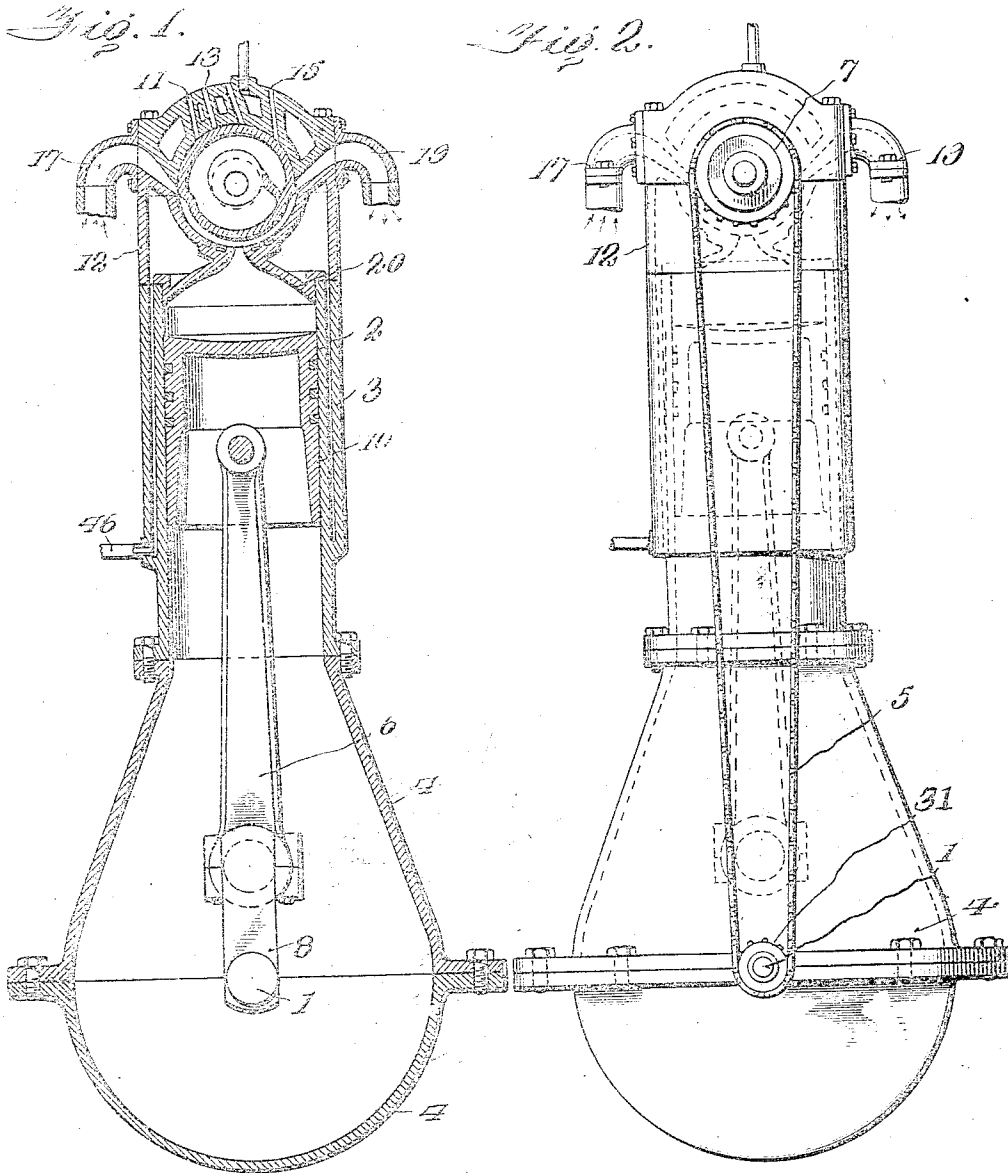


F. K. SHAFFER,
GAS ENGINE.
APPLICATION FILED MAY 20, 1912.

Patented Nov. 9, 1915.
4 SHEETS—SHEET 1.

1,160,113.



Witnesses

Helge H. Murray
Frederick W. Worn

33

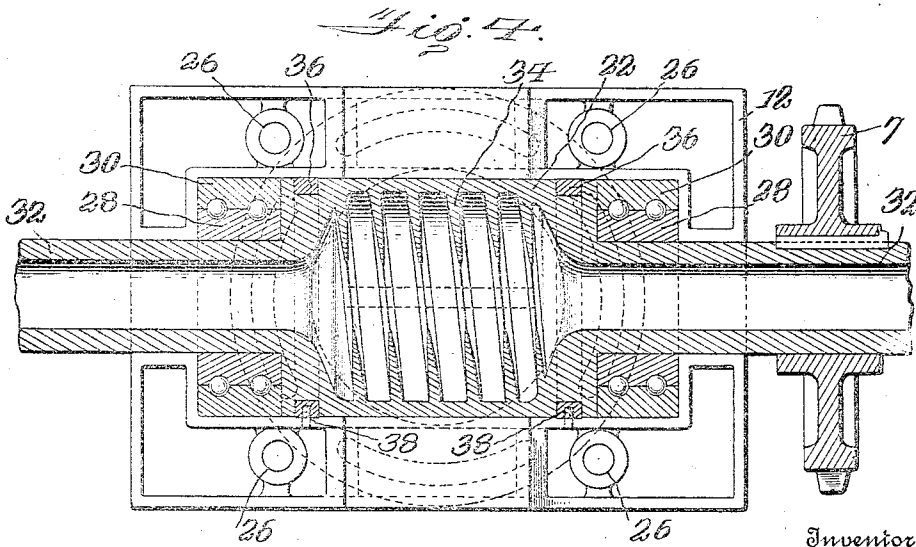
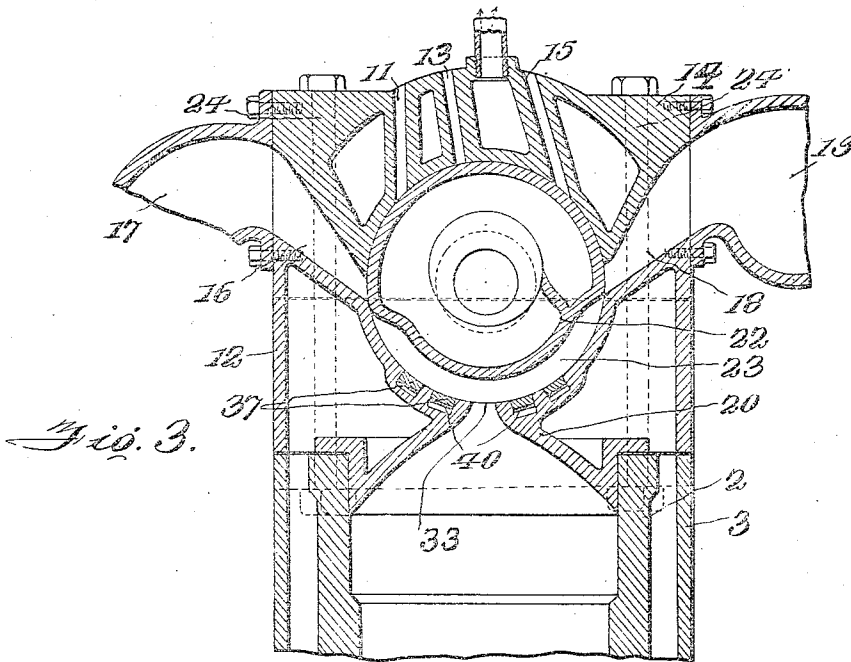
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4 SHEETS—SHEET 2.



Witnesses

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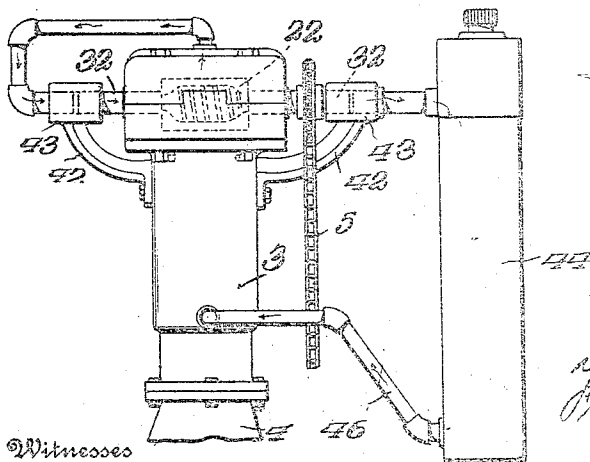
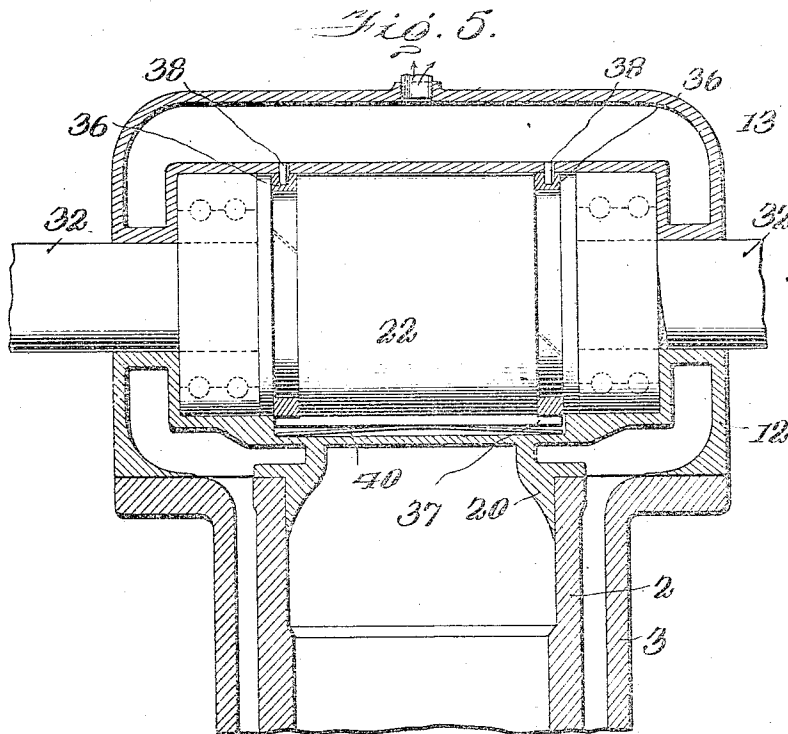
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4 SHEETS—SHEET 3.



Witnesses

Helge W. Murray
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Fred K. Shaffer Inventor

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C. A. Mason

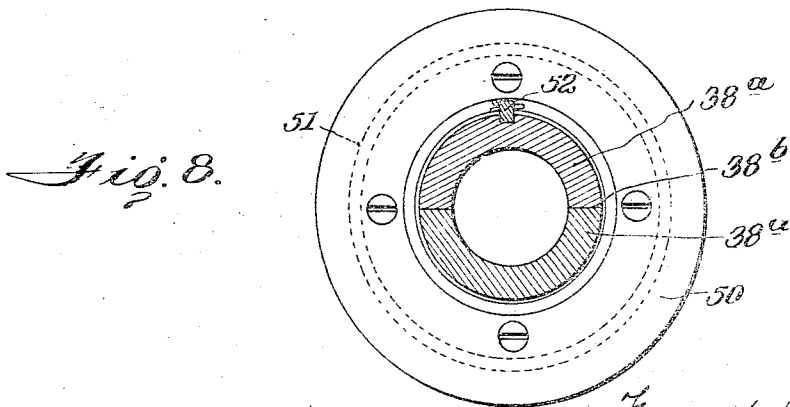
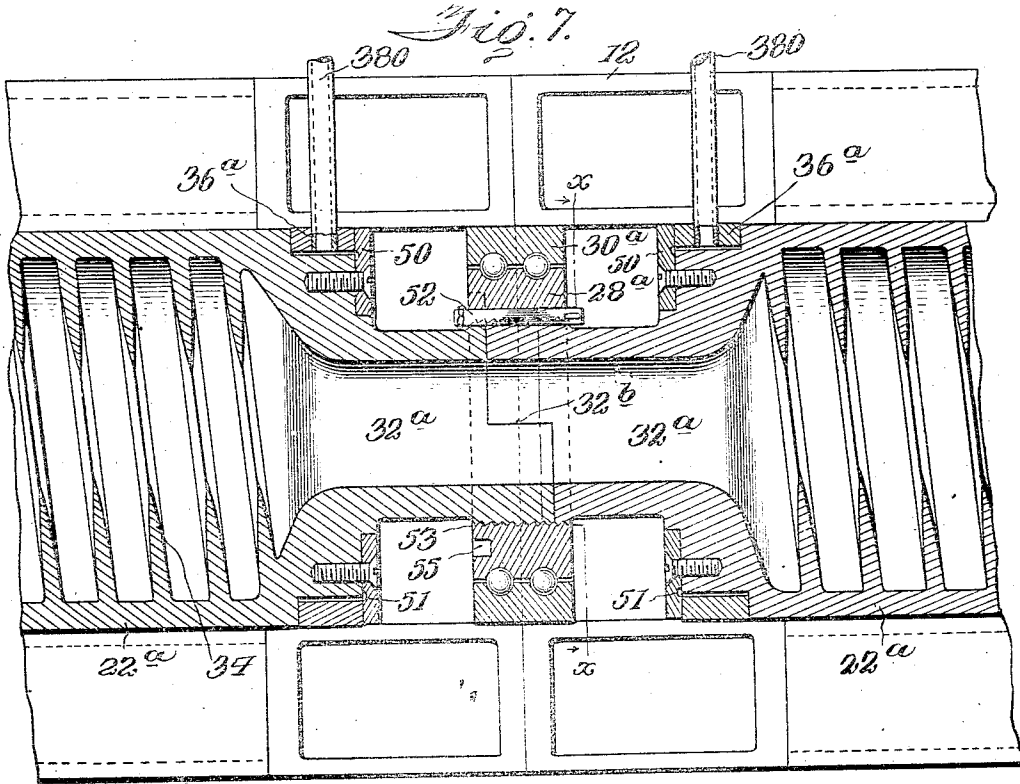
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F. K. SHAFFER.
GAS ENGINE.
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1,160,113.

Patented Nov. 9, 1915.

4 SHEETS—SHEET 4.



Witnesses

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UNITED STATES PATENT OFFICE.

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GAS-ENGINE.

1,160,113.

Specification of Letters Patent.

Patented Nov. 9, 1915.

Application filed May 20, 1912. Serial No. 698,603.

To all whom it may concern:

Be it known that I, FRED K. SHAFFER, a citizen of the United States, residing at Sedalia, in the county of Pettis and State of Missouri, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

This invention relates to gas engines, preferably of the internal combustion type, and more particularly the invention relates to an improved valve mechanism for such engines. Some of the features of the valve mechanism are also of more general utility, and may be employed with other engines than those above referred to.

One of the objects of the invention is to provide in connection with a rotary valve for gas and other engines, an improved construction and arrangement whereby the fuel gas is economically used and conserved, by preventing the gas from being drawn from the carbureter or other supply by the partial vacuum created by rotation of the valve, and its discharge into the exhaust passage.

Another object is to provide an improved construction of packing strips for a rotary or other similar valve whereby the losses due to leakage are reduced to a minimum.

Another object is to provide a valve of the type referred to which is also constructed to act as a circulating pump for the cooling liquid, thereby reducing the number of parts associated with the engine, and furnishing a reliable means to impel the circulating liquid during the operation of the engine.

Another object of the invention is to provide a simple and reliable means for coupling a series of rotary valves together for use in multiple cylinder engines.

With these, and other important objects in view, the invention consists in the construction and arrangement of parts hereinafter described and more particularly pointed out in the claims.

In the drawings Figure 1 shows in vertical section a gas engine embodying the present improvement; Fig. 2 is an end elevation thereof; Fig. 3 is a vertical section showing the upper portion of the cylinder, the valve casing and valve; Fig. 4 is a horizontal section through the valve and its casing; Fig. 5 is a vertical longitudinal sectional view of the valve casing, the valve being shown in elevation; Fig. 6 is a view showing an en-

gine, radiator and circulating connections 55 showing the manner of application of the combined valve and pump; Fig. 7 is an enlarged longitudinal section illustrating the mode of connecting two or more valves and also showing a slight modification of the 60 packing means; and Fig. 8 is a sectional view on the line *x-x*, Fig. 7.

The numeral 2 indicates the cylinder of a gas engine which is bolted to a two-part crank case 4 which sustains bearings for the 65 main shaft 1 having connection through the usual crank 8 and pitman 6 with the piston 10. The cylinder 2 is surrounded by a water jacket 3 and a valve casing, which is herein shown as composed of two sections, 12, 14, 70 rests upon the upper end of the cylinder 2 to which latter it may be secured by the bolts 24, or in any other usual or convenient manner.

The valve casing is shown as provided at 75 its central, lower portion, with a downwardly extending spherical-shaped head 20 which is provided with a circular flange to rest upon the upper end of the cylinder 2, as shown best in Figs. 1, 3 and 5. The valve 80 casing is provided with a cylindrical recess within which the rotary valve 22 is fitted. The valve is provided with reduced tubular extensions 32, and, as shown in Fig. 4, rings 30 are clamped between and carried by the 85 two-part casing 12, 14, while rings 28 are secured to the tubular extensions 32 of the valve to rotate therewith, said rings being grooved to form raceways for anti-friction balls, and constituting ball bearings upon 90 which the valve rotates. At suitable points near the outer ends of the valve, annular grooves are provided to receive the packing rings 36, which are immovably secured to the two-part valve casing by dowel pins 38, 95 as shown in Figs. 4 and 5, or other suitable means to hold the packing rings against rotation with the valve. The packing rings 36 may be in one piece, with their ends divided by diagonal cuts as indicated by 100 dotted lines in Fig. 5, or they may be composed of any desired number of parts, or joined in any suitable manner. This arrangement provides that when the two-part valve casing is tightly clamped together, 105 and the pins 38 enter the recesses in the rings 36 a gas tight joint is formed between the interior circumference of the valve cas-

ing and the periphery of the packing rings, so that in order for the gas to escape around the rings it must travel along the lines of forming contact between the valve and rings, which is represented by the inner surface, and two side walls of the rings. It is proposed to introduce a suitable lubricant, as for example graphite and oil in the proper proportions, between the recesses in the valve and the walls of the packing rings which will not only tend to reduce friction, but will also aid in securing a gas tight joint between the valve and ring. The lower section of the valve casing is also provided with a series of grooves which are arranged transversely of the packing rings 36 and in which are mounted packing strips 37, and springs 40, shown as having their ends resting upon the outer walls of the recesses and their centers bearing against the strips 37, normally act to yieldingly press these strips against the valve. The ends of the strips 37 are shown, see Fig. 5, as slightly recessed at points where they lap over and engage the outer faces of the rings 36. These recesses provide for a certain amount of play between the ends of the strips and the packing rings in order to compensate for reduction of metal due to the wear on the valve and strips.

The valve is provided with a long port 23, as shown in Figs. 1 and 3 which is in length slightly less than 180° of the circumference of the valve. The inlet passage 16 in the casing is extended downwardly and inwardly at an inclination, and this passage communicates with the gas supply pipe 17 which is provided with an abrupt bend downwardly from the upper wall of the passage 16, as shown in Figs. 1 and 3. The exhaust passage 18 is likewise formed upon an inclination as shown, and has communication with an exhaust pipe 19, which latter is preferably flared or enlarged, as compared with the gas supply pipe, to admit of a free ventage of the burnt gases. At suitable points above, and beyond the inlet passage 16 are formed the vent passages 11, 13 and an additional vent passage 15 may be provided between the passage 13 and the exhaust passage 18. The purpose of these several passages will be explained hereinafter.

The valve recess 23 is so arranged and proportioned relatively to the inlet and exhaust ports which are located, respectively, at the inner ends of the passages 16 and 18, and the rotation of the valve is so timed relatively to the position of the crank that as the valve rotates in a clockwise direction it will, starting with the parts in the position shown in Figs. 1 and 3, first establish communication between the inlet port and the cylinder as the piston moves outwardly. Upon completion of the outward stroke, and upon movement of the piston inwardly for

compression the valve will have reached a position to cut off the port leading into the cylinder from the base 20 until the compression stroke is completed. Upon the ignition of the compressed charge the piston will again move outwardly to complete the working stroke, during which time also the port at the top of the cylinder will remain closed. Upon the next inward movement of the piston the port 23 will have reached a point to establish communication between the cylinder port 33 and the exhaust port at the end of passage 18, and thus permit the escape of the burnt gases. In connection with the operation of the valve the construction and arrangement of the inlet and exhaust passages 16 and 18, and also the arrangement of the pipe 17, are important. It is well known that the efficiency of engines of this type is materially increased if the gases are conducted into and out of the cylinder with as little deflection as possible, and that where the gas, particularly from the carbureter, flows through tortuous passages, or around abrupt bends, the efficiency of the engine is materially reduced. In order, therefore, to obtain the highest efficiency possible through a correct designing of the passages for the gases, the walls of the inlet passage 16 are so arranged as to direct the gas in practically a straight line downwardly into the port leading to the upper end of the cylinder when the valve 22 has moved to the position for uncovering the inlet port. This occurs immediately after the valve has moved from the position shown in Figs. 1 and 3 of the drawings. The direction in which the spent gas flows from the cylinder into the exhaust passage 18 is also in practically a straight, unbroken line, by reason of the formation of the walls of the passage 18 relative to the valve port 23, and the port at the top of the cylinder. When the valve has reached a point where the port 23 establishes communication between the cylinder and the exhaust ports, the gases are discharged in practically a straight, unbroken line through these ports and passages, to the exhaust pipe 19. The above features I regard as highly important in engines of this type.

In a rotary valve of the type herein illustrated, there is a tendency, as the valve rotates past the inlet port, to force the gas backwardly into the carbureter, or other source of supply, and when the valve has reached the point to cut off communication with the cylinder, upon further rotation a partial vacuum is created which tends to draw the gases from the supply and discharge them at a later period into the exhaust pipe. In order to prevent these undesirable results, I have formed the supply pipe 17, as shown in Figs. 1 and 3, with an abrupt bend, or gooseneck which acts as a

trap or pocket for the gas and prevents it from being forced over into the exhaust. When the valve is rotated sufficiently to cover the cylinder port, shortly after the leading end of the valve port 23 passes the inlet gas port, communication with the atmosphere is established through the vent pipes 11 and 13, which progressively breaks the partial vacuum caused by the rapid rotation of the valve. By these means great economy in the fuel consumption of the engine is secured in that it has been found that valves of this type have a tendency to draw the fuel gas out of the supply pipe and discharge it into the exhaust pipe during the compression and working strokes of the engine.

A passage 15 which is located beyond the passage 13, is designed to establish communication between a suitable source of air pressure and the exhaust port in the valve casing immediately before the cylinder port of the engine is open to exhaust. By using a suitable controlling valve for the passage 15 an induced draft of air may be supplied, through a suitable timing device, to increase the velocity of the burnt gases through the exhaust passage, and thereby add to the efficiency of the engine. It will be understood that if a valve is used with a suitable timing device for the control of the induced draft through the passage 15, that such valve will be opened at the proper times in the cycle of the engine to admit air under pressure to the exhaust passage before the latter is in communication with the outlet port 23 at the end of the cylinder.

As shown in Fig. 4, the valve 22 is hollow and is provided interiorly with spiral ribs 34, of any desirable form or construction, which adapts the valve to act as a screw pump for the cooling liquid. As shown in Fig. 3 the longitudinal opening through the center of the spiral ribs 34 is eccentric to the axis of the valve 22. This form is preferable, as the depression of the valve shell caused by the valve port would result in a reduction of the width of the flange on one side of the valve if the longitudinal opening through the flange was concentric with the longitudinal opening through the valve. The tubular extensions 32, see Fig. 6, have connection through a running joint, with bearings 43 which are carried by brackets 42 sustained from the water jacket 3. One of the bearings 43 may have connection with the radiator 44, which in turn has communication through a pipe 46 with the circulating space inclosed by the water jacket 3, as shown in Figs. 1 and 6. The opposite bearing 43 also has connection, through a suitable pipe or conduit, with the upper portion of the water jacket of the valve casing, as shown. The valve may be rotated by any suitable mechanism, but as herein shown

movement is imparted to it through suitable sprockets 31, 7, which are carried by the shaft 1 and one of the tubular extensions 32, respectively, and a chain 5, the gearing being in the ratio of two to one. When the valve is rotated through the described connections it serves not only to control the admission of fuel to the engine, and the exhaust of the burnt gases in the usual manner of valves of this type, but also through the spiral flange 34 it acts to cause a circulation of the cooling liquid through the jackets of the cylinder and valve casing, and the radiator. By this construction also the liquid which is circulated by and through the valve acts to cool the latter, the spiral flange contributing to this result as it serves to conduct the heat which the valve receives from the combustion chamber opposite the recess 23 to the interior of the valve, opposite the inlet and exhaust ports, where such heat is radiated to the cooling liquid. It is also a most important fact that the cool water being heavier, will be thrown by centrifugal force outward, thereby keeping a layer or stratum of cool water next the valve shell, while the water of higher temperature will tend to remain at the center and be forced by the pump to the radiator to be cooled. These results aid materially in reducing the tendency of the rotary valve to become overheated.

Referring to Figs. 7 and 8, which show a construction to be employed in connection with multiple cylinder engines, a series of valves of the type above described have tubular extensions 32^a whose adjacent extremities are formed with shoulders 32^b which overlap and snugly fit together in the manner shown in Fig. 7. The peripheries of the inner portions of the extensions 32^a are enlarged and provided with screw threads 53 upon which an interiorly threaded ring 28^a is mounted. Suitable means to prevent rotation of this ring on the threads 53 when the parts are assembled is provided, which may consist of a key pin 52 which is driven into a recess formed partly through the threads on the extensions 32^a, and the female thread in the ring 28^a, said pin being suitably secured in position by cotter pins, or other means. The rings 28^a and 30^a have formed in their adjacent surfaces ball raceways to receive anti-friction balls, and constitute therewith a ball bearing, it being understood that the ring 30^a is firmly clamped between the inner walls of the valve casing when the parts are assembled. The inner faces of the adjacent valves 22^a, 22^b, are provided with shoulders to receive rings 50, and recesses in the ends of the valves inclose packing rings 36^a which latter are substantially like the rings 36 shown in Fig. 5. The rings 50 are shown as being secured in position by screws which are threaded suit-

ably in the ends of the valves. Preferably, dowels in the form of hollow steel pins 380 extend through the walls of the valve casing and at their inner ends enter holes in the rings 36^a, to hold these rings against rotation. The rings 50 are shown as provided with circular grooves 51, whereby the outer portions of the rings are permitted to yield slightly, and said rings thus form yielding clamps to maintain a tight fit with the edges of the packing rings 36^a. The hollow pins 380 serve to conduct a suitable lubricant as graphite mixed with a proper proportion of oil, to the spaces between the bearing portions of the rings, and the inner walls of the valve recesses which receive the rings, as well as between the surfaces of the packing rings and the adjacent surfaces of the retaining rings 50.

It is believed that from the above description of the construction of the several parts, their mode of operation and advantages will be readily understood.

The right is reserved to make such changes in the form, proportions, and relative arrangements of the parts as fall within the spirit of the following claims.

Having thus described my invention, what I claim as new and desire to secure by Letter's Patent of the United States is:—

1. A gas engine having, in combination, a cylinder and piston, a valve casing having inlet, exhaust and cylinder ports, and a vent passage located between the inlet and exhaust ports, a rotary valve in the casing having a recess arranged to alternately establish communication between the cylinder and the inlet and exhaust ports, and to connect said passage with the inlet port when the cylinder port is closed, and thereby prevent drawing the fuel gas over into the exhaust port.

2. A gas engine having, in combination, a cylinder and piston, a valve casing having inlet, exhaust and cylinder ports, and a plurality of vent passages located between the inlet and exhaust ports, a rotary valve in the casing having a recess arranged to alternately establish communication between the cylinder and the inlet and exhaust ports, said valve port being arranged to successively connect said passages with the inlet port when the cylinder port is closed, to prevent the formation of a vacuum and the drawing of the fuel gas over into the exhaust port.

3. A gas engine having, in combination, a cylinder and piston, a valve casing mounted at one end of the cylinder and having a port in axial alinement with the cylinder, inlet and exhaust passages located respectively on opposite sides of the cylinder port and inclined downwardly and inwardly in directions to conduct the gases in straight lines toward and from the cylinder port,

and a rotary valve in said casing having an arc-shaped peripheral recess so arranged as to permit unobstructed flow of the gases between the said passages and the cylinder port.

4. A gas engine having, in combination, a cylinder and piston, a valve casing mounted at one end of the cylinder and having a port to communicate with the cylinder, an inlet passage located above and laterally of said port and inclined downwardly in a direction to conduct the gas in a straight line thereto, a supply pipe connected with said passage and having a lateral bend forming with said passage a trap to retard the backward flow of gas during the rotation of the valve, an exhaust passage, and a rotary valve in said casing to control said passages.

5. A gas engine having, in combination, a cylinder and piston, a valve casing mounted on the cylinder and having a port to communicate with the cylinder, an inlet passage located above and laterally of said port and inclined downwardly in a direction to conduct the gas in a straight line thereto, a supply pipe connected with said passage and having a lateral bend forming with said passage a trap to retard the backward flow of gas during the rotation of the valve, an exhaust passage, a vent passage located between said inlet and exhaust passages, and a rotary valve in said casing to control said passages.

6. In an engine of the type described, the combination with a valve casing, of a rotary valve therein having a port, and peripheral grooves on opposite sides of the port, packing rings in said grooves, and means on said casing to hold the rings against rotation with the valve.

7. In an engine of the class described, the combination with a valve casing, of a rotary valve therein having a port and rectangular peripheral grooves on opposite sides of said port, rectangular packing rings in said grooves having holes therein, and dowel pins carried by the casing and arranged to enter the holes and retain said rings against rotation.

8. In an engine of the type described, the combination with a valve casing having suitable passages, and a longitudinal groove therein, a packing strip in said groove, a rotary valve in said casing having a port and peripheral grooves on opposite sides of said port, packing rings in said grooves arranged transversely of said strip, means for securing said rings to the casing, and means to yieldingly hold said strip in engagement with the valve.

9. In an engine of the type described, the combination with a valve casing having inlet and exhaust passages, a cylinder port, and longitudinal grooves on opposite sides of said port, spring-pressed packing strips

in said grooves, a rotary valve in said casing having a port and peripheral grooves on opposite sides of said port, packing rings in said grooves arranged transversely of said strips, and means for securing said rings to the casing.

10. In an engine of the type described, the combination with a valve casing, of a plurality of rotary valves therein having tubular stems terminating in oppositely facing, interlocking shoulders formed by removing a semicircular section from the end of each stem, and means to detachably connect said stems.

11. In an engine of the type described, the combination with a valve casing, of a plurality of rotary valves therein having tubular stems terminating in oppositely facing, interlocking shoulders formed by removing a semicircular section from the end of each stem, and provided exteriorly with male threads, a coupling ring having a female thread to engage the adjacent threads on said stems, and locking means to prevent rotation of said ring on said stems.

12. In an engine of the type described, the combination with a two-part casing, of a plurality of rotary valves therein having stems terminating in oppositely facing interlocking shoulders and provided exteriorly with male threads, a coupling ring having a female thread to engage the adjacent threads on said stems, a ring surrounding said coupling ring, the adjacent faces of said rings having grooves to contain balls and constituting a ball bearing, and said outer ring being clamped between the members of said casing.

13. In an engine of the type described, the combination with a valve casing, of a plurality of rotary valves therein having connected stems, and peripheral recesses adjacent said stems, packing rings in said recesses having holes therein, and tubular pins fixed to the casing and fitting said holes whereby said pins hold the rings against rotation and provide for supplying a lubricant to the bearing surfaces between the rings and their recesses.

14. In an engine of the type described, the combination with a valve casing, of a plurality of rotary valves therein having connected stems, a ball bearing to support said stems at their point of connection, said valves having peripheral recesses adjacent their stems, packing rings in said recesses having holes therein and tubular pins fixed to the casing and fitting said holes to hold the rings against rotation and to also permit the introduction of a lubricant between the bearing surfaces of the rings and recesses.

15. In an engine of the class described, a valve casing, a plurality of rotary valves therein having connected stems and peripheral

recesses with open sides adjacent said stems, packing rings in said recesses, retaining rings secured to the valves and serving to close the open sides of the recesses, and means for securing the packing rings against rotation.

16. In an engine of the class described, a valve casing, a plurality of rotary valves therein having connected stems and peripheral recesses with open sides adjacent said stems, packing rings in said recesses, retaining rings having a yieldable portion to close said recesses and bear on said packing rings, and means for securing the packing rings against rotation.

17. In a gas engine, the combination of a cylinder, a piston, a valve casing having suitable inlet and exhaust ports, a rotary hollow valve to control said ports provided interiorly opposite said ports with a spiral flange whereby the valve may act also as a pump and the spiral flange radiate the heat from the valve shell inwardly, and suitable means to connect the interior of said valve with the source of cooling liquid and the engine.

18. In a gas engine, a rotary hollow valve having an exterior recess to control the admission of gas to the engine, and the exhaust therefrom, and having also an interior helical rib located opposite said recess and acting as a pump and also to radiate the heat inwardly, pipe connections between said pump and the cooling liquid supply, and between said pump and the engine, and means to rotate said valve.

19. In a gas engine, a hollow rotary valve having opposite tubular stems, and a port to control the admission of gas to the engine and its exhaust from the engine, a spiral flange in said valve located opposite said port, whereby the valve may act as a pump and said flange radiate the heat inwardly, and suitable pipe connections with said stems to conduct the cooling liquid through the valve.

20. In a multi-cylinder, internal combustion engine, the combination with one cylinder thereof, and a rotary valve having only one distributing chamber therein, of a valve casing having a gas admission port, a combustion chamber port connected with the cylinder, an exhaust port, and a scavenging port connected to the atmosphere controlled by the valve, said gas admission port and said scavenging port being adapted to be connected together by said chamber during a part of the time when said combustion chamber port is closed by the valve.

21. The combination of an engine cylinder having a port, a gas chamber and an exhaust, a rotating valve comprising a recessed body and means for clearing the valve recess of gas as it passes from the gas chamber to the exhaust.

22. In an internal combustion engine, the combination with a cylinder having a port, of a gas intake, an exhaust, a recessed valve member for controlling communication between intake, exhaust and cylinder, and means for preventing the delivery by the valve of gas to the exhaust.

In testimony whereof I affix my signature in presence of two witnesses.

FRED K. SHAFFER.

Witnesses:

W. E. SCHOENBORN,
H. P. ROBERTS.