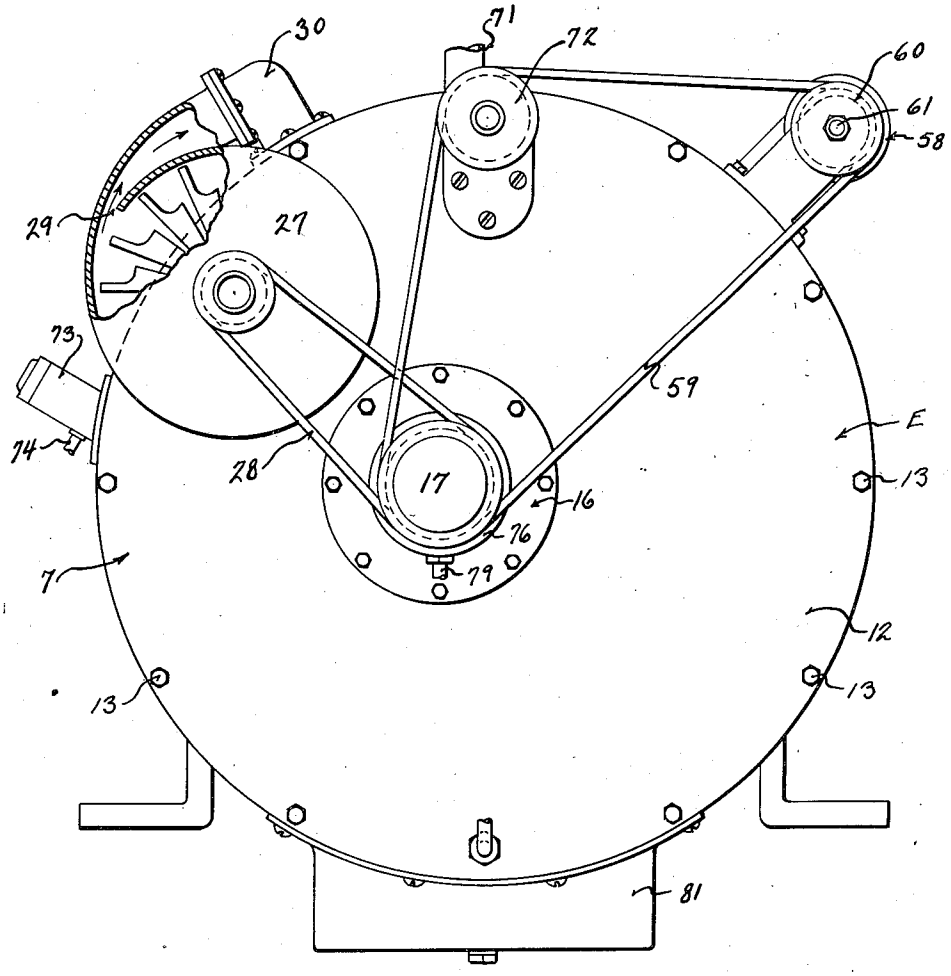
Jan. 25, 1949. G. F. PIEPER 2,460,192

ROTARY DIESEL ENGINE

Filed Sept. 20, 1946 4 Sheets-Sheet 1

Fig. 1.



INVENTOR
GEORGE F. PIEPER

BY Young & Wright

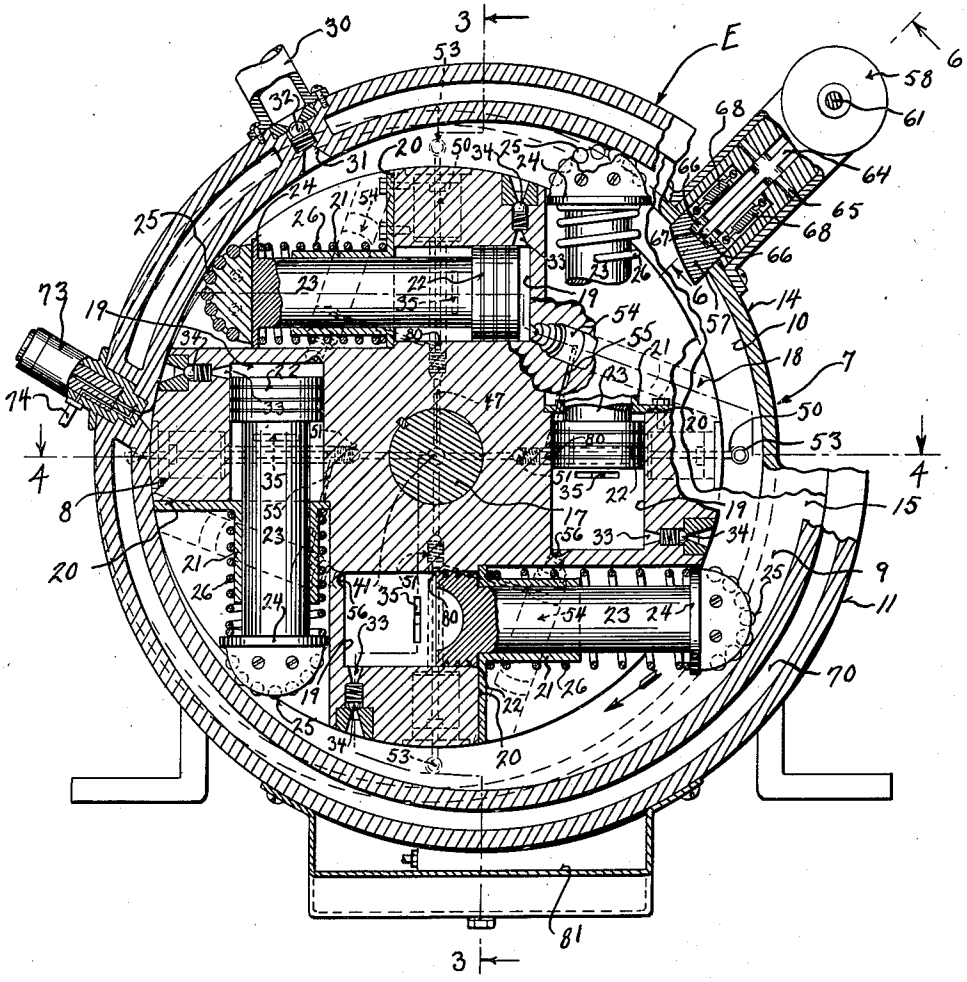
ATTORNEYS

Jan. 25, 1949. G. F. PIEPER 2,460,192

ROTARY DIESEL ENGINE

Filed Sept. 20, 1946 4 Sheets-Sheet 2

Fig. 2.



INVENTOR
GEORGE F. PIEPER

BY

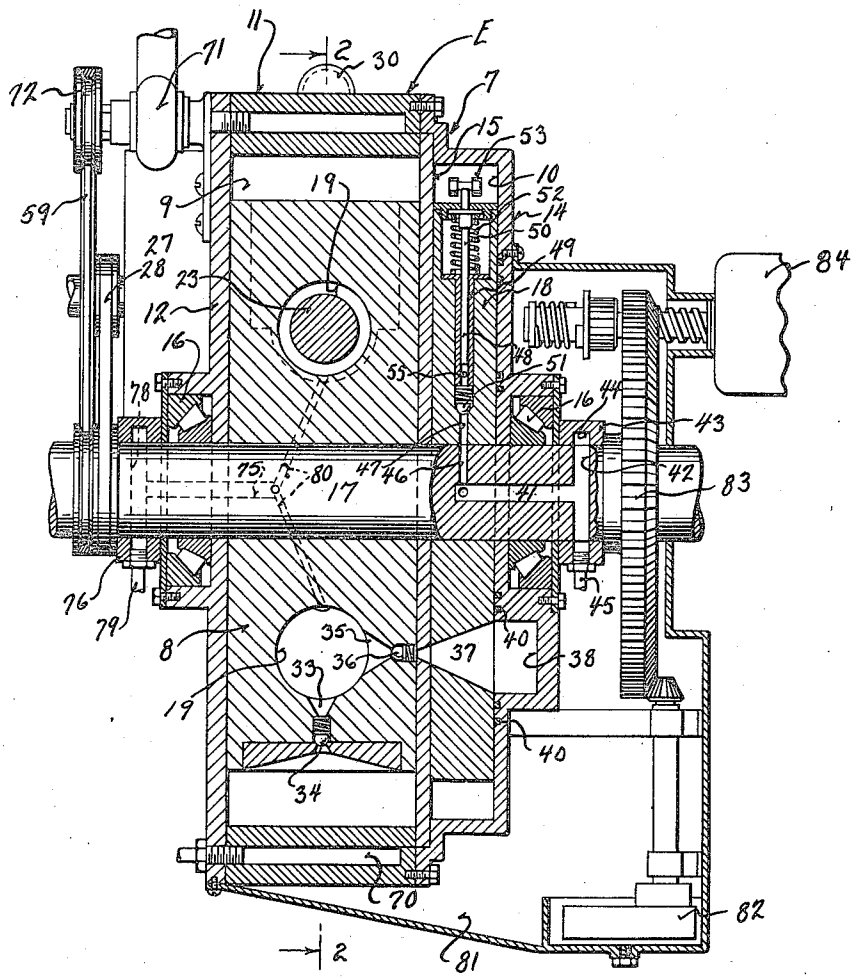
ATTORNEYS

Jan. 25, 1949. G. F. PIEPER 2,460,192

ROTARY DIESEL ENGINE

Filed Sept. 20, 1946 4 Sheets-Sheet 3

Fig. 3.



INVENTOR
GEORGE F. PIEPER

BY Wallace & Wright

ATTORNEYS

Jan. 25, 1949. G. F. PIEPER 2,460,192

ROTARY DIESEL ENGINE

Filed Sept. 20, 1946 4 Sheets-Sheet 4

Fig. 4.

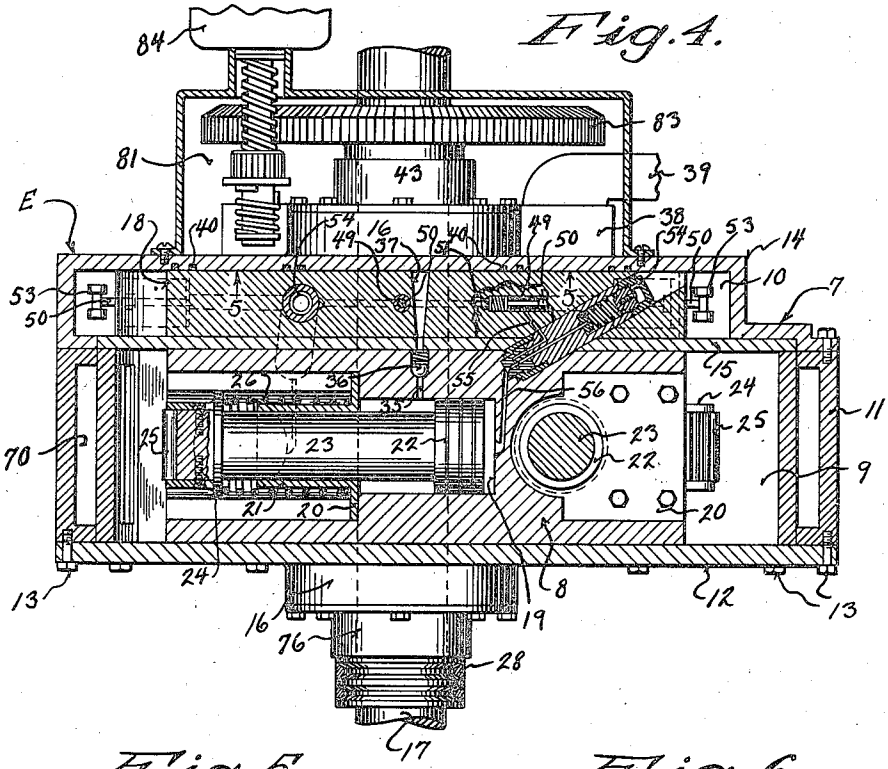


Fig. 5.

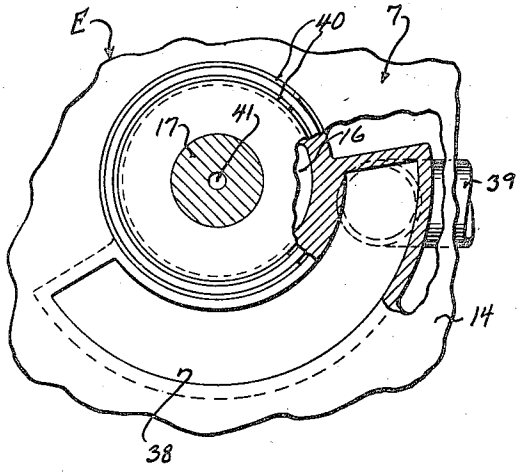
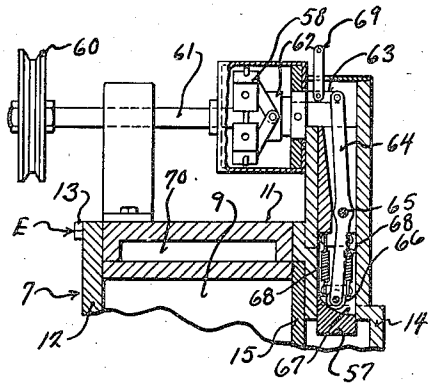


Fig. 6.



INVENTOR
GEORGE F. PIEPER

BY Williamson Wright

ATTORNEYS

Patented Jan. 25, 1949 2,460,192

UNITED STATES PATENT OFFICE

2,460,192

ROTARY DIESEL ENGINE

George F. Pieper, Milwaukee, Wis.

Application September 20, 1946, Serial No. 698,283

1 Claim. (Cl. 123—43)

1

This invention appertains to rotary Diesel engines and is a further advancement in this art over my prior Patents 2,263,274, 2,263,275 and 2,352,403, issued respectively to me on November 18, 1941, and June 27, 1944.

One of the primary objects of my invention is to provide a novel power rotor having cylinders formed directly therein with reciprocating pistons mounted in the cylinders, the arrangement being such that the power thrust is delivered directly to the base of the cylinders, i. e. the rotor, whereby to cause the rapid positive driving of the rotor without the use of any intermediate operating mechanism.

Another salient object of my invention is to provide novel means for arranging the cylinders and the pistons in the rotor, so that the cylinders will be disposed around the power shaft and substantially tangentially to a circle concentric to the power shaft, whereby the power thrust will be delivered directly to the rotor at one side of its axis.

A further object of my invention is to provide novel means for arranging the rotor eccentric in the stator and the pistons in the rotor in such a manner that during movement of the rotor, the pistons will be automatically actuated on their compression strokes.

A further important object of my invention is to provide novel means for delivering air under compression to the cylinders for facilitating, first the scavenging of the burnt charges therein and second, the maximum and desired amount of clean air for the combustion charge.

A still further object of my invention is to provide novel means for delivering atomized fuel at the desired time to a cylinder loaded with air under high compression, to bring about the effective firing of the fuel mixture.

A still further important object of my invention is to provide novel means for varying the active stroke of the fuel pumps to increase or decrease the amount of fuel charge to the cylinders.

With these and other objects in view the invention consists in the novel construction, arrangement and formation of parts, as will be hereinafter more specifically described, claimed, and illustrated in the accompanying drawings, in which drawings:

Figure 1 is a side elevational view of my novel rotary Diesel engine, parts of the figure being shown broken away and in section to illustrate structural detail.

Figure 2 is a central sectional view through the engine taken substantially on the line 2—2 of

2

Figure 3 looking in the direction of the arrows, illustrating the novel arrangement of the cylinders and pistons in the rotor and the means for automatically actuating the fuel pumps.

Figure 3 is a substantially diametric section through the engine taken on the line 3—3 of Figure 2 looking in the direction of the arrows.

Figure 4 is a view taken substantially at right angles to Figure 3 and on the line 4—4 of Figure 2 looking in the direction of the arrows.

Figure 5 is a fragmentary detail sectional view taken substantially on the line 5—5 of Figure 4 looking in the direction of the arrows and illustrating the exhaust chamber in the stator.

Figure 6 is a fragmentary detail sectional view taken substantially on the line 6—6 of Figure 2 looking in the direction of the arrows and illustrating the novel means for bringing about the varying of the active stroke of the fuel pumps.

Referring to the drawings, in detail, wherein similar reference characters designate corresponding parts throughout the several views the letter E generally indicates my improved rotary Diesel engine.

The engine E includes a stator 7 in which is eccentrically mounted the rotor 8.

The stator 7 can be constructed in various manners and as illustrated includes a rotor chamber 9 and a pump chamber 10. The stator can consist of an annular outer wall 11 and a side disc end wall 12. This end wall 12 can be rigidly fastened to the annular outer wall 11 in any suitable way, such as by machine screws 13. Fastened to the other side of the outer wall 11 from the end wall 12 is an end wall 14 and this wall is formed to provide the chamber 10. As shown in Figures 2, 3, and 4 the chamber 10 is eccentrically disposed relative to the chamber 9 and is separated therefrom by a disc plate 15. This disc plate 15 rotates with the rotor 8 as will be later set forth. The end walls 12 and 14 carry suitable bearings 16 for rotatably supporting the power or drive shaft 17. The rotor 8 and the disc 15 are securely fastened to the shaft 17 and also rigidly fastened to the shaft for rotation therewith is the pump plate 18. This pump plate 18 is mounted for rotation within the pump chamber 10.

As previously stated the rotor 8 is eccentrically mounted within the stator 7 and the chamber 9 and consequently the rotor only bears against the stator outer wall 11 at one point.

The rotor 8 is in the nature of a circular solid block and this block is provided at quarters with cylinders 19 and these cylinders in effect form chords relative to the circumference or periphery

of the rotor and the cylinders extend tangentially relative to a circle concentric with the axis of the rotor.

To facilitate assemblage, the rotor block is cut away at quarters as at 20 and the cylinders 19 communicate with these cut away portions. Fastened securely in the cut away portions are guide sleeves 21 which actually form continuations of the cylinders. These sleeves, however, are of less diameter than the diameter of the cylinders. Reciprocally mounted within each cylinder is a piston 22 and each piston has formed thereon or secured thereto a piston rod 23 which is slidably mounted within its sleeve 21. The end of each piston rod remote from the piston 22 has a cap 24 carrying antifriction bearings 25. These bearings are preferably arranged in a semicircle and the caps 24 and the bearings carried thereby are normally urged into constant bearing contact with the inner face of the stator outer wall 11, by means of relatively heavy expansion springs 26. These springs are coiled about the sleeves 21 and the rods 23 and bear against the caps 24 at the inner ends of the sleeves.

From the description so far, it can be seen that combustion takes place between a piston 22 and the inner wall or head of the cylinder and consequently during the firing of the charge a thrust is exerted on the rotor which is substantially tangential to a circle concentric to the axis of the rotor.

Novel means is provided for supplying an adequate amount of clean fresh air to the cylinders and this means consists of a pump 27. The pump can be fastened to the stator and is shown to be of the rotary impeller type and can be driven by means of a belt 28 from the shaft 17. The outlet 29 of the pump communicates with a conduit pipe 30 which in turn communicates with an inlet port 31 formed in the stator. This air inlet port communicates with the rotor chamber 10 and hence this chamber is filled with clean fresh air between the periphery of the rotor and the inner face of the outer wall 11 of the stator. A one way check valve 32 is placed in the port 31 so as to permit the flow of air under pressure into the chamber 10 but to prevent the back flow of fluid into the pipe 30.

Adjacent to the inner end of each cylinder 19 is an air inlet port 33. These ports are formed directly in the rotor and each port is controlled by a spring pressed check valve 34. Hence, at appropriate times fresh air can be sucked into the cylinders in quantities adjacent to the inner ends thereof. Each cylinder also has communicating therewith a flared exhaust port 35 and these ports are formed directly in the rotor adjacent to the outer ends of the cylinders. One way check valves 36 are placed in the exhaust ports. These exhaust ports 35 communicate at all times with exhaust ports 37 formed in the disc 15 and the pump plate 18. The exhaust ports in the pump plate flare outwardly and communicate at certain times with an arcuate exhaust channel 38 formed in the closure plate 14. This closure plate carries an exhaust pipe 39 which communicates with the exhaust channel 38.

It can be seen that annular gasket rings 40 can be carried by the closure plate 14 and that these rings bear against the pump plate and function to set up a seal between the pump plate and the closure plate 14.

Novel means is provided for supplying atomized fuel under pressure to the inner ends of the cylinders 19 at the desired times. This means includes an axial longitudinally extending passage-way 41 formed in the shaft 17. The outer end of this passage-way communicates with radially extending passage-ways 42 which communicate at all times with a stationary fuel supply ring 43. This ring has its inner face provided with an annular fuel channel 44 with which the radial ways 42 communicate. Fuel is constantly supplied to the channel 44 by a conduit tube 45 which leads from any suitable source of supply. The inner end of the axial passage-way 41 has communicating therewith radially extending fuel feed passage-ways 46 and these passage-ways 46 in turn communicate with similar passage-ways 47 formed in the pump plate 18. A pump 48 is provided for each cylinder and consequently there are four pumps 48 mounted on the pump plate 18. The pump plate 18 is bored radially to receive the pumps and the passage-ways 47 in the pump plate communicate with the inner ends of the pumps. Each pump includes a cylinder 49 and a piston 50. A spring pressed check valve 51 controls the flow of fuel into a pump from a passage-way 47. Each pump piston is normally urged outwardly by an expansion coil spring 52 and the outer ends of the pump pistons 50 carry antifriction rollers 53 which are disposed within the pump chamber 10. The purpose of these rollers will be later set forth.

Operating in conjunction with the pumps are fuel injectors 54 and these injectors are carried by the rotor 8, the plate 15 and the pump plate 18 and there is a fuel injector 54 for each pump and each cylinder. These fuel injectors are of the type commonly used for spraying atomized fuel into the cylinders of Diesel engines and it is to be noted that each pump is provided with a port 55 which communicates with its injector 54. The nozzle of each injector communicates with a passage-way 56 in the rotor which leads to the inner end of its cylinder 19. Briefly, on the out stroke of a fuel pump piston 50 fuel will be taken into the pump from the passage-ways 41, 46, and 47 and on the inward stroke of a pump piston the fuel under high compression will be forced into the injector and thence into an atomized state into a cylinder.

The fuel pumps are operated in proper sequence and at the proper time by a cam shoe 57 which projects into the pump chamber 10 through the closure wall 14. As a pump piston passes the cam shoe 57 the rollers 53 will ride against the inclined face of the shoe and a pump piston 50 will be forced inwardly placing the fuel in its cylinder 49 under high compression. The fuel under high compression will in turn be supplied to a fuel injector 54 through the passage-way 55 and the fuel will then be sprayed by the injector into a cylinder 19. As the rollers 53 ride off of the cam shoe 57 the pump spring 52 will forcibly carry the piston 50 outwardly and consequently fuel will be sucked into the pump cylinder 49 from the passage-way 47. It being understood that the outward movement of a pump piston will create a suction and unseat the check valve 51 to permit the drawing in of the fuel.

If so desired the cam shoe 57 can be adjusted radially inward and outward of the pump chamber 10 so as to regulate the working stroke of the fuel pump pistons 50. By controlling the active stroke of the pump pistons the quantity of fuel taken in by the pumps and then delivered

to the injectors can be controlled. The cam shoe 57 can be adjusted in different manners. This adjustment can either be by a manually controlled mechanism or by an automatically controlled mechanism. In the present instant I have shown the cam shoe adjustable by an automatic mechanism and in accordance with the speed of rotation of the rotor 8. A governor 58 is provided and this governor is rotated from the engine shaft 17 by means of a pulley belt 59. The pulley belt 59 is trained over a pulley wheel on the shaft 17 and over a pulley wheel 60 on the governor shaft 61. The governor 58 is of the centrifugal weight type and as the weights thereof move outwardly by centrifugal force, a collar 62 is actuated back and forth. This collar in turn operates, through the medium of links 63 a lever 64. This lever is rockably mounted intermediate its ends on a pivot pin 65. The inner end of the lever 64 carries a roller 66 which bears at all times against a cam track 67 formed in the cam shoe 57. Contractile coil springs 68 are operatively connected to the shoe and to the stator casing and normally tend to pull the cam shoe outwardly and against the roller 66. Upon the swinging of the lever 64 the roller acting on the cam track tends to force the shoe inwardly and as the roller moves to the deep end of the cam track the spring 68 functions to pull the cam shoe outwardly. If desired the lever 64 can have operatively connected thereto a link 69 which can lead to a hand operating mechanism.

Referring to the operation of the engine, it can be seen (see Figure 2) the piston 23 in the lower left quadrant is being forced inwardly due to the engagement of the cap 24 with the stator outer wall and is completing its compression stroke. The piston 23 in the upper left quadrant is approaching firing position. The piston 23 in the upper right quadrant is in its power stroke. The piston 23 in the lower right quadrant is in position for scavenging and is just starting on its scavenging stroke.

A complete cycle of operation would proceed as follows:

Air enters the air blower 27 and is forced through pipe 30, past check valve 32, through port 31 into the air chamber 10. As the rotor 8 revolves in a clockwise direction (still referring to Fig. 2) the piston 23 in the lower right hand quadrant is approximately in position for inward movement. At this time air under pressure from the chamber 9 is sweeping through the rotor air port 33 past the check valve 34 into the cylinder 19. The air functions to replace the burnt gases in the chamber and sweeps the burnt gases from the previous charge through the exhaust port 35 into the port 37 and exhaust chamber 38 from whence it finds its way out to the exhaust pipe.

As the rotor advances, this piston is forced into its cylinder 19 by pressure of the stator outer wall 11 against the piston cap 24. The cylinder is now filled with air, which has been rushing in from the air chamber 9 and the exhaust port 35 will be cut off and the air will be compressed in the cylinder until the advance of the rotor brings this piston into a position similar to the piston in the upper left quadrant, and with the air in the cylinder at its maximum compression, the fuel pump 48 in the pump section of the rotor will be adjacent to the cam shoe 57 in the stator. Further slight movement of the rotor actuates this fuel pump, as the fuel pump roller head 53 passes over the cam shoe. The actuation of the pump forces the fuel (drawn previously from the

passage 41 in the shaft) under pressure into the injector for the cylinder and when pump pressure is released, the injector then sprays the atomized fuel into the cylinder, and the charge under compression is fired. It can be seen that the quick charge of fuel from the pump, momentarily forces the spring pressed fuel injector rod back, and when pump pressure is released, the spring pressed injector rod forces the fuel out of the restricted injector nozzle into the cylinder.

The power of the expanding charge caught between the piston and the base of the cylinder is exerted against the cylinder base which advances the rotor until the exhaust passage 35 is uncovered by the piston head. This brings the pressure in the cylinder below the pressure of the air in the air chamber 9 and fresh air again sweeps into the cylinder. This cycle of operation is continuous as long as fuel is supplied to the pumps.

The engine can be cooled in any preferred way and as illustrated the outer wall 11 of the stator is provided with a water jacket 70. Water is circulated through the jacket by a water pump 71 and the pump can be driven from the pulley belt 59. It can be seen that this belt is also trained over a pulley wheel 72 carried by the shaft of the pump.

Likewise the engine can be lubricated in any preferred way and I have shown oil injector 73 carried by the stator. This injector can be supplied with lubricating oil from an oil line 74 and oil is forced under pressure through the line to the injector. The injector 73 sprays the pistons and rotor walls as they pass the injector. The shaft 17 can also be provided with an axial passage-way 75 for the lubricating oil and this passage-way communicates with a lubricating oil ring 76 by radial passage-ways 78. This oil ring is securely fastened to the stator and receives its lubricating oil from a supply line 79. The axial lubricating oil passage-way 75 has communicating therewith passage-ways 80 which lead to the cylinders for lubricating the lower cylinder walls. The stator can be provided with an oil sump 81 in which is positioned an oil pump 82 and the outlet of this pump can communicate with the oil lines 74 and 79. The pump can be driven from the shaft 17 by a gear 83 and this gear can also be used in conjunction with a starter 84 for initially turning over the engine.

From the foregoing description, it can be seen that I have provided a simple form of rotary Diesel engine in which the power thrust is delivered directly to the rotor.

Changes in details may be made without departing from the spirit or the scope of my invention but what I claim as new is:

In a rotary internal combustion engine of the type having a stator, a rotor eccentrically mounted in said stator with cylinders therein arranged around the axis of the rotor and extending substantially tangentially to a circle concentric with said axis, pistons slidably mounted in said cylinders, and means urging the pistons in said cylinders to a compression position by the outer wall of the stator during a part of the cycle of rotation of the rotor; said rotor having engagement at one point only with the outer wall of the stator and defining an air chamber between the stator and rotor, means for supplying fresh air in quantities to the chamber, inwardly opening intake valves communicating with the inner ends of the cylinders and having communication with the fresh air chamber, whereby upon

outward movement of the pistons, fresh air will be sucked into the cylinders, and means for supplying atomized fuel to the cylinders at the appropriate times during rotation of the rotor.

GEORGE F. PIEPER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
272,562	Lenhardt	Feb. 20, 1883
580,838	Almond	Apr. 20, 1897
931,837	Beach	Aug. 24, 1909
1,095,355	Ricardo et al.	May 5, 1914
1,154,844	Cole	Sept. 28, 1915
1,282,745	Brown	Oct. 29, 1918
1,341,332	McDonald	May 25, 1920
1,572,541	Lawrence	Feb. 9, 1926
1,646,695	Hubbard	Oct. 25, 1927
1,990,660	McCann	Feb. 12, 1935

FOREIGN PATENTS

Number	Country	Date
202,857	Germany	Oct. 15, 1908
29,367	Great Britain	Dec. 15, 1909
347,600	Great Britain	Apr. 27, 1931