightly overhangs the peripheral edge of the stator, for a purpose presently to appear.

The opposite edge of the rim has secured thereto, as at 15, a ring 16, the inner edge of which flatly abuts the face of the disk 10 at the corresponding side thereof and closes the space between the periphery of the disk and the rim 12. The inner edge of the sealing ring is maintained in engagement with the rim of the disk 10 by the retaining ring 17 which is suitably secured to the face of the disk. The sealing ring 16 has at its inner face a thickened portion 18, the inner edge of which abuts the periphery of the disk 10. The disk 13 has suitably secured thereto a shaft 19, at present shown as rotatably mounted in a bearing 20.

At circumferentially spaced points, the inner face of the rim has walls 21 projecting inwardly therefrom toward the periphery of the stator and the terminal portion of these walls have arcuate extensions 22 fitting against the face of the stator. Between this arcuate wall and the overlying portion of the rim 12, a chamber 23 is formed, the outer end of which is closed by a radially movable gate 24 slidably mounted in the rim, as at 25. The exterior of the rim is provided with suitable guides 26 in which the stems 27 of the gates are mounted. Tension springs 28 constantly urge the inner ends of the gates into engagement with the periphery of the stator 10. The sides and bottoms of the gates are provided with packing 28ª which engages the inner face of the enlargements 14 and 18 of the disk 13 and ring 16 and the face of the stator. The lower ends of these gates at that side remote from the arcuate extensions 22 of the wall 21 are provided with flanges or feet 29, the purpose of which will hereinafter appear.

The inner faces of the rims are provided with sockets 30 in which these feet may be located when the gate is forced outwardly. Each guide 26 has pivoted thereto a spring-

pressed latch 31 which, when the gate is in its outermost position, engages a pin 32 carried by the gate to retain it in such position until the latch is released.

The inner or stator engaging face of the arcuate extensions 22 are formed with grooves 33 extending from the face 34 of the wall 21 remote from the chamber 23 to a point adjacent the free end of the arcuate extension. At the last named end of the groove, the wall of the arcuate extension is perforated by a valve seat 35 having coacting therewith a poppet valve 36, the stem 37 of which is slidably directed through the rim 12 and operates within a suitable guide 38 secured to the exterior of the rim. These valves are seated by springs 39. In each chamber, a spark plug 40 or some similar means is provided for exploding a charge contained therein. The stator is provided with radially directed slots 41 corresponding in number and arrangement to the chambers 23. Slidably mounted within each slot is a piston 42 or 42ª urged outwardly by a spring 43 for engagement with the interior wall of the rim 12. These pistons have suitable packings 44 for engagement with the side walls of their grooves and with the wall of the rim. Pistons 42ª have arranged at opposite sides thereof exhaust and intake ports 45 and 46, the exhaust ports being located at that side of the piston opposing the faces 34 of the walls 21. A shaft or support for the stator is provided at 47 which is preferably hollow to permit the passage of the intake and exhaust conduits 48 and 49 which communicate with these ports.

The latches 31 each comprise a bell crank lever, one arm 50 of which engages with the pin 32, the other arm 51 of which is substantially radially disposed to the rotor. This arm is engaged by a releasing cam 52 carried by the outer end of a support 53 immediately after a piston 42ª, having associated therewith the intake and exhaust ports, has been passed by the gate 24 of the chamber 23, so that the gate is released and permitted to close. The faces 34 of the walls 21 act as cams to force the pistons 42, 42ª inwardly against the action of their springs 43. The springs 43 of the pistons 42 are of greater strength than the springs 28, which urge the gates to closed position, so that when a piston 42 engages with a gate by the foot 29 thereof, the gate is forced outwardly, so that it may be engaged by its latch and held in open position.

In the operation of the device and assuming the parts to be in the position illustrated in Figure 1 and the rotation of the rotor 11 to be in the direction of the arrow A of this figure, the space between the piston 42ª and the adjacent face 34 of the wall 21 is being scavenged, by reason of the fact that the products of combustion are trapped between the face of this piston and the wall. Since their passage to the chamber 23 is opposed by the action of the spring of the poppet valve and their passage through the exhaust port 45 is unopposed, these gases will follow the course of least resistance and pass to the exhaust conduit 48. Between the opposite face of the piston 42ª and the adjacent gate 24, an explosive charge is being introduced for, as the gate recedes from the piston, a vacuum will be produced, drawing the charge through the intake port 46. The charge previously introduced between the other of the gates 24 and wall 21 is being compressed by the piston 42 and since there is no escape for this charge except through the poppet valve 36, this charge is entering the chamber 23 which is approaching the piston 42 and being compressed therein. Between the opposite face of the piston 42 and the wall 21, a previously exploded charge is exerting its charge to cause rotation of the rotor. As the chamber, next adjacent the piston 42ª, passes this piston, the cam 52 releases the latch, permitting the gate to close, so that the chamber 23 may be sealed for the reception of the charge which has been introduced between the opposite face of the piston 42ª and the other of the gates 24. As the piston 42 leaves the end of the arcuate extension 22, it forces the gate 24 outwardly, so that is latched. At the same time, the charge within the chamber 23 is exploded in any suitable manner. It will be noted that each of the pistons is simultaneously performing two functions, the piston 42 simultaneously compressing a charge and acting as a wall against which the exploded charge may exert its force in one of the arcuate cylinders 53, while the piston 42ª is acting to scavenge the other cylinder and introduce a charge thereto.

While I have illustrated the rotor as provided with two chambers and one each of the pistons 42 and 42ª, it will be obvious that any number of chambers and pistons may be provided and it will also be obvious that a number of units similar to that illustrated might be mounted upon a single shaft and connected with one another for synchronous action. Furthermore, if desired, a greater number of pistons may be provided than chambers. For example, one of the chambers of the present structure could be omitted and the two pistons retained or a structure of this character could be extended to include any desired number of chambers and abutments. Any suitable means may be provided for cooling the engine. In the present structure, air cooling is employed and effected by the rapid rotation. If desired, instead of making the member 10 a stator, this member may rotate, in which event two rotors are provided which are oppositely acted upon by the explosion. I accordingly do not

limit myself to such specific structure except as hereinafter claimed.

I claim:—

1. In a rotary internal combustion engine, a stator and a rotor combining to produce arcuate cylinders each having at one end thereof a chamber, radially movable gates closing the outer ends of said chambers, radially movable pistons corresponding in number and arrangement to the chambers, alternate pistons being adapted to engage and move said gates to open position, means for latching the gates in open position, the remaining pistons each having associated therewith intake and exhaust ports communicating with the cylinder at opposite sides thereof, the first named pistons trapping a charge previously admitted behind the last named piston and compressing the same and a poppet valve permitting admission of the compressed charge to the adjacent chamber.

2. In a rotary internal combustion engine, a rotor and a stator combining to produce a series of arcuate cylinders having at corresponding ends thereof compression chambers for the reception of an explosive charge, gates normally preventing communication between each cylinder and its associated chamber, pistons traversing said cylinders during rotation of the rotor, alternate pistons by their engagement with said gates shifting the gates to open position, means for latching the gates in open position, means for releasing the gates immediately after passage of one of the remaining pistons, means for admitting an explosive charge immediately behind the last named pistons, means for educting the products of combustion immediately in advance of the last named pistons and check valve controlled means permitting the passage of a charge compressed within a cylinder by one of the first named pistons to the chamber of the succeeding cylinder.

3. In a rotary internal combustion engine, a rotor and a stator combining to produce a series of arcuate cylinders having at corresponding ends thereof compression chambers for the reception of an explosive charge, radially shiftable gates normally preventing communication between each cylinder and its associated chamber, radially movable pistons traversing said cylinders during rotation of the rotor, alternate pistons by their engagement with said gates shifting the gates to open position, means for latching the gates in open position, cam means for releasing the gates immediately after passage of one of the remaining pistons, means for admitting an explosive charge immediately behind the last named piston, means for educting the products of combustion immediately in advance of the last named piston and means for conducting a charge compressed in one cylinder by one of the first named pistons to the chamber of the succeeding cylinder.

4. In a rotary internal combustion engine, a rotor and a stator combining to produce a series of arcuate cylinders having at corresponding ends thereof compression chambers for the reception of an explosive charge, radially movable spring-pressed gates normally preventing communication between each cylinder and its associated chamber, radially movable spring-pressed pistons traversing said cylinders during rotation of the rotor, alternate pistons engaging said gates and having springs of greater strength than the springs urging said gates to closed position, means for latching the gates in open position, cam means releasing the gates immediately after passage of any of the remaining pistons, means for admitting an explosive charge immediately behind the last named pistons, means for educting the products of combustion immediately in advance of the last named piston and means for transferring a charge compressed by one of the first named pistons within a cylinder to the chamber of the succeeding cylinder.

5. In a rotary internal combustion engine, a rotor and a stator combining to produce a series of arcuate cylinders having at corresponding ends thereof compression chambers for the reception of an explosive charge, gates normally preventing communication between each cylinder and its associated chamber, pistons traversing said cylinders during rotation of the rotor, alternate pistons by their engagement with said gates shifting the gates to open position, means for latching the gates in open position, means for releasing the gates immediately after passage of one of the remaining pistons, means for admitting an explosive charge immediately behind the last named pistons, means for educting the products of combustion immediately in advance of the last named pistons and check valve controlled means permitting the passage of a charge compressed within a cylinder by one of the first named pistons to the chamber of the succeeding cylinder, said chambers each including a radial wall having an arcuate extension, the check valve having its seat in said arcuate extension, the face of the extension of the wall having a groove placing said seat in communication with the adjacent end of the preceding cylinder.

6. In a rotary internal combustion engine, a rotor and a stator combining to produce a series of arcuate cylinders having at corresponding ends thereof compression chambers for the reception of an explosive charge, gates normally preventing communication between each cylinder and its associated chamber, pistons traversing said cylinders during rotation of the rotor, alternate

pistons by their engagement with said gates shifting the gates to open position, means for latching the gates in open position, means for releasing the gates immediately after passage of one of the remaining pistons, means for admitting an explosive charge immediately behind the last named pistons, means for educting the products of combustion immediately in advance of the last named pistons and check valve controlled means permitting the passage of a charge compressed within a cylinder by one of the first named pistons to the chamber of the succeeding cylinder, said chambers each including a radial wall having an arcuate extension, the check valve having its seat in said arcuate extension, the face of the extension of the wall having a groove placing said seat in communication with the adjacent end of the preceding cylinder, the face of the radial wall confronting the compressible cylinder in the form of a cam causing a radial movement of the piston.

7. In a rotary internal combustion engine, a rotor and a stator combining to produce a series of arcuate cylinders having at corresponding ends thereof compression chambers for the reception of an explosive charge, gates normally preventing communication between each cylinder and its associated chamber, pistons traversing said cylinders during rotation of the rotor, alternate pistons by their engagement with said gates shifting the gates to open position, means for latching the gates in open position, means for releasing the gates immediately after passage of one the remaining pistons, means for admitting an explosive charge immediately behind the last named pistons, means for educting the products of combustion immediately in advance of the last named pistons and check valve controlled means permitting the passage of a charge compressed within a cylinder by one of the first named pistons to the chamber of the succeeding cylinder, said chambers each including a radial wall having an arcuate extension, the check valve having its seat in said arcuate extension, the face of the extension of the wall having a groove placing said seat in communication with the adjacent end of the preceding cylinder, said gates each having its inner end portion arranged immediately adjacent the arcuate extension of said wall when the gate is in the closed position.

In testimony whereof I hereunto affix my signature.

JAMES F. GARDNER.