B. F. AUGUSTINE.

ROTARY HYDROCARBON ENGINE.

APPLICATION FILED AUG. 15, 1917.

1,316,346.

Patented Sept. 16, 1919.

6 SHEETS—SHEET 1.

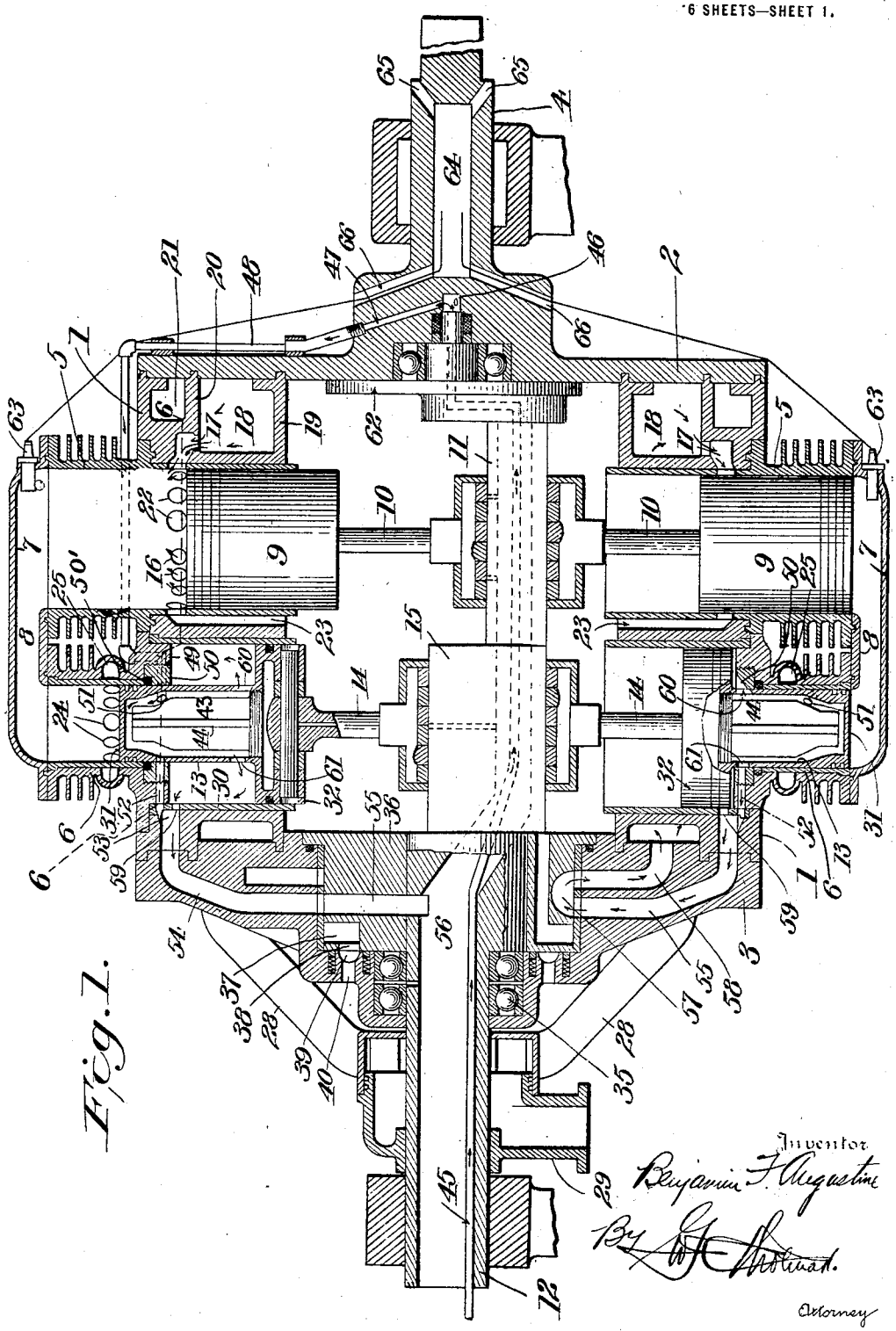


Fig. 1.

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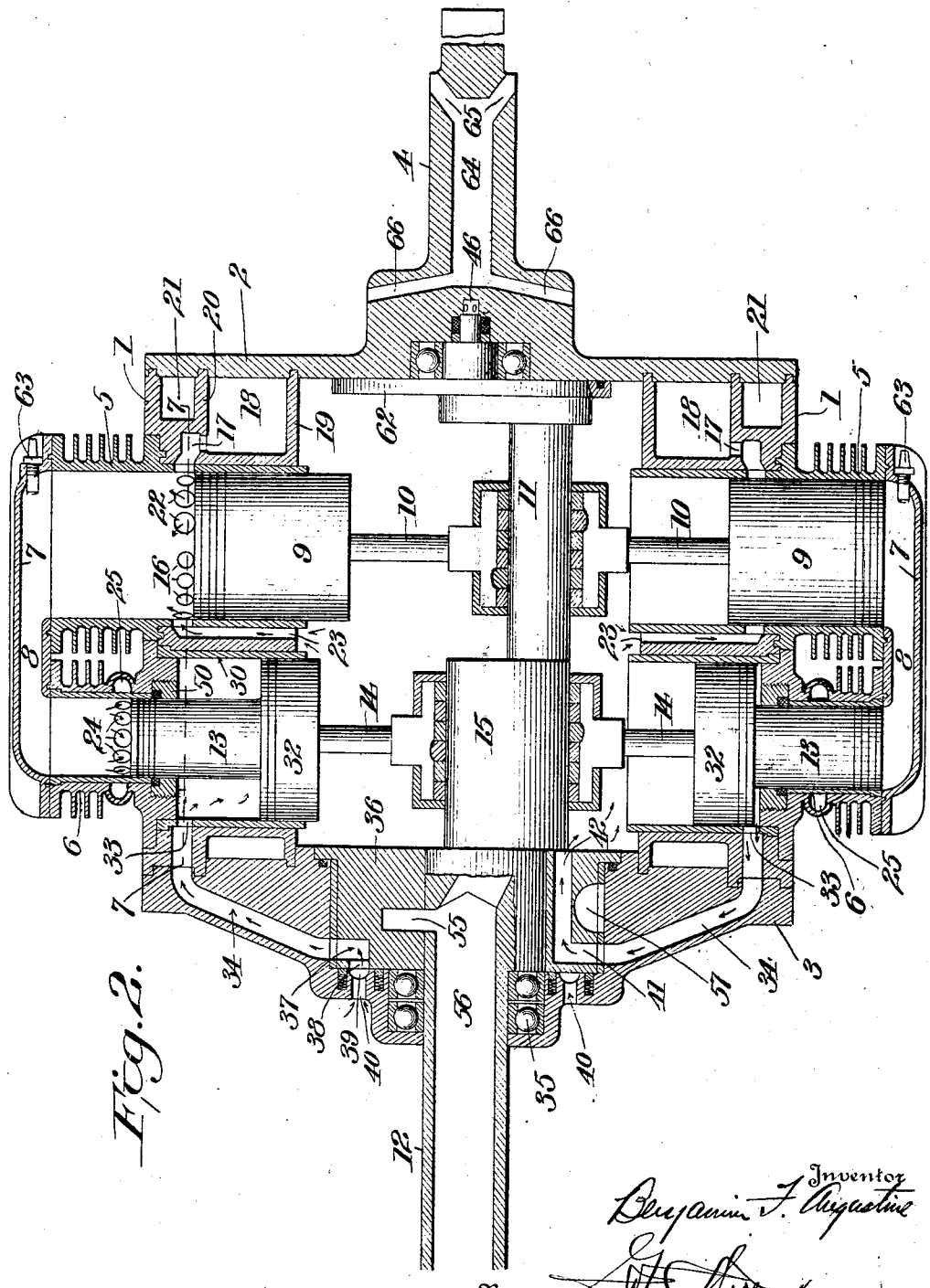


Fig. 2.

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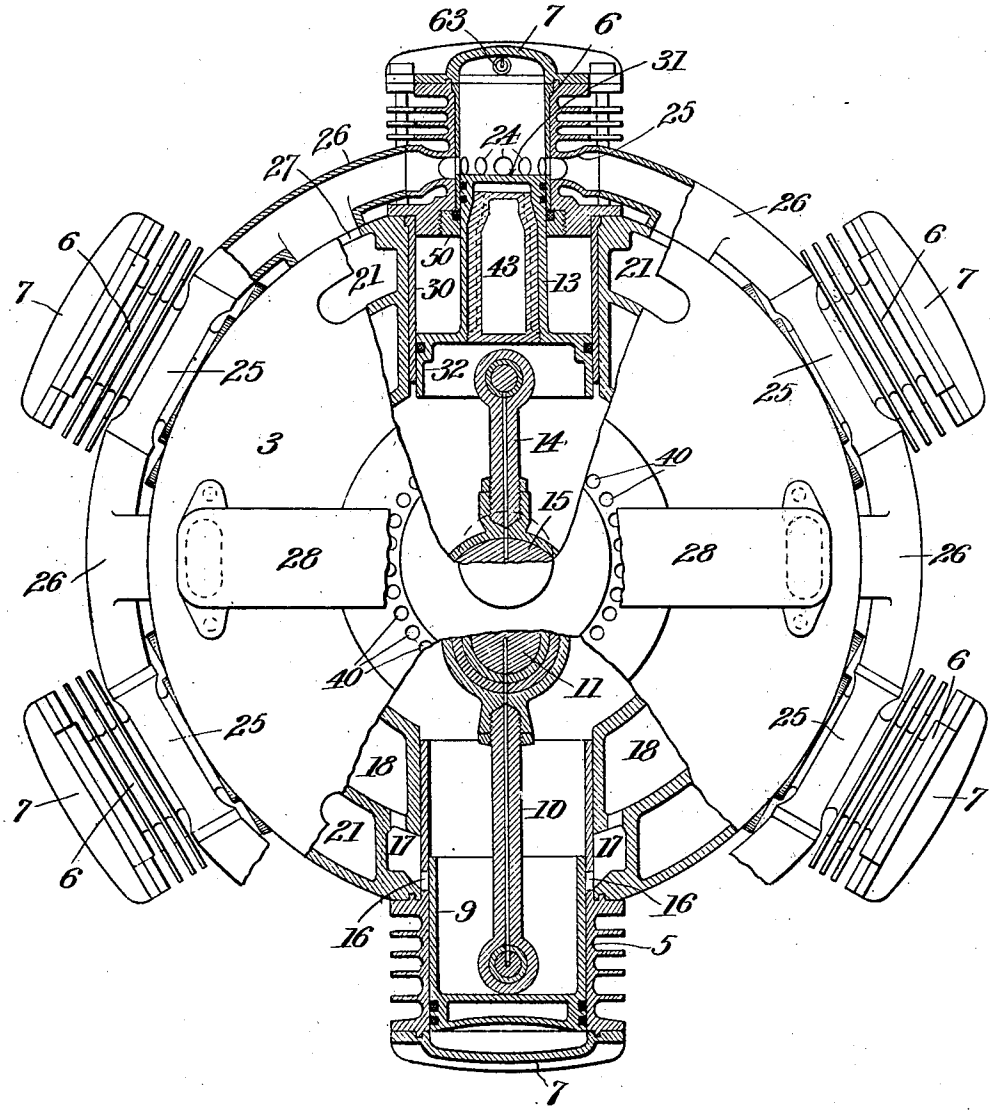
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6 SHEETS—SHEET 3.

Fig. 3.



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6 SHEETS—SHEET 4.

Fig. 5.

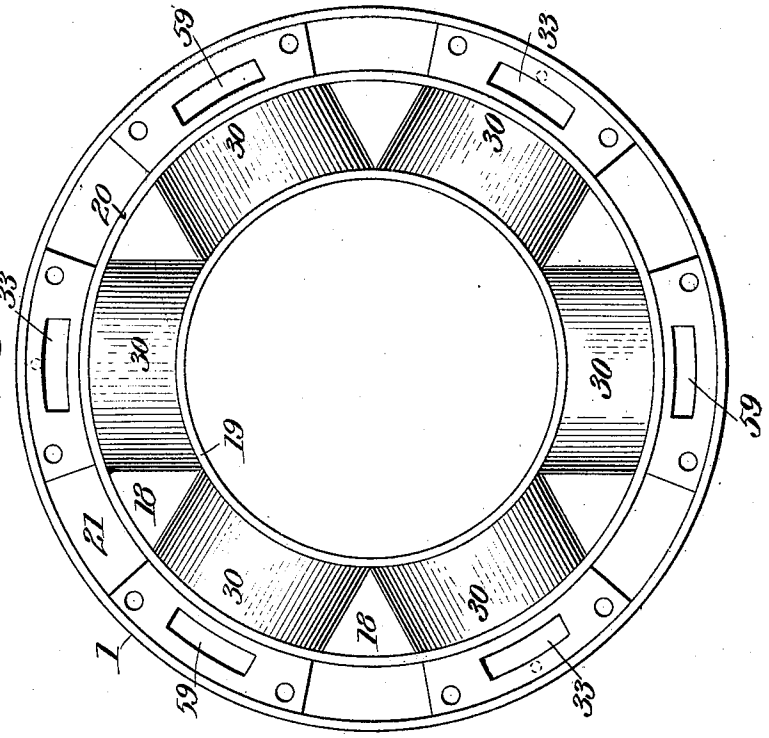
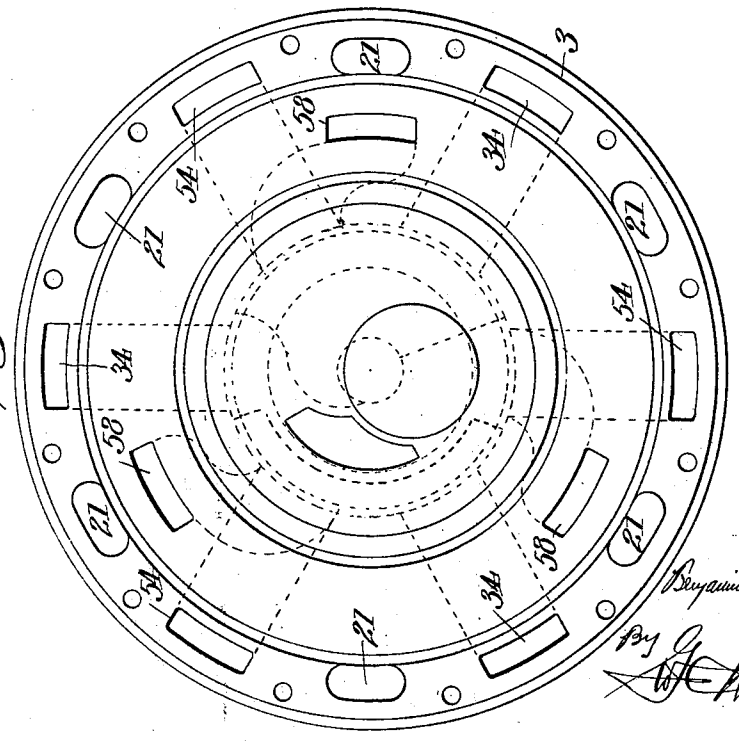


Fig. 4.



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6 SHEETS—SHEET 5.

Fig. 6.

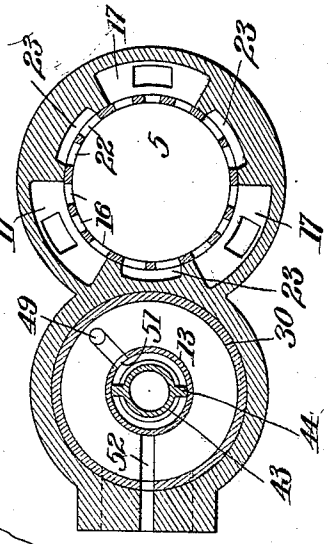


Fig. 7.

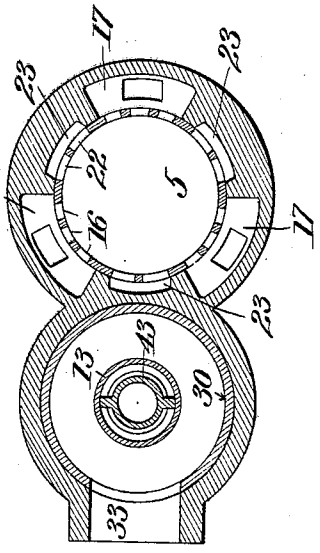
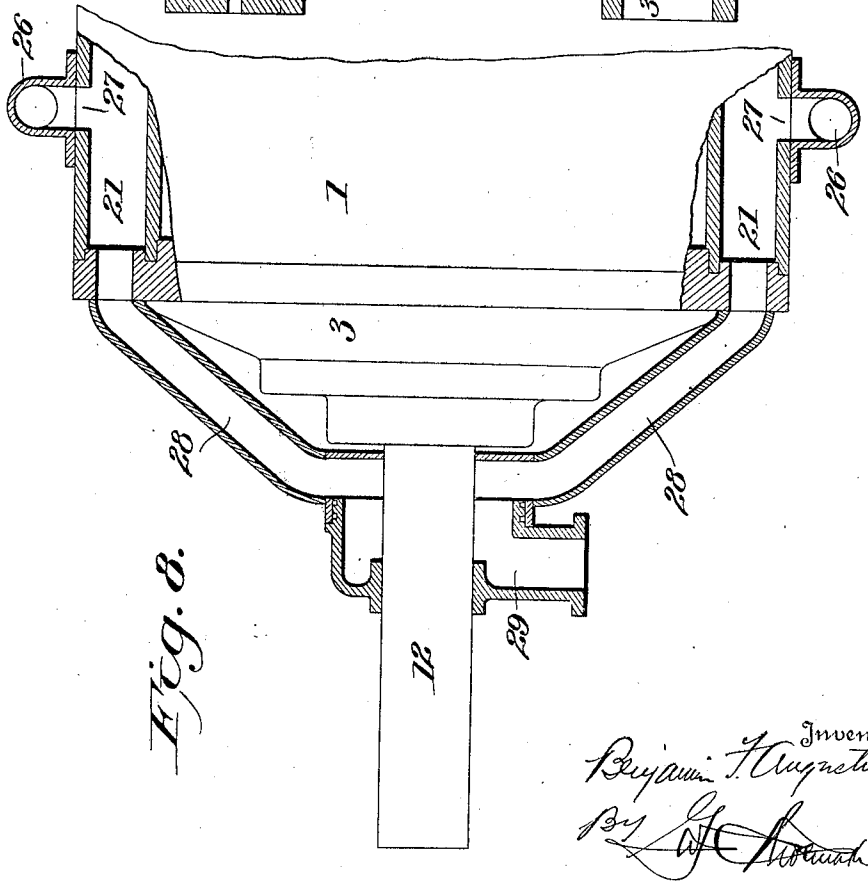


Fig. 8.



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6 SHEETS—SHEET 6.

Fig. 10.

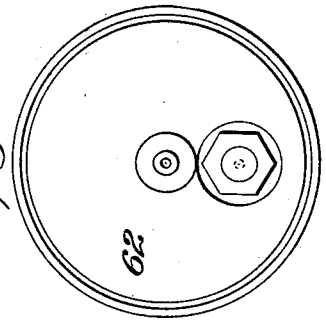


Fig. 13.

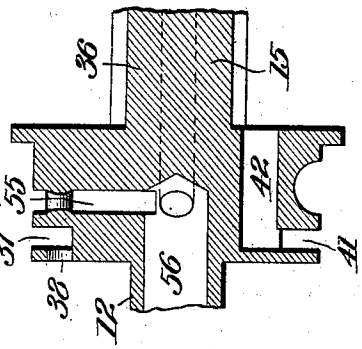


Fig. 9.

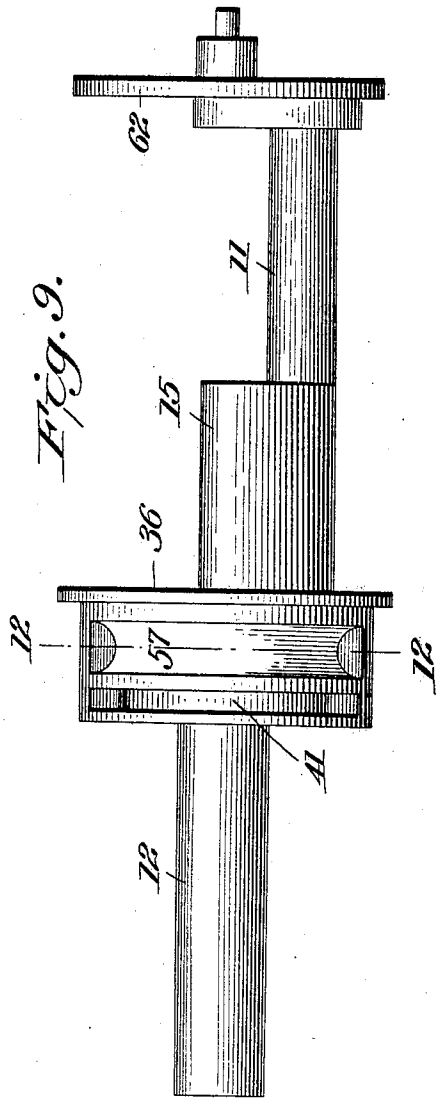


Fig. 12.

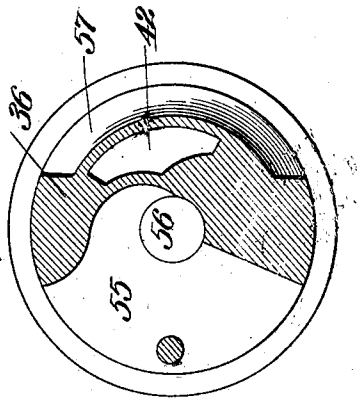
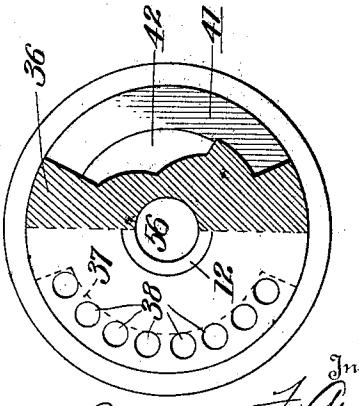


Fig. 11.



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UNITED STATES PATENT OFFICE.

BENJAMIN F. AUGUSTINE, OF BUFFALO, NEW YORK.

ROTARY HYDROCARBON-ENGINE.

1,316,346. Specification of Letters Patent. Patented Sept. 16, 1919.

Application filed August 15, 1917. Serial No. 186,417.

To all whom it may concern:

Be it known that I, BENJAMIN F. AUGUSTINE, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented certain new and useful Improvements in Rotary Hydrocarbon-Engines, of which the following is a specification.

The invention relates to new and useful improvements in hydrocarbon engines, and more particularly to an engine of this character which is adapted to use heavy hydrocarbon such as kerosene, or the like.

An object of the invention is to provide a hydrocarbon engine of the above type, wherein the heat of combustion within the cylinders may be utilized for vaporizing a hydrocarbon liquid fuel, prior to the admission of the same to the expansion chamber of the cylinders.

Another object of the invention is to provide an engine of the above type wherein the piston is provided with a vaporizing chamber adapted to receive the hydrocarbon liquid fuel and gasify the same, prior to the admission of the gasified fuel to the expansion chamber of the cylinders.

A still further object of the invention is to provide an engine of the above character wherein a blast of air is used for driving or transferring the gasified fuel from the chamber in the piston to the fuel supply chamber.

A still further object of the invention is to provide means whereby the exhaust gases may be utilized for further heating and gasifying the fuel in the fuel supply chamber prior to the admission of the same to the expansion chamber of the cylinders.

Another object of the invention is to provide means for admitting air to the cylinders for scavenging the cylinders and in such manner that the vaporized fuel admitted to the cylinders is thoroughly mixed with the air.

Another object of the invention is to provide means for supplying air to the engine and also for transferring the fuel to a fuel supply chamber.

Another object of the invention is to provide a rotary engine of the above character wherein the liquid fuel is supplied through a pipe arranged so that the centrifugal force acting on the fuel aids in carrying the fuel to the vaporizing means.

Another object of the invention is to provide a rotary engine of the above type wherein the liquid fuel is gasified in a chamber formed in one of the operating pistons and wherein a pumping device is asociated with said piston for pumping air through the vaporizing chamber for forcing or transferring each individual charge to a fuel supply chamber.

These and other objects will be obvious, and will in part be more fully disclosed.

In the drawings which show by way of illustration one embodiment of the invention:

Figure 1 is a longitudinal sectional view of an engine embodying the invention, the section being taken through the cylinders having means for gasifying the hydrocarbon fuel;

Fig. 2 is a similar view through the cylinders having means to pump air only;

Fig. 3 is a view partly in end elevation and partly in section through one of the cylinders having intake ports and through one of the cylinders having exhaust ports;

Fig. 4 is a view of one of the end heads as viewed from the inner side thereof;

Fig. 5 is an end view of the engine casing;

Fig. 6 is a transverse sectional view on the line 6—6 of Fig. 1;

Fig. 7 is a sectional view on the line 7—7 of Fig. 2;

Fig. 8 is a view partly in section and partly in side elevation of one end of the engine casing showing the manner of handling the exhaust gases;

Fig. 9 is a side view of the shaft showing the balancing plate attached thereto;

Fig. 10 is an end view of the same;

Fig. 11 is a view partly in end elevation and partly in section showing the air ports in the extension carried by the shaft;

Fig. 12 is a sectional view on the line 12—12 of Fig. 9;

Fig. 13 is a longitudinal sectional view of a portion of the shaft and the enlargement or extension formed therein.

The invention consists broadly in a casing mounted to rotate in bearings and provided with a plurality of radially disposed cylinders. These cylinders are preferably arranged in pairs. The expansion chambers in each pair of cylinders are connected so as to form in effect, a single expansion chamber. Each cylinder is provided with a piston. One of the cylinders is provided with fuel intake ports and also with air intake ports, and these ports are controlled by the piston of that cylinder. The other cylinder is provided with exhaust ports and these exhaust ports are controlled by the piston of this other cylinder.

The piston controlling the exhaust ports is in the form of a sleeve closed at both ends. The chamber formed by this sleeve is utilized as a vaporizing chamber for the hydro-carbon fuel which is to be used in the engine. Associated with this piston is a pump piston which draws in air and this air is used for forcing the vaporized fuel gases from the chamber in the piston around to a supply chamber formed in the engine casing. The supply chamber in the engine casing is also wholly or partially surrounded by a chamber which receives the exhaust gases; so that the heat from the exhaust gases may be absorbed by the fuel gases, thus thoroughly gasifying the fuel and transforming this heat into power. The crank casing serves as an air supply chamber and air is supplied thereto by suitable means.

Referring more in detail to the drawings my improved hydrocarbon engine consists of a casing 1 which is provided with heads 2 and 3. The head 2 has a projecting shaft 4 which is mounted to rotate in a suitable bearing. These heads close the engine casing. The engine casing is provided with six pairs of cylinders as shown in the present embodiment of the invention. One of the cylinders is indicated at 5, while the other is indicated at 6. As shown in the drawings, the cylinder 5 is of considerable larger diameter than the cylinder 6. This may be varied, however, to suit desired conditions. The two cylinders are connected by an end cap 7 which is formed with a passage way 8. This passage way serves to connect the expansion chambers of the two cylinders so as to form in effect a single expansion chamber. Located in the cylinder 5 is a piston 9. A pitman 10 is connected to this piston, and this pitman is in turn connected through a suitable bearing with the crank 11 on a fixed shaft 12. Located in the cylinder 6 is a piston 13. This piston 13 is connected to a pitman 14, and the pitman 14 coöperates with a crank 15 on the shaft 12. The crank 11 is of greater eccentricity than the crank 15, so that the piston 13 has a shorter stroke than the piston 9.

The cylinder 5 is provided with a series of fuel intake ports 16. These fuel intake ports are connected with passages 17 which in turn are connected with a fuel supply chamber 18. The fuel supply chamber is formed by an inner cylindrical partition 19 and an outer cylindrical partition 20. Between the outer cylindrical partition and the outer wall of the casing is a chamber 21 which is adapted to receive the exhaust gases. The cylinder 5 is also provided with air intake ports 22. The casing is provided with channels 23 and when the cylinder is in place it forms with these channels passage ways leading from the air intake ports to the crank casing so that air is free to pass through these passage ways from the crank casing to the intake ports and thence to the cylinder.

The cylinder 6 is provided with exhaust ports 24. Surrounding each cylinder 6 is a casing 25 which receives the exhaust gases from the exhaust ports. A pipe 26 connects adjacent casings 25; and this pipe is connected to the casing at the opening 27 in the outer wall which leads to the chamber 21 so that the exhaust gases from the cylinders 6 pass into the exhaust chamber 21. The exhaust gases from the chamber 21 are led through pipes 28 (see Fig. 3) to a bonnet 29 which in turn is connected to a single exhaust pipe.

It will be noted that the cylinder 6 is a relatively short cylinder. At the inner end of this cylinder and in tandem therewith, is a pump cylinder 30. This pump cylinder is of much larger diameter than the cylinder 6. The piston 13 as above noted, is in the form of a sleeve closed at its outer end by a thin wall indicated at 31, in the drawings. At the inner end of the piston 13 there is a second piston 32 which coöperates with the pump cylinder 30. These two pistons 13 and 32 are formed in tandem and are connected to the pitman 14.

As above noted, there are six pairs of cylinders, and associated with each pair of cylinders there is a pump cylinder. Three of the pump cylinders operate to pump air only to the crank casing; while the other three pump cylinders operate to pump air and fuel to the fuel supply chamber. In Fig. 2 of the drawings, I have shown the pump cylinders which supply air to the crank casing. Each pump cylinder is provided with a port 33 which connects with a passage 34 in the head 3 of the casing. This head 3 is formed with an opening through which the main shaft 12 extends.

A suitable bearing 35 is provided between the head and the shafts, so that the head together with the crank casing may freely rotate about the fixed shaft. Said shaft is formed with an enlargement or extension 36. Said extension is provided with a port 37 (see Fig. 13) which is adapted to register with the passage 34. There are openings 38 which lead from the port 37 to the outer face of the enlargement or extension 36 and these openings are constantly in register with an annular chamber 39 which is connected by means of openings 40 with the atmosphere. When the parts are in the position shown in Fig. 2, air is being drawn in through the passage 34 into the pump cylinder by the upper pump, the piston of which is just reaching the end of its stroke. On the opposite side of the enlargement or extension 36 from the port 37, is a port 41 (see Fig. 13), which extends down into the extension and connects with a lateral passage 42 which leads to the inner face of this extension and connects with the crank casing. When the passage 34 is in register with this port 41, air is transferred from the pumps into the crank casing as shown by the lower pump in Fig. 2 which is just finishing its stroke.

Three of the pump cylinders operate to pump air and fuel. In Fig. 1 of the drawings, I have shown a section through two of these cylinders. Located within the chamber in the piston 13, is a hollow core 43 having ribs 44 which extend across the sleeve forming a partition, thus dividing the chamber in the piston into two parts. The partition terminates short of the outer end of the sleeve so that the two parts of the chamber are thus connected. The fuel which, as above noted, is a heavy hydrocarbon such as kerosene, is carried to the engine through a pipe 45. (See Fig. 1). The shaft 12 is hollow, and the pipe 45 extends through this hollow shaft to the extreme forward end of the shaft. At the end of the shaft there is a chamber 46 into which the fuel is discharged. A pump may be used if desired for forcing the fuel through the pipe into this chamber. Extending radially from the chamber 40, is a series of passages 47 one for each pair of cylinders pumping gas and air. A pipe 48 is connected to each passage and extends along the head of the engine casing and across the outer wall thereof to a cylinder 6. Said pipe connects with a passage way 49 which opens through the wall of a collar 50 operating to hold the cylinder 6 in place and in effect, forming an extension of said cylinder. A packing ring 50′ between the collar and the end of the cylinders prevents leakage. The piston 13 is formed with a port 51 which is adapted to register with the passage 49 when the piston is in position shown at the upper part of Fig. 1. At this time the cylinder is moved outwardly to its extreme outer position. The centrifugal force carries the fuel out through the pipe 48 and when this port 51 is in register with the passage 49 a charge of liquid fuel will flow into the chamber in the piston and will be carried by centrifugal force out against the inner wall of the head of the piston. The plate 31 forming the head of the piston is comparatively thin, and will become extremely hot. The liquid fuel thrown against this hot plate will be quickly vaporized, and turned into a dry gas.

On the opposite side of the piston from the port 51, there is an outlet port 52 which is adapted to register with a passage 53 formed in the engine casing. This passage communicates with a passage 54 formed in the head 3 of the engine casing. The passage 54 is adapted to register with a port 55 (Fig. 13), formed in the enlargement or extension 36. This port extends down through the fixed shaft and communicates with a chamber 56 extending lengthwise of the fixed shaft. This is the chamber in which the pipe 45 is located. When the ports are in the position shown in Fig. 1, the upper pump piston 32 is just reaching the inner end of its stroke. In other words, the cylinder has moved outwardly to its extreme position. While the piston is moving to this position the passage 54 has been in register with the port 55 and air is drawn in through the hollow shaft and the passage 54 into the pump cylinders. Just as the piston reaches this position the fuel port is opened, as above noted, and a supply of fuel is admitted to the hollow piston. As the engine rotates this pump piston moves to the position shown in connection with the lower cylinder in Fig. 1. The passage 54 comes into register with a port 57, which connects the passage 55 with a passage 58 and this passage 58 leads to the fuel supply chamber 18. There is a port 59 which connects the pump cylinder with this passage 54. The piston 13 is provided with a port 60 which connects the pump cylinder with the chamber inside said piston, and also with a port 61 likewise connecting the pump cylinder with the chamber inside the piston. The port 61 is adapted to register with the port 52, when the piston is at the outer end of its stroke or at the position shown at the lower part of Fig. 1. The pump piston draws in air from the hollow shaft as above noted. The air drawn into the pump cylinder during the first part of the pumping stroke is transferred through the port 59 and the passage 54 to the fuel supply chamber. The pump piston 32 cuts off the port 59 before the pump piston finishes its stroke. The further move-

ment of the pump piston after this port 59 is cut off causes the air remaining in the pump cylinder to pass through the port 60 over the top of the partition in the chamber in the piston and out through the port 52 carrying with it the gasified fuel and this air and gasified fuel is forced by the pump around into the fuel supply chamber.

As above stated, only three of the pump cylinders are connected to the fuel supply pipe, and pump fuel to the fuel supply chamber. The other three pumps, pump air only. They are similarly constructed however, to the pistons pumping fuel, with the result at the end of the stroke of the air pumping cylinders air is forced through the hollow piston and about the inner wall of the piston head, thus cooling the same.

The ports in the enlargement or extension 36 are of sufficient length so that the pump cylinders pumping fuel through their coöperative action draw in air continuously and supply air and fuel continuously to the fuel supply chamber, it being understood of course, that each pump cylinder is cut off as the pump piston passes the dead center and is inactive so as to prevent any back discharge of the fuel gases from the fuel supply chamber. The pump cylinders are so proportioned as to supply the proper volume of air and fuel gas for the six pairs of cylinders. The fuel gas which is vaporized in the piston is further heated and turned into an extremely dry gas, by reason of the fact that the fuel supply chamber is surrounded by a chamber receiving the exhaust gases. The fuel gas takes the heat out of the exhaust gases and transforms the same into work, thus greatly increasing the efficiency of the engine.

The ports in the extension or enlargement 36, for the air, are also so proportioned that the pump cylinders pumping air only receive and supply air continuously to the crank casing. Neither the air nor the gas is placed under compression in the pumps nor do the pumps work under vacuum. The pumps operate to transfer a volume of air and gas for the engine. The air delivered to the crank casing is placed under slight compression therein. The air also being drawn from the atmosphere is cool and will absorb heat units from the shaft and bearings, also from the inner parts of the engine, which transfers these heat units into work.

It will be noted that the pistons 13 and 32 are connected to the same pitman 14 and this pitman performs three functions; it operates the piston 32 to draw in air and to compress the air and it also becomes the abutment for the piston 13 on the expansion of the gases.

The exhaust ports are uncovered by the piston 13 after the fuel gases have been fully expanded. In this connection it will be noted that the pistons are at the opposite ends of the expansion chamber and operate in multiple, that is, move simultaneously under the power of expanding gases and therefore an extreme expansion of the gases is obtained. As soon as these exhaust ports are partly opened, the pressure in the cylinders is relieved, then the air intake ports begin to open, permitting fresh air in the crank casing to rush into the cylinder 5 completely scavenging the cylinders and forcing the burnt gases out through the exhaust ports. After a small portion of air has been admitted and the burnt gases have been forced away from the region adjacent the head of the piston 9, then the fuel intake ports are opened permitting the dry gasified fuel to enter with the remainder of the air thoroughly mixing with the same, and forming a uniform charge. The gas is then compressed and fired, completing the two cycle operation.

To aid in starting the engine, a lighter hydrocarbon fuel such as gasolene may be used, in which case the gasolene fuel is supplied to the chamber 56 in the hollow shaft. During the supply of gasolene the heavy hydrocarbon fuel may be cut off, if desired. The gasolene will be drawn into the pump cylinders and delivered by the same to the fuel supply chamber, wherein it will be thoroughly gasified and then admitted to the cylinders. It will be noted that a large portion of the air admitted to the cylinders is received into the crank casing, and while this air absorbs some of the heat of the inner parts of the engine it is comparatively cool when it passes into the cylinders so that a very large volume of air may be quickly admitted to the cylinders and the fuel gas is mixed with this relatively large volume of air in the cylinders.

As above noted, the crank casing is under slight compression and in order to balance the parts of the engine against this pressure, I have provided a balance plate 62 which is attached to the end of the shaft and seated against the head 2 of the casing. This balance plate is of substantially the same area as the enlargement or extension 36 formed in the shaft so that the endwise pressure of the air against one end plate of the engine casing will be substantially balanced by the endwise pressure of the air against the other end plate.

Each pair of cylinders is provided with a spark plug 63. As a convenient means for leading the wires for ignition purposes to the spark plugs, I have provided the shaft 4 with the chamber 64 which extends through the bearing for this section of the shaft. Openings 65 lead from the outer face of the shaft into the chamber 64. Also openings 66

lead from the outer wall of the shaft to the inner chamber 64 at the other side of the bearing. The ignition wires extend through these openings 65, thence through the chamber 64 and the openings 66 and thence outwardly along the casing to the spark plugs. By this arrangement I am able to provide a very small commutator which may be located close to the shaft 4.

It is obvious that my improvements from certain aspects of the invention may be applied to other types of engines than the two cycle type described herein. It is also obvious that changes in the details of construction and the arrangements of the parts may be made without departing from the spirit of the invention as set forth in the appended claims.

What is claimed is:

1. A hydrocarbon engine including in combination a casing, a plurality of cylinders carried thereby, a piston for each cylinder, certain of said pistons having a vaporizing chamber formed therein separated from the expansion chamber of the cylinder by a thin wall, means for supplying liquid fuel to said chamber, and means for utilizing the vaporized fuel from said chamber for operating the engine.

2. A hydrocarbon engine including in combination a casing, a plurality of cylinders carried thereby, a piston for each cylinder, certain of said pistons having a vaporizing chamber formed therein separated from the expansion chamber of the cylinder by a thin wall, means for supplying liquid fuel to said chamber, and means for forcing air through the vaporizing chamber for driving a charge of vaporized fuel therefrom, and means for utilizing the vaporized fuel and air for operating the engine.

3. A hydrocarbon engine including in combination a casing, a plurality of cylinders carried thereby, a piston for each cylinder, certain of said pistons having a vaporizing chamber formed therein separated from the expansion chamber of the cylinder by a thin wall, means for supplying liquid fuel to said chamber, means for forcing air through the vaporizing chamber for driving a charge of vaporized fuel therefrom, means for utilizing the vaporized fuel and air for operating the engine, and means for furnishing air to the engine cylinders independently of the said vaporized fuel and air.

4. A rotary hydrocarbon engine including a fixed shaft having a crank, a casing rotating about said shaft, a plurality of radially disposed cylinders carried by said casing, a piston for each cylinder, a pitman connecting each piston with the crank, a vaporizing chamber separated from the expansion chamber of certain of the cylinders by a thin wall, and means for supplying liquid fuel to said vaporizing chamber, and means whereby the vaporizing fuel may be utilized for operating the engine.

5. A rotary hydracarbon engine including a fixed shaft having a crank, a casing rotating about said shaft, a plurality of radially disposed cylinders carried by said casing, a piston for each cylinder, a pitman connecting each piston with the crank, a vaporizing chamber rotating with the casing and having an outer thin plate forming a part of the walls of the expansion chamber of the cylinder whereby the heat of combustion may be utilized to heat the vaporizing chamber, means for supplying said vaporizing chamber with a liquid fuel, and means for utilizing the vaporizing fuel in the chamber for operating the engine.

6. A rotary hydrocarbon engine including in combination a fixed shaft having a crank, a casing mounted to rotate about the shaft, a plurality of radially disposed cylinders carried by the casing, a piston for each cylinder, a pitman connecting each piston with the crank, certain of said pistons having vaporizing chambers formed therein separated from the expansion chamber of the cylinder by a thin plate, means for supplying liquid fuel to said chamber and against said thin plate, and means for utilizing the vaporized fuel gases in said chamber for operating the engine.

7. A rotary hydrocarbon engine including in combination a fixed shaft having a crank, a casing mounted to rotate about the shaft, a plurality of radially disposed cylinders carried by the casing, a piston for each cylinder, a pitman connecting each piston with the crank, certain of said pistons having vaporizing chambers formed therein separated from the expansion chamber of the cylinder by a thin plate, means for supplying liquid fuel to said chamber and against said thin plate, means for forcing air through said vaporizing chamber for driving the vaporized fuel therefrom, and means for utilizing the vaporized fuel and air for operating the engine.

8. A rotary hydrocarbon engine including in combination a fixed shaft having a crank, a casing rotating about said shaft, a plurality of radially disposed cylinders carried by said casing, a piston for each cylinder, a pitman connecting each piston to the crank, certain of said pistons having a vaporizing chamber formed therein separated from the expansion chamber of the cylinder by a thin plate, a partition for dividing said chamber, means for intermittently admitting liquid fuel to said chamber at one side of said partition whereby said fuel may be carried by centrifugal force against said thin plate, a fuel supply cham-

ber between the pavorizing chamber and the cylinders, and means for transferring the vaporized fuel from said vaporizing chamber to the fuel supply chamber.

9. A rotary hydrocarbon engine including in combination a fixed shaft having a crank, a casing rotating about said shaft, a plurality of radially disposed cylinders carried by said casing, a piston for each cylinder, a pitman connecting each piston to the crank, certain of said pistons having a vaporizing chamber formed therein separated from the expansion chamber of the cylinder by a thin plate, a partition for dividing said chamber, means for intermittently admitting liquid fuel to said chamber at one side of said partition whereby said fuel may be carried by centrifugal force against said thin plate, a fuel supply chamber between the vaporizing chamber and the cylinders, and means for passing a blast of air through the vaporizing chamber after the fuel therein has been vaporized for transferring the vaporized fuel to the fuel supply chamber.

10. A rotary hydrocarbon engine including in combination a fixed shaft having a crank, a casing mounted to rotate about the shaft, a plurality of radially disposed cylinders carried by the casing, a piston for each cylinder, a pitman connecting each piston with the crank, certain of said pistons having vaporizing chamber formed therein separated from the expansion chamber of the cylinder by a thin plate, means for supplying liquid fuel to said chamber and against said thin plate, means for forcing air through said vaporizing chamber for driving the vaporized fuel therefrom and means for utilizing the vaporized fuel and air for operating the engine, said piston having an air intake port at one side of said partition, pumping means connected to said intake port for intermittently supplying air thereto, an outlet port on the other side of said partition and means connecting said outlet port to the fuel supply chamber.

11. A rotary hydrocarbon engine including in combination a fixed shaft having a crank, a casing mounted to rotate about the shaft, a plurality of radially disposed cylinders carried by the casing, a piston for each cylinder, a pitman connecting each piston with the crank, certain of said pistons having vaporizing chambers formed therein separated from the expansion chamber of the cylinder by a thin plate, means for supplying liquid fuel to said chamber and against said thin plate, means for forcing air through said vaporizing chamber for driving the vaporized fuel therefrom and means for utilizing the vaporized fuel and air for operating the engine, said piston having an air intake port at one side of said partition, pumping means connected to said intake port for intermittently supplying air thereto, and outlet port on the other side of said partition and means connecting said outlet port to the fuel supply chamber, and means for utilizing the exhaust gases for heating the fuel supply chamber.

12. In a hydrocarbon engine including in combination a casing, a plurality of cylinders, a piston for each cylinder, a fuel supply chamber for supplying the chambers with a gasified fuel, a vaporizing chamber, means for intermittently admitting the liquid fuel to the vaporizing chamber, and means for intermittently passing a blast of air through said vaporizing chamber for conveying the vaporized fuel to the fuel supply chamber.

13. In a hydrocarbon engine including in combination a casing, a plurality of cylinders, a piston for each cylinder, a fuel supply chamber for supplying the chambers with a gasified fuel, a vaporizing chamber, means for intermittently admitting the liquid fuel to the vaporizing chamber, means for intermittently passing a blast of air through said vaporizing chamber for conveying the vaporized fuel to the fuel supply chamber, and means for utilizing the exhaust gases for heating the fuel supply chamber.

14. A rotary hydrocarbon engine including in combination a fixed shaft having a crank, a casing mounted to rotate about said shaft, a plurality of radially disposed cylinders carried by said casing, a piston for each cylinder, a pitman connecting each piston with the crank, a pump cylinder arranged in tandem with certain of said first named cylinders, a pump piston connected to and operated by the pitman for the piston of the cylinder, the piston of said cylinder having a vaporizing chamber formed therein, a liquid fuel supply passage, said piston having a port adapted to register with the passage to admit a charge of fuel, said piston having an air intake port and an air outlet port arranged whereby air may be forced by the pump piston through the vaporizing chamber for carrying the vaporized gases to the engine.

15. A rotary hydrocarbon engine including in combination a fixed shaft having a crank, a casing mounted to rotate about said shaft, a plurality of radially disposed cylinders carried by said casing, a piston for each cylinder, a pitman connecting each piston with the crank, a pump cylinder arranged in tandem with certain of said first named cylinders, a pump piston connected to and operated by the pitman for the piston of the cylinder, the piston of said cylinder having a vaporizing chamber formed therein, a liquid fuel supply passage, said piston having a port adapted to register

with the passage to admit a charge of fuel, a fuel supply chamber, and means whereby said pump piston may deliver air to the fuel supply chamber, a portion of said air passing through the vaporizing chamber for conveying the vaporized fuel gases to said fuel supply chamber.

16. A rotary hydrocarbon engine including in combination, a casing, a fixed shaft having a crank formed therein, a plurality of radially disposed cylinders carried by said casing, a piston for each cylinder, a pitman connecting each piston with the crank, a plurality of pump cylinders arranged in tandem with certain of said first named cylinders, a pump piston arranged in tandem with the piston for said cylinders and operating therewith, said casing having partitions forming an air chamber about the crank in the shaft, and a fuel supply chamber surrounding the air chamber, means whereby certain of said pump cylinders may deliver air to the air chamber, means for vaporizing a liquid fuel and means for transferring said vaporized liquid fuel and air to the fuel supply chamber, means for admitting air from the air chamber to the cylinders, and means for admitting the vaporized fuel and air to the fuel supply chamber of each cylinder.

17. A rotary gas engine including in combination a fixed shaft, a casing rotating about said shaft, a plurality of radially disposed pairs of cylinders one cylinder of each pair having air intake ports and fuel intake ports controlled by the piston of the cylinder, the other cylinder of each pair having exhaust ports controlled by the piston of said cylinder, a pump cylinder arranged in tandem with each cylinder having exhaust ports, a pump piston connected to and moving with the piston for the cylinder having the exhaust ports, each of said last named cylinders having chambers formed therein, means for admitting liquid fuel to certain of said chambers whereby it may be vaporized by the heat from the cylinders, a fuel supply chamber, means whereby air may be delivered by the pumps associated with the pistons receiving the liquid fuel to the fuel supply chamber, and a portion of said air passed through a vaporizing chamber for forcing the vaporized fuel gases to the fuel supply chamber, and means for connecting the fuel intake ports to the fuel supply chamber.

18. A rotary gas engine including in combination a fixed shaft, a casing rotating about said shaft, a plurality of radially disposed pairs of cylinders one cylinder of each pair having air intake ports and fuel intake ports controlled by the piston of the cylinder, the other cylinder of each pair having exhaust ports controlled by the piston of said cylinder, a pump cylinder arranged in tandem with each cylinder having exhaust ports, a pump piston connected to and moving with the piston for the cylinder having the exhaust ports, each of said last named cylinders having chambers formed therein, means for admitting liquid fuel to certain of said chambers whereby it may be vaporized by the heat from the cylinders, a fuel supply chamber, means whereby air may be delivered by the pumps associated with the pistons receiving the liquid fuel to the fuel supply chamber, and a portion of said air passed through a vaporizing chamber for forcing the vaporized fuel gases to the fuel supply chamber, means for connecting the fuel intake ports to the fuel supply chamber, said casing having an air chamber about the shaft means whereby the other pump cylinders deliver air to the air chamber, and means for connecting the air intake ports with said air chamber.

19. A rotary gas engine including in combination a fixed shaft, a casing rotating about said shaft, a plurality of radially disposed pairs of cylinders one cylinder of each pair having air intake ports and fuel intake ports controlled by the piston of the cylinder, the other cylinder of each pair having exhaust ports controlled by the piston of said cylinder, a pump cylinder arranged in tandem with each cylinder having exhaust ports, a pump piston connected to and moving with the piston for the cylinder having the exhaust ports, each of said last named cylinders having chambers formed therein, means for admitting liquid fuel to certain of said chambers whereby it may be vaporized by the heat from the cylinders, a fuel supply chamber, means whereby air may be delivered by the pumps associated with the pistons receiving the liquid fuel to the fuel supply chamber, and a portion of said air passed through a vaporizing chamber for forcing the vaporized fuel gases to the fuel supply chamber, means for connecting the fuel intake ports to the fuel supply chamber, said casing having an air chamber about the shaft means whereby the other pump cylinders deliver air to the air chamber, and means for connecting the air intake ports with said air chamber, said air intake ports being arranged between the fuel intake ports and so proportioned as to admit air to the cylinder prior to and during the admission of the fuel.

20. A rotary hydrocarbon engine including in combination a fixed shaft having a chamber extending longitudinally therethrough to the inner end thereof, a crank formed in said shaft, a casing rotating about said crank, a plurality of radially disposed cylinders carried by said casing, a vaporizing chamber associated with certain of said

cylinders for receiving and vaporizing liquid fuel by the heat in the combustion chamber, an oil pipe extending through the chamber in said shaft to the inner end thereof, a fuel chamber in the casing receiving the fuel from said pipe, radially extending pipes connecting said fuel chamber with each of said vaporizing chambers whereby the centrifugal force acting on the liquid fuel will convey the same from the fuel chamber to the vaporizing chambers.

21. A rotary engine including in combination a fixed shaft, a casing mounted to rotate about said shaft and having a projecting shaft mounted in a bearing for supporting one side of said casing, a plurality of radially disposed cylinders carried by the casing, said shaft rotating with the casing having a chamber formed therein extending through the bearing, passages leading to the chamber at each side of the bearing, ignition wires extending through said passage and through said chamber and radially along the casing to the cylinder.

In testimony whereof I affix my signature.

BENJAMIN F. AUGUSTINE.