J. Z. SAVOIE.

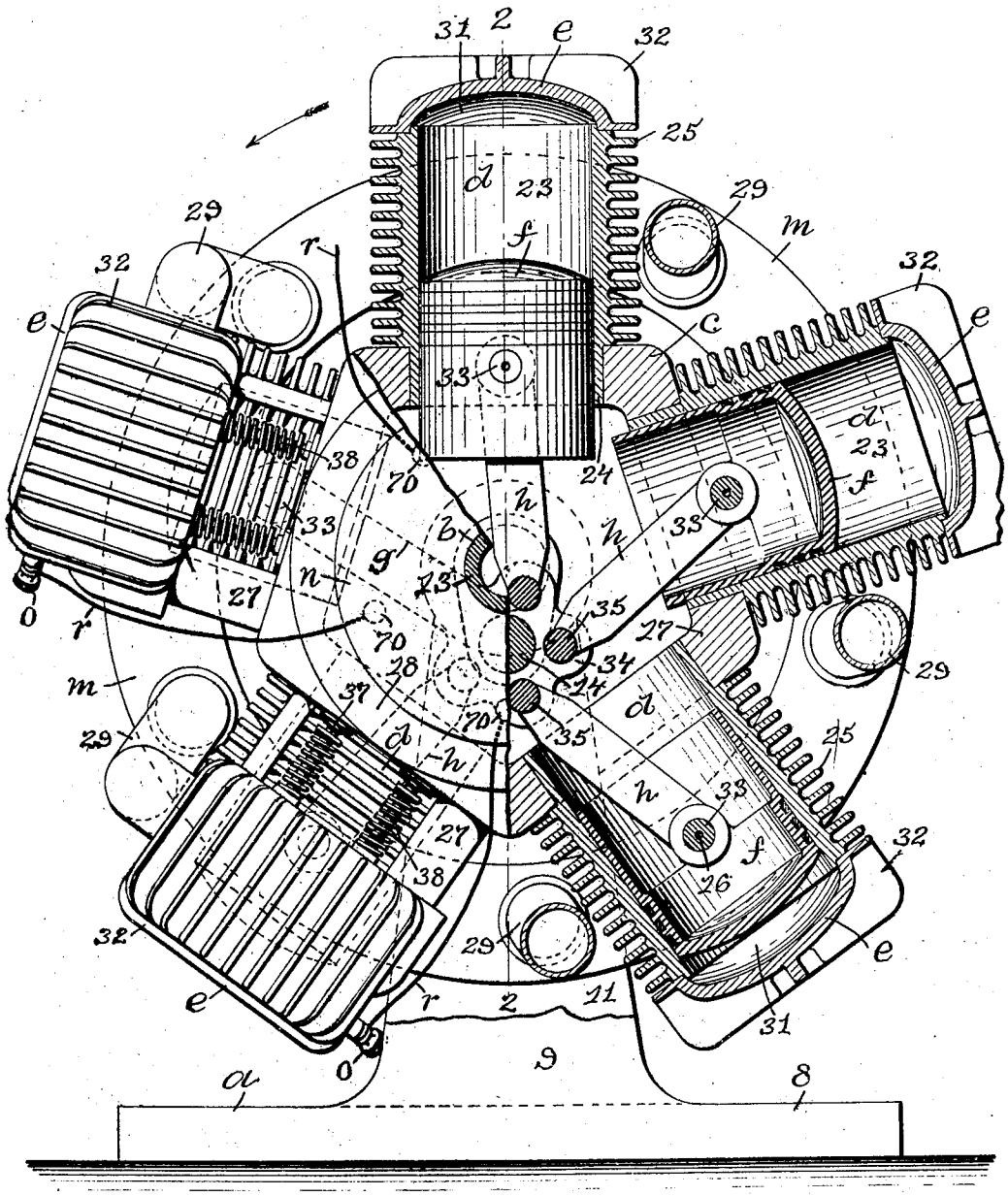
ENGINE.

APPLICATION FILED JAN. 16, 1908.

981,316. Patented Jan. 10, 1911.

3 SHEETS—SHEET 1.

Fig. 1.



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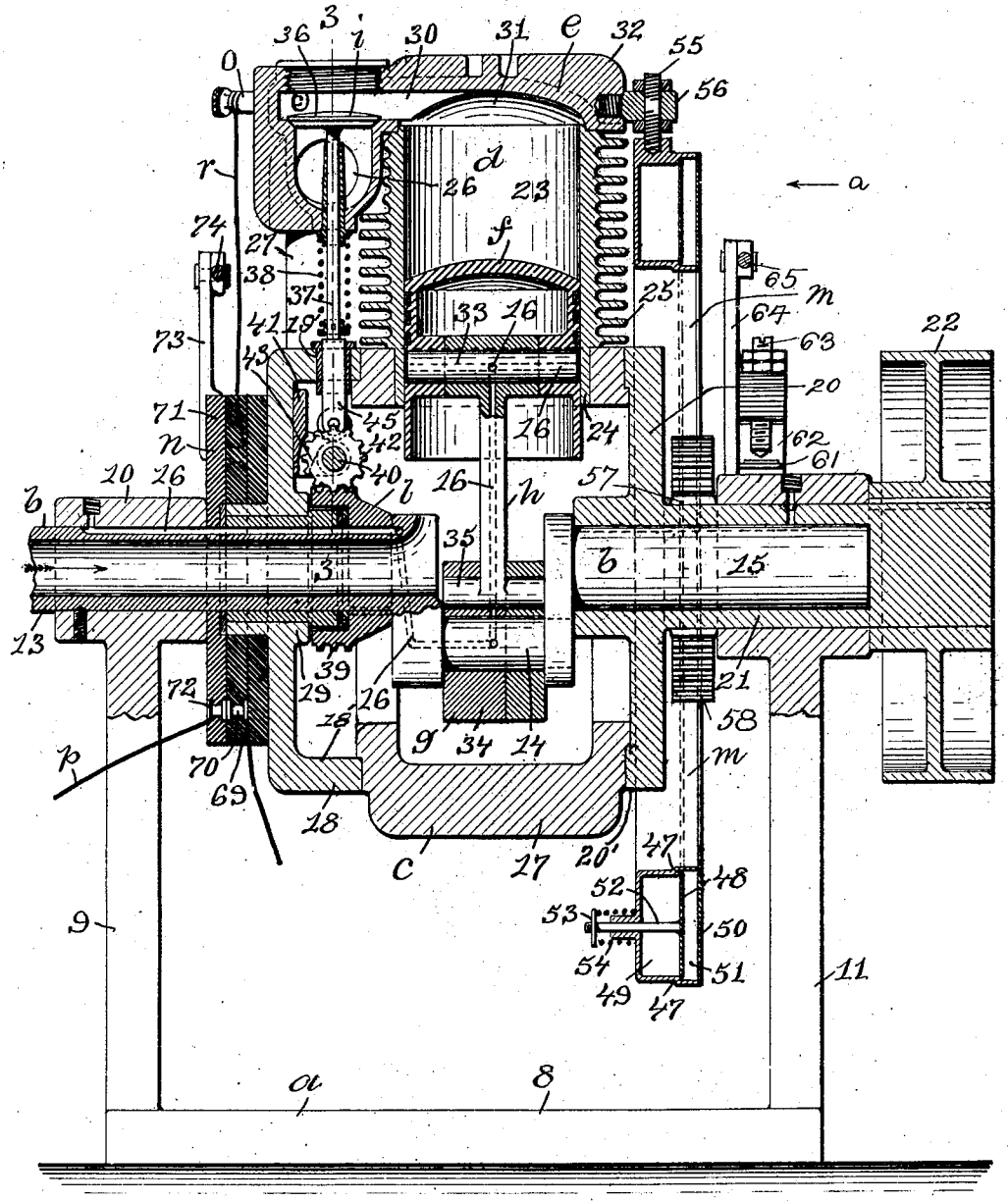
3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 3.

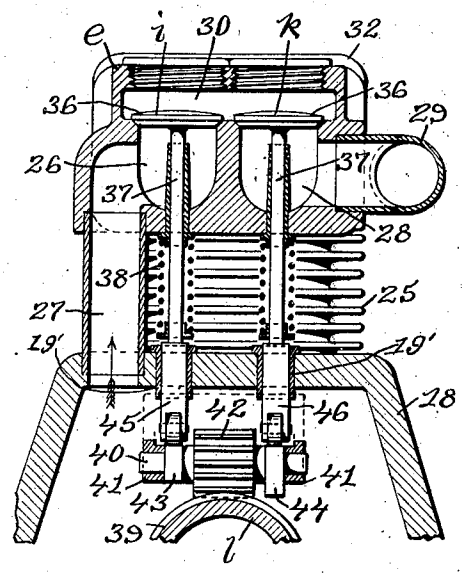


Fig. 4.

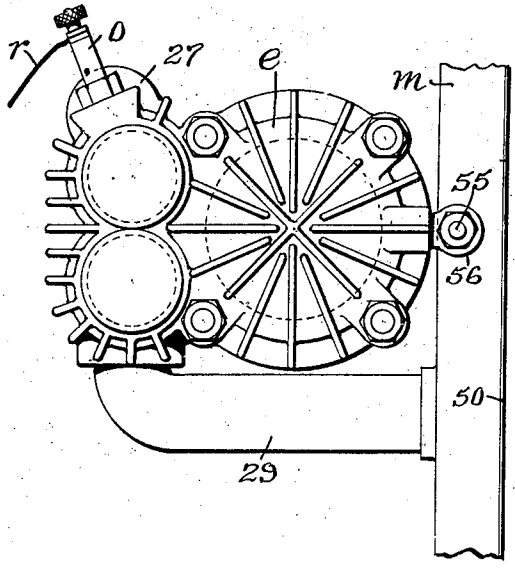


Fig. 5.

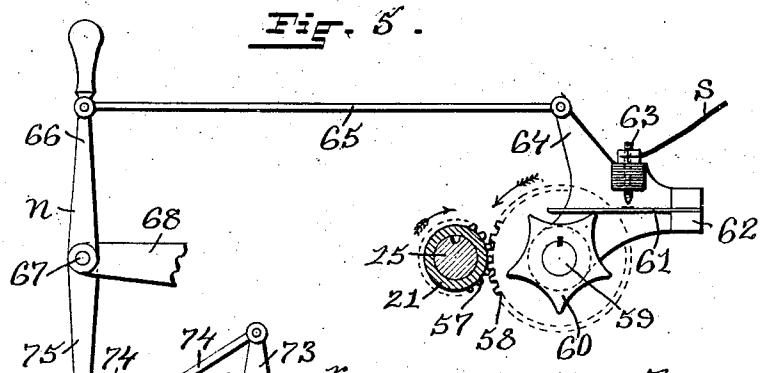
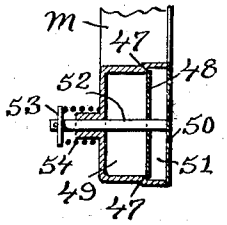


Fig. 6.

Fig. 7.



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UNITED STATES PATENT OFFICE.

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ENGINE.

981,316. Specification of Letters Patent. Patented Jan. 10, 1911.

Application filed January 16, 1908. Serial No. 411,080.

To all whom it may concern:

Be it known that I, JOSEPH Z. SAVOIE, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented a new and useful Improvement in Engines, of which the following is a specification.

This invention has reference to an improvement in gas engines and more particularly to an improvement in rotary gas engines.

The object of my invention is to improve the construction of a four cycle air cooled rotary gas engine, whereby a plurality of air cooled cylinders revolve around a fixed crank shaft.

Further objects of my invention are to increase the power, reduce the vibration, lessen the weight, and simplify the construction of an air cooled four cycle rotary gas engine having a plurality of air cooled cylinders adapted to revolve around a fixed crank shaft.

A still further object of my invention is to reduce the cost of manufacturing rotary gas engines having a plurality of air cooled cylinders.

My invention consists in the peculiar and novel construction of an air cooled rotary gas engine, said rotary gas engine having details of construction, as will be more fully set forth hereinafter and claimed.

Figure 1 is a vertical view partly in section looking at the valve side of the engine. Fig. 2 is a vertical sectional view taken approximately on line 2 2 of Fig. 1, showing more fully the construction of the engine. Fig. 3 is a detail vertical sectional view taken on line 3 3 of Fig. 2 through the valves. Fig. 4 is a detail end view of one of the air cooled cylinders, showing the exhaust pipe connection with the circular muffler and the location of the spark plug. Fig. 5 is a detail side view of the sparking mechanism, showing the timer and the means for operating the same. Fig. 6 is a detail side view of the distributer forming a part of the sparking mechanism, and Fig. 7 is a detail transverse sectional view through the muffler.

In the drawings, *a* indicates the frame of my improved rotary gas engine, *b* the fixed crank shaft, *c* the engine casing, *d d* the air cooled cylinders, *e e* the cylinder heads, *f f* the pistons, *g* and *h h* the connecting rods, *i* the intake valve, *k* the exhaust valve, *l* the valve operating mechanism, *m* the circular muffler, *n* the sparking mechanism, *o o* the spark plugs, *p* a wire leading from the battery and spark coil (not shown) to the distributer in the sparking mechanism *n*, *r r* wires leading from the distributer to the spark plugs *o o*, and *s* the wire leading from the timer in the sparking mechanism to the battery.

The frame *a* may be of any shape or configuration. As shown in the drawings the frame *a* consists of a base 8 having the vertical support 9 at one end with the hub 10 and the vertical support 11 at the opposite end with the bearing 12, as shown in Fig. 2.

The fixed crank shaft *b* has the tubular end 13 extending through the hub 10 and forming the intake pipe for the engine, the central fixed crank 14 in the engine casing *c*, the solid end 15 extending into the bearing 12 and the oil duct 16 which extends first lengthwise on the top of the tubular end 13 from an oil hole in the hub 10 to the crank 14, as shown in Fig. 2. The tubular end 13 of the crank shaft is secured in the hub 10 in any well known way.

The engine casing *c* consists of a five sided hollow casting or peripheral collar 17 having a circular hole in each flat peripheral side for the cylinders *d d* and open ends closed by a plate 18 secured to the casting 17 and having a central bearing 19 rotatably supported on the tubular end 13 of the fixed crank shaft *b*, and a plate 20 secured to the casting 17 having the central tubular hub 21 rotatably supported on the solid end 15 of the crank shaft *b* and extending through the bearing 12. A driving pulley 22, or other means of transmitting power, is secured to or on the outer end of the tubular hub 21, as shown in Fig. 2. Said end closing plates 18 and 20 are provided with peripheral flanges 18′ and 20′ by means of which the plates are secured in suitable manner to the collar *c*. The flange on plate 18, which is on that side of the casting or collar *c* which carries the valve casings and gearing is formed of sufficient depth to provide a housing for the valve driving mechanism hereinafter described, and is provided with bushed apertures 19′ to permit the projection and operation therein of valve-stems 37.

The cylinders *d d* each have the cylindri-

cal bore 23 for the pistons *f f*, the reduced inner end 24 where they enter the circular holes in the periphery of the engine casing *c*, and the usual radial cooling flanges 25 25, as shown in Figs. 1 and 2.

The cylinder heads *e e* are each constructed to fit the outer ends of the cylinders *d d* and to have the intake port 26 controlled by the intake valve *i* and connected to the interior of the engine casing *c* by the intake pipe 27, the exhaust port 28 controlled by the exhaust valve *k* and connected to the muffler *m* by the exhaust pipe 29, the port 30 leading from the intake and exhaust ports 26 and 28 to the compression chamber 31 and the radial cooling flanges 32 32, as shown in Figs. 2, 3 and 4. The spark plug *o* extends into the port 30 above the intake valve *i*, as shown in Fig. 2. The pistons *f f* are of the usual form and have a sliding fit in the cylinders *d d*, as shown in Figs. 1 and 2.

The connecting rod *g* has its outer end pivotally secured to a piston *f* by a wrist pin 33 driven transversely through the piston and an enlarged inner end 34 rotatably secured to the crank 14. The connecting rods *h h* are pivotally secured at their outer ends to the pistons *f f* and are pivotally secured at their inner ends 35 35 to the enlarged inner end 34 of the connecting rod *g* in a circle at equal distances apart, as shown in Figs. 1 and 2. The oil duct 16 extends down through the crank 14 to the center of the crank where it separates into five oil ducts. Each oil duct 16 now extends lengthwise through a connecting rod into a wrist pin 33 and then out through each end of the wrist pin, as shown in full and broken lines in Fig. 2, thereby lubricating the crank 14, the inner and outer ends of the connecting rods *g* and *h h*, and the pistons *f f* in the cylinders *d d*.

The intake and exhaust valves *i* and *k* are interchangeable and each has the usual head 36, the stem 37, which extends through its corresponding bushed aperture 19′ in said flange 18′ of plate 18, and the coiled spring 38 for holding the valves in their closed or normal positions, as shown in Figs. 2 and 3.

The valve operating mechanism *l* consists of a worm 39 secured from rotating on the tubular end 13 of the crank shaft *b* in the casing *c*, a cam shaft 40 for each set of valves and rotatably secured in bearings 41 41 to the inner face of the plate 18 in a transverse position to the crank shaft *b*. Each cam shaft 40 has a worm gear 42 meshing with the fixed worm 39, an intake cam 43 and an exhaust cam 44. The slides 45 and 46 are reciprocally supported in the periphery of the plate 18 in a position for the intake cam 43 to engage with a roll on the inner end of the slide 45 and for the outer end of the slide 45 to engage with the end of the stem of the intake valve *i* and for the exhaust cam 44 to engage with a roll on the inner end of the slide 46 and for the outer end of the slide 46 to engage with the end of the stem of the exhaust valve *k*, as shown in Fig. 3.

The circular muffler *m* is in the form of an annular trough having inlet openings for the exhaust pipes 29 29, the internal annular ledges 47 47, a circular plate 48 in the form of a flat ring adapted to loosely fit in the trough on the annular ledges 47 47 and forming an inclosed circular chamber 49, a circular plate 50 in the form of a flat ring adapted to close the open face of the muffler and forming a circular chamber 51, a series of stems 52 52 secured at their inner ends to the backs of the circular plates 48 and 50 and extending through holes in the back of the muffler, (the stems 52 52 on the plate 50 extending through holes in the plate 47) each stem 52 having a washer 53 secured on its end and a coiled spring 54 intermediate the washer and the back of the muffler, whereby the circular plates 48 and 50 are held in their closed or normal positions under spring tension, as shown in Figs. 2 and 7. The muffler is adjustably secured to the cylinder heads *e e* by the bolts 55 and 56, as shown in Fig. 2, and revolves with the engine.

The sparking mechanism *n* comprises a gear 57 secured to or forming a part of the tubular hub 21 and meshing with a gear 58 of twice its diameter on a shaft 59 rotatably supported in bearings (not shown) on the support 11, a five pointed star cam 60 secured on the shaft 59 in a position to engage with a contact spring 61 supported at one end in a frame 62 pivotally supported on the shaft 59 and having the insulated contact screw 63 to which the battery wire *s* is connected and an arm 64, and a rod 65 pivotally connected to the arm 64 and to a hand lever 66 secured to a transverse shaft 67 supported in brackets 68 68 on the vertical supports 9 and 11. A circular insulating plate 69 is secured to the end plate 18 of the engine casing *c* and revolves with the engine. This plate 69 has a series of five insulated contact points 70 70 in a circle at equal distances apart and each contact point 70 is electrically connected to a spark plug *o* by a wire *r*. A circular insulating plate 71 is rotatably supported on the tubular end 13 of the crank shaft *b* and constructed to have an insulated contact point 72 in a position to engage in succession with the contact points 70 70 on the plate 69 and an arm 73 pivotally connected to a rod 74 which in turn is pivotally connected to an arm 75 secured to the transverse shaft 67, as shown in Figs. 2, 5 and 6. The contact point 72 is electrically connected to the spark coil of the battery (not shown) by the wire *p*. By this construction the star

cam 60 in the timer is given one-half a revolution for one revolution of the engine, and the plate 71 of the distributer is moved when required in unison with the frame 62 of the timer, whereby the contact point 72 in the distributer is always in a position to form an electrical contact with one of the contact points 70 in the plate 69 of the distributer, when the contact spring 61 of the timer is forced by the cam 60 into contact with the contact screw 63. By moving the hand lever 66 toward the engine the spark is advanced and by a reverse movement of the lever 66 the spark is retarded.

In the operation of my improved four cycle rotary gas engine the tubular end 13 of the fixed crank shaft *b* is connected to a carbureter or source of gas supply (not shown) and the wires *p* and *s* electrically connected to a spark coil and battery (not shown). Starting with a cylinder in the lowest position, the intake valve *i* is opened by the valve operating mechanism *l* and the function of suction is performed in the first half revolution of the engine, the gas being drawn through the tubular end 13 of the crank shaft *b*, the engine casing *c*, the intake pipe 27, the intake port 26 and the port 30 into the cylinder, and the intake valve *i* closed. The gas is now compressed in the second half revolution and exploded when the cylinder has reached its approximately lowest position through and controlled by the sparking mechanism *n*. The engine is now driven in the direction of the arrow, as shown in Fig. 1, for the third half of a revolution or during the working stroke of the piston. On the fourth half of a revolution the exhaust valve *k* is opened by the valve operating mechanism *l* and by the time the cylinder has reached its lowest position the burned gases have been forced out through the exhaust port 28, the exhaust pipe 29 and the muffler *m*. The exhaust valve *k* is now closed. These operations are now repeated successively in each cylinder, an explosion taking place in every second cylinder as it reaches approximately its lowest point, or five explosion or working strokes for each two revolutions of the engine. The exhaust or burned gases first exhaust into the circular chamber 49 in the muffler *m* when the force of the exhaust moves the circular ring 48 outward against the tension of the coiled springs 54 54 and allows the burned gases to further exhaust into the circular chamber 51 when the force of the exhaust will move the circular plate 50 outward against the tension of the springs 54 54 and allow the exhaust to escape from the muffler, thereby silencing the exhaust.

I do not wish to confine myself to the number of cylinders shown, as it is evident that the engine may be constructed to have any number of cylinders, without materially affecting the spirit of my invention.

Having thus described my invention, I claim as new and desire to secure by Letters Patent;—

1. A rotary gas engine, comprising, in combination, a hollow fixed crank shaft, a crank casing rotatable on said shaft and communicating with said hollow crank shaft to form a fuel chamber, cylinders on said casing, pistons slidable in said cylinders and connected to said crank shaft, removable heads on said cylinders provided with offset valve chambers, fuel feeding conduits connected said fuel chamber and said valve chambers, valves operated within said valve chambers, and valve operating mechanism connected to said valves and actuated from said shaft, said casing consisting of a polygonal peripheral member having a cylinder on each face, and end plates seated on said peripheral member, the end plate on one side being offset to form a housing to contain the valve operating mechanism and through which the latter extends.

2. A rotary gas engine, comprising, in combination, a hollow fixed crank shaft, a crank casing rotatable on said shaft, and communicating with said hollow crank shaft to form a fuel chamber, cylinders on said casing, pistons slidable in said cylinders and connected to said crank shaft, removable heads on said cylinders provided with offset valve chambers having outlet and inlet valve openings, and an ignition chamber, and valves operative in said chambers. conduits forming feeding means between said casing and said inlet valve openings, and valve operating mechanism mounted on said shaft and casing, said casing being provided on one side with a dished side to form a housing for said valve operating mechanism, and said valve chambers being located opposite said housing to present the valve stems of the inlet and exhaust valves in juxtaposition to said valve operating mechanism.

3. A rotary gas engine, comprising, in combination, a hollow fixed crank shaft, a crank casing rotatable on said shaft and communicating with the latter to provide a fuel chamber, a plurality of cylinders seated and secured in apertures in said casing, pistons slidable in said cylinders and connected to said crank shaft, removable heads on said cylinders, valve casings formed on said heads at one side thereof, inlet and outlet valves carried by said casings, conduits for feeding fuel from the interior of said crank casing to said inlet valves, and means operative within said crank casing for reciprocating said valves, said crank casing comprising a polygonal peripheral collar, end plates having hollow

shaft bearings, and flanges on said end plates abutting said polygonal peripheral collar, the flange on said plate adjacent said valve casings being of substantial depth and provided with apertures, to permit the housing and the projection through said apertures of said valve operating mechanism.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOSEPH Z. SAVOIE.

Witnesses:
ADA E. HAGERTY,
J. A. MILLER.