C. P. BROCKWAY.

INTERNAL COMBUSTION ENGINE.

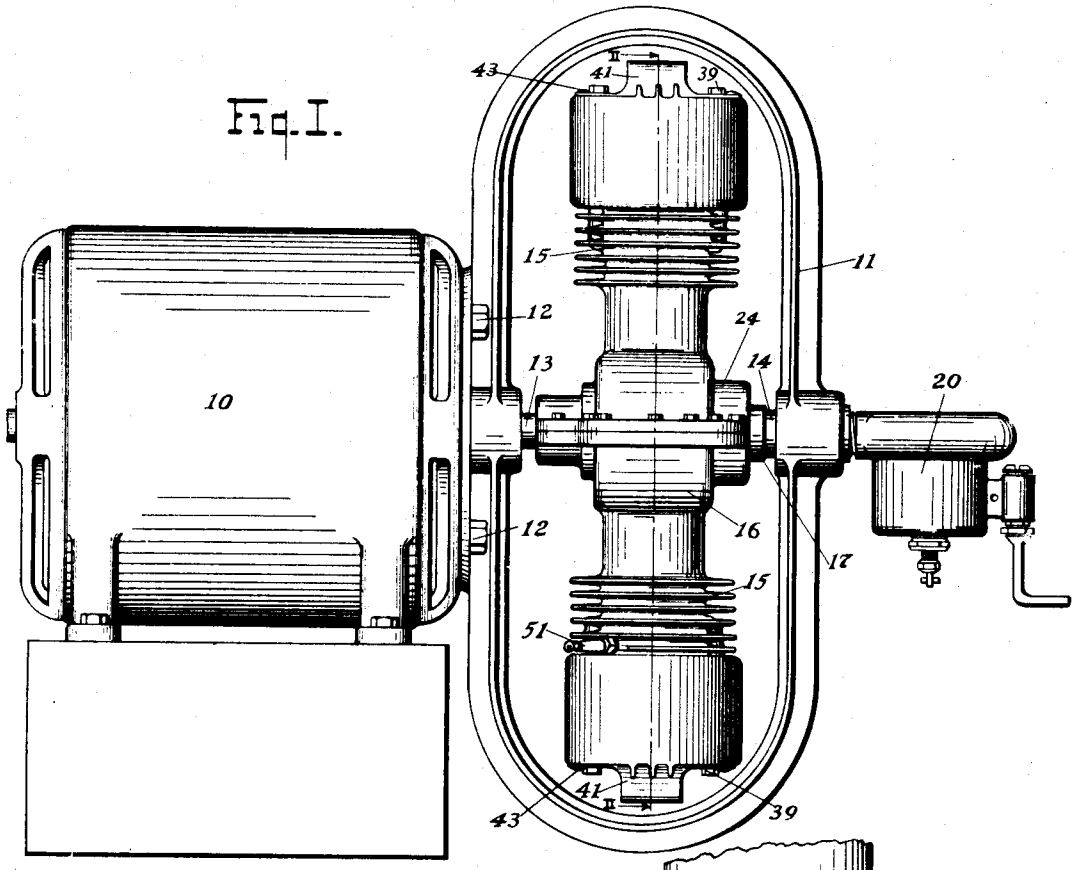
APPLICATION FILED APR. 8, 1919.

1,437,928.

Patented Dec. 5, 1922.

5 SHEETS—SHEET 1.

Fig. I.



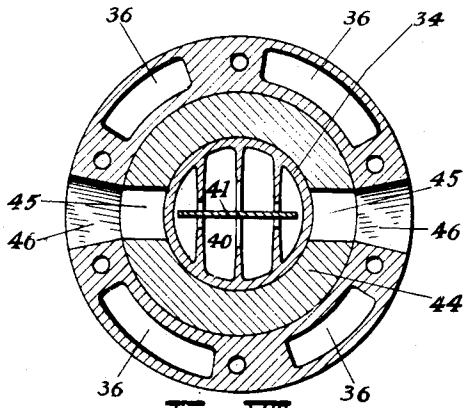


Fig. VIII.

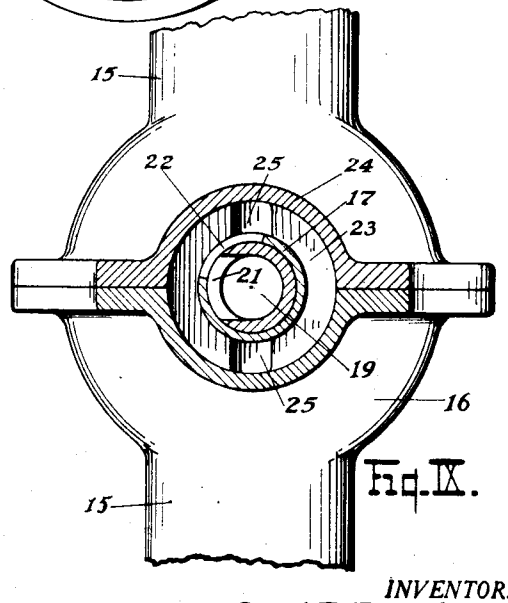


Fig. IX.

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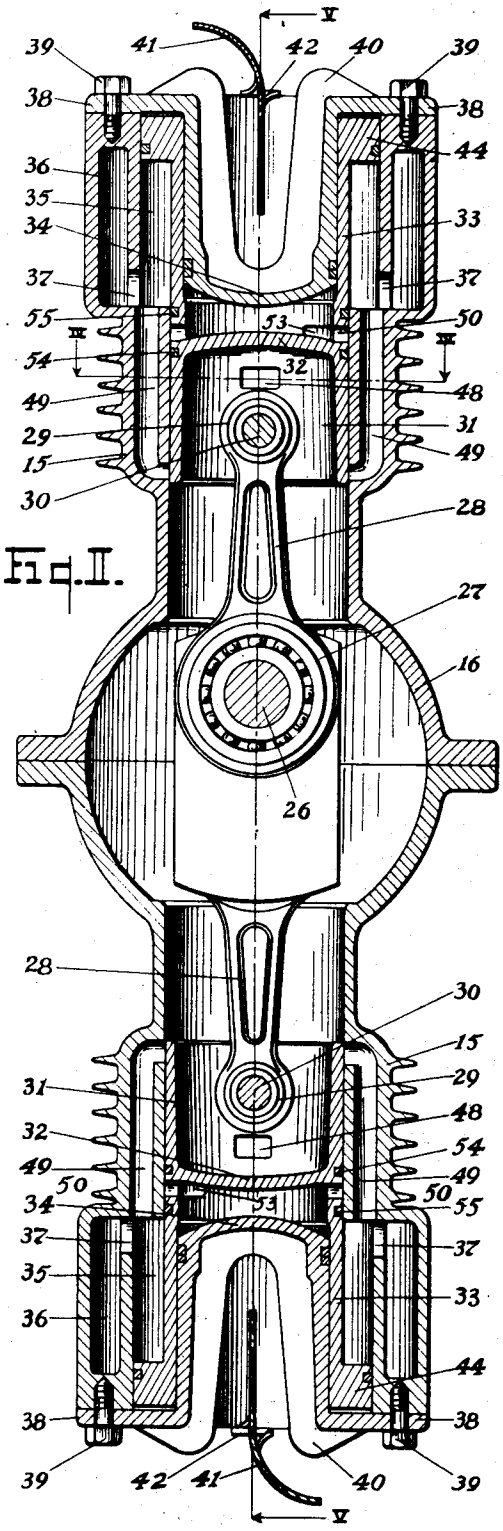


Fig. II.

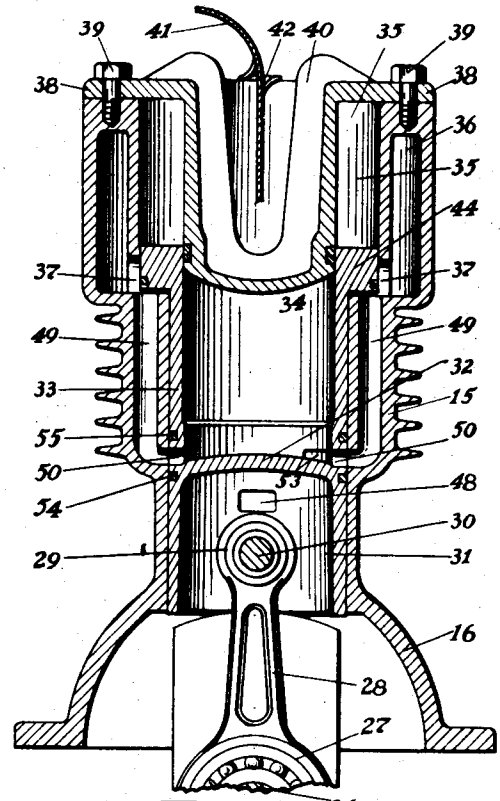


Fig. III.

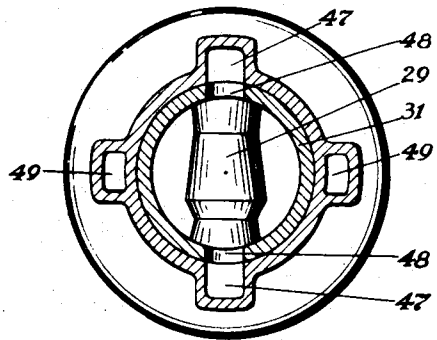


Fig. IV.

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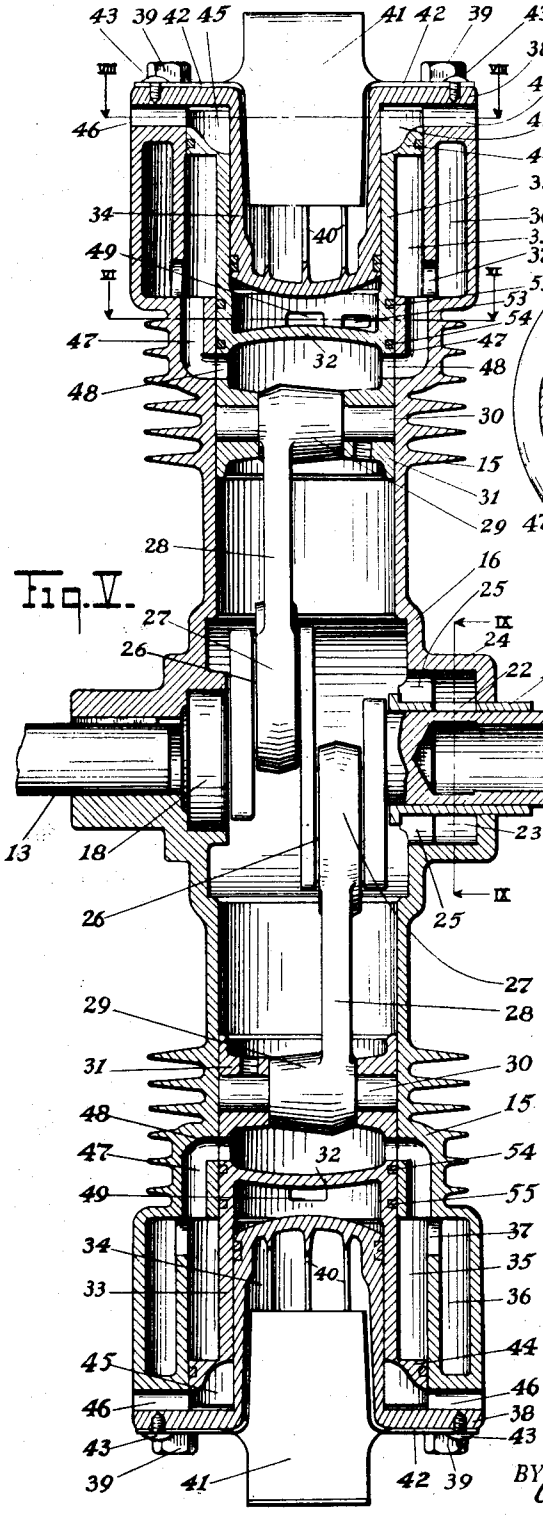


Fig. V.

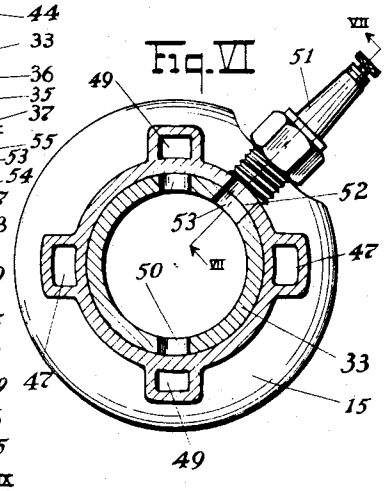


Fig. VI.

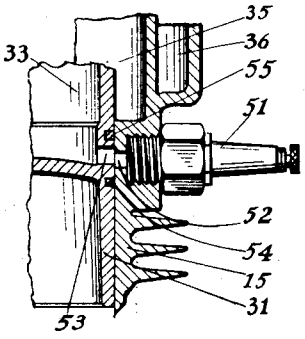


Fig. VII.

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INTERNAL COMBUSTION ENGINE.

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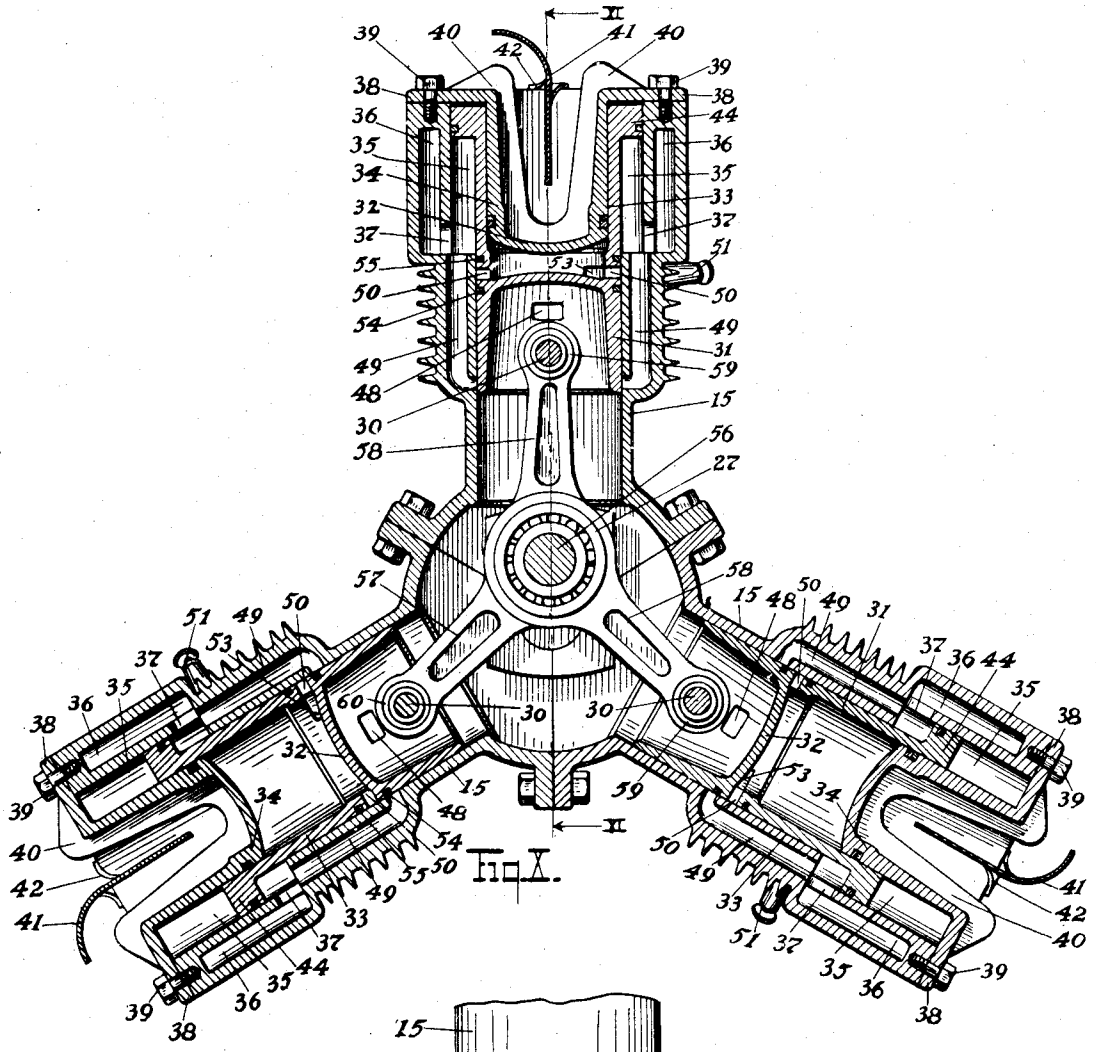


Fig. X.

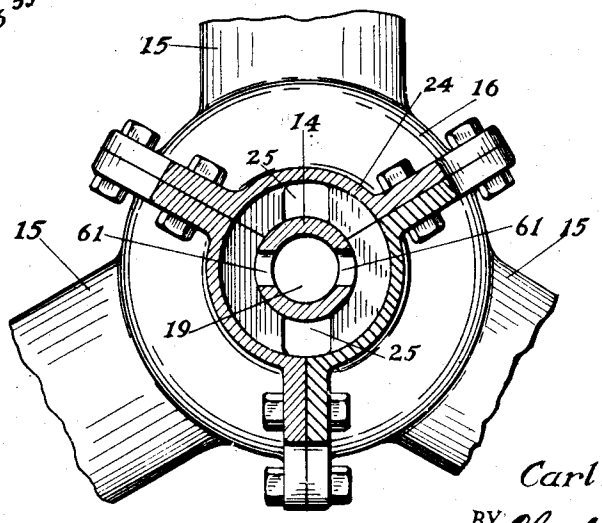


Fig. XII.

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INTERNAL COMBUSTION ENGINE.

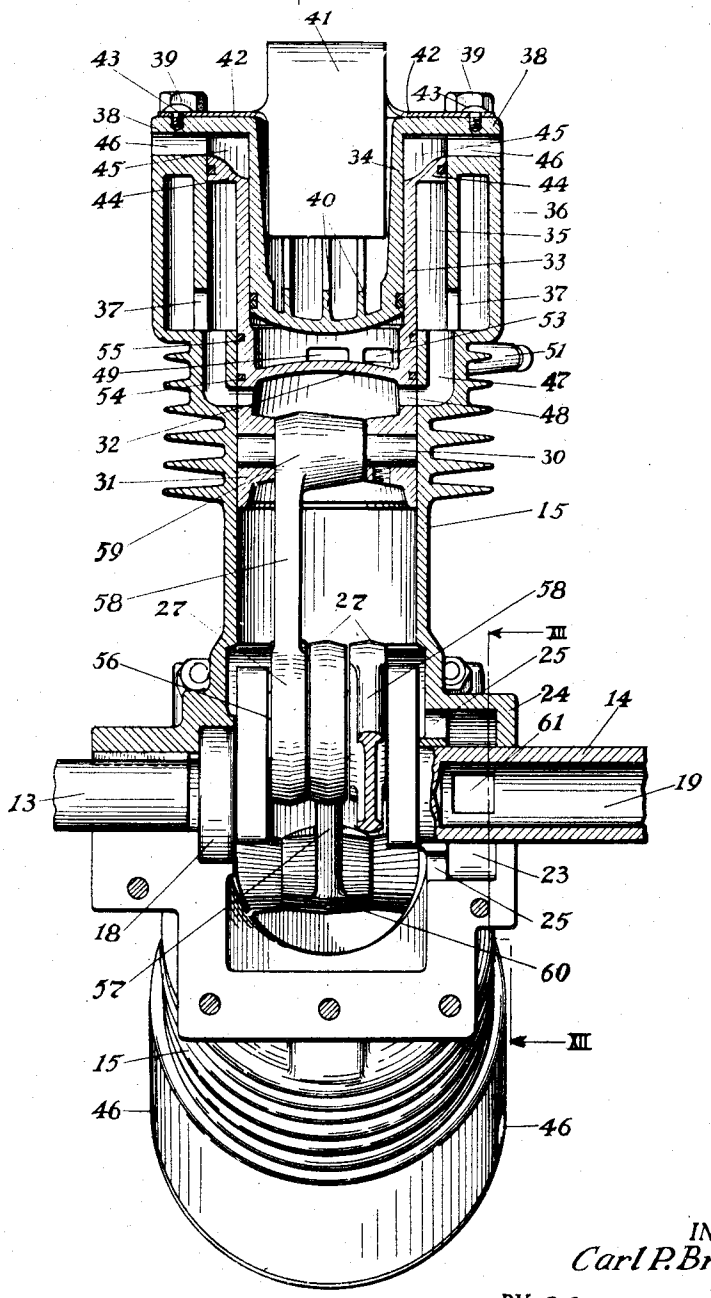
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Patented Dec. 5, 1922.

5 SHEETS—SHEET 5.

Fig. XI.



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Patented Dec. 5, 1922. 1,437,928

UNITED STATES PATENT OFFICE.

CARL P. BROCKWAY, OF TOLEDO, OHIO, ASSIGNOR TO INDUSTRIAL RESEARCH CORPORATION, OF TOLEDO, OHIO, A CORPORATION OF DELAWARE.

INTERNAL-COMBUSTION ENGINE.

Application filed April 8, 1919. Serial No. 288,573.

To all whom it may concern:

Be it known that I, CARL P. BROCKWAY, a citizen of the United States, residing at Toledo, in the county of Lucas and State of Ohio, have invented certain new and useful Improvements in Internal-Combustion Engines, of which I declare the following to be a full, clear, and exact description.

This invention relates to improvements in internal combustion engines, particularly those of the two cycle type with revolving cylinders.

One of the objects of the invention is the provision of means for compressing the fuel gas before it enters the combustion chamber, said means comprising an auxiliary compression chamber in which moves a plunger driven by the engine piston.

Another object of the invention is the provision of an exhaust passage through said plunger permitting the escape of exhaust gases through said compression chamber outside of said plunger head, whereby the compression chamber is heated, thus greatly assisting in the vaporization of the next charge compressed therein.

A further object of the invention is the arrangement of parts in such manner as to cause the incoming gases to flow over both the under and upper surfaces of the hot piston head.

Still another object is the provision of a mounting for the spark plug where it will be covered, except at the time of sparking, thereby reducing the fouling of the sparking points.

Other objects, and objects relating to details of construction and economies of manufacture, will appear as I proceed with the description of that embodiment of the invention, which, for the purposes of the present application, I have illustrated in the accompanying drawings, in which:

Figure I is a view in side elevation of a two cycle engine embodying my invention, shown as direct connected to a motor-dynamo for current generating purposes.

Fig. II is a transverse sectional view of the engine taken substantially on the line II—II, Fig. I.

Fig. III is a fragmental view similar to Fig. II, but showing the piston in its innermost position.

Fig. IV is a cross section taken on the line IV—IV, Fig. II.

Fig. V is a longitudinal, sectional view of the engine taken substantially on the line V—V, Fig. II.

Fig. VI is a view in cross section on the line VI—VI, Fig. V.

Fig. VII is a fragmental, detail, sectional view on the line VII—VII, Fig. VI.

Fig. VIII is a cross section on the line VIII—VIII, Fig. V.

Fig. IX is a cross section on the line IX—IX, Fig. V.

Fig. X is a section on a plane at right angles to the crank shaft of a three cylinder engine embodying my invention.

Fig. XI is a central longitudinal section through one of the cylinders, this view being taken substantially on the line XI—XI, Fig. X.

Fig. XII is a cross section on the line XII—XII, Fig. XI, showing the gas intake through the fixed crank shaft.

Similar reference characters refer to like parts throughout the views.

In Fig. I, I have shown an engine embodying my invention direct connected to a motor-dynamo 10. Although the engine is of general utility, I have found that it is particularly suited for use in portable electric generating plants because of the large amount of power developed per unit of weight. In this figure the engine bearings are mounted in a support 11, one side of which is secured by suitable fastenings 12 to the casing of the electric machine 10. Obviously it could be designed for attachment to substantially any machine upon which it might be desirable to use the engine.

The support 11 carries at the left end (Figs. I and V) a rotating shaft 13, while at the right it is clamped to a stationary shaft 14. In the modification shown in Figs. I to IX inclusive, each cylinder 15 is built integral with half the crank case 16, while in the modification in Figs. X, XI and XII, each cylinder is integral with one third of the crank case. Before the two halves of the crank case in the first modification are bolted together, a bearing sleeve 17 is inserted between them on the right side, Fig. V, and a bearing ring 18 is mounted in a recess in the inner left side of the casing. Within the ring 18 is rotatably mounted one end of the crank shaft, the other end being integral with the shaft 14. In the

operation of the engine, the sleeve 17, ring 18 and shaft 13 rotate with the cylinder while the crank shaft, including the straight portion 14, remains stationary. Shaft 14 is bored out centrally at 19 to form a path for the fuel gas as it enters the engine from any convenient source, such as the carbureter 20 shown in Fig. I. The bore 19 does not extend through the inner end of the shaft 14, but is in communication with a radial port 21, Fig. IX, which registers once during each revolution with a port 22 in the sleeve 17, the latter port being constantly in communication with an annular passage 23 in the bearing boss 24 of the crank case. Ports 25 connect the annular passage with the interior of the crank case.

In the two cylinder engine, the crank shaft includes two crank pins 26, upon which are mounted rotatably the bearings 27 of connecting rod 28. The outer ends of the rods have comparatively long bearings 29 so as to extend past the center lines of the piston pins 30, thereby reducing, if not elimnating, uneven wear between the pins 30 and the bearings 29. Pistons 31 carry outside the piston heads 32, sleeves 33, which slide with the pistons in the cylinders 15 and outside of the cylinder heads 34. At the outer end of the cylinder proper and integral with it, is a compression chamber made up of two concentric annular compartments 35 and 36, which are connected at their lower or inner ends by four evenly spaced passages 37 in the intermediate wall. The cylinder head 34 is cup-shaped, as shown in the drawings, and is provided at its outer extremity with an annular flange 38, which overlies and closes the ends of the compartments 35 and 36, and is secured by means of lag screws 39 to the outer end wall of the compartment 36. The cylinder head has cooling flanges 40, and in order that air may be directed down into the head, I mount a sheet metal fin 41 upon the head in a diametrical position, said fin extending downwardly well into the cavity of the head. Its outer end is curved forwardly, that is, towards the side which is in advance during rotation of the engine. Air is caught by the curved portion of the fin and forced inwardly along the forward side of the fin to the bottom of the cavity in the head, and then passes out upon the other side of the fin, absorbing heat from the flanges 40 during its passage. A convenient method of holding the fin in place is illustrated in the drawing, where integral side extensions 42 are bent at right angles to the principal portion of the fin so as to lie upon the cylinder head flange 38, to which the extensions 42 are fastened by means of screws 43.

The sleeve 33 carries at its outer end an annular plunger 44, fitting snugly in the compartment 35. Across the upper or outer surface of the plunger 44 at diametrically opposite points, there are formed passages 45 which permit communication between the combustion chamber and the space above the plunger 44, when the latter is at the inner limit of its stroke. In the outer end of the compartment 36, separated from the interior thereof, are two diametrically positioned exhaust ports 46, which, in the drawings, happen to be shown opposite the passages 45. Diametrically opposed passages 47 connect the space at the bottom of the compartments 35 and 36 in front of two of the passages 37, with ports 48 through the piston just beneath its head 32, when the piston is at the outer limit of its motion. When the piston is at the inner limit of its motion, diametrically opposed passages 49, at right angles to the passages 47 are in communication through the other two of the passages 37 with the outer compression chamber 36 at one end, and at the other end through ports 50 in the piston sleeve 33 with the combustion chamber.

A spark plug 51 is threaded into the cylinder walls just below the auxiliary compression chmaber 35, 36. Its sparking points are exposed to the gases in the combustion chamber through ports 52 in the cylinder and 53 in the piston head, when the piston is in its outermost position. The piston and sleeve may carry packing rings 54 and 55 to prevent leakage of gas and consequent loss of power through the port 53.

In the operation of the two cylinder engine, while the pistons are moving upward, or outward, the gas intake passage through the shaft 14 and the crank case, is open, and fuel is drawn into the crank case. As the piston begins to descend or move inwardly, this passage is closed and the gas in the crank case is compressed by the further inward movement of the piston. The sleeve 17 having closed the port 22 at this time however, prevents the pressure from being transmitted backwardly through the pipe 19 to the carbureter. At the outer end of the piston stroke, ports 48 in the piston, just beneath the piston head, come into register with the passages 47, leading to the auxiliary compression chamber, into which the gas rushes due to the depression in chambers 35 and 36. As each piston begins to move inwardly once more, the plunger 44 carried upon the end of the sleeve 33, forces the gas out of the compartment 35 through the passages 37 into the compartment 36, thereby putting it under considerable pressure. Now when the piston reaches its innermost position, ports 50 register with passages 49 and the gas from the compartment 36 flows rapidly into the combustion chamber just above the hot piston head 32. The outward stroke compresses the gas in the combustion chamber in the usual way,

and at the end of the outward stroke it is exploded by a spark across the sparking points of the plug 51, which is uncovered just at that time by the registration of ports 52 and 53 in the cylinder and valve sleeves respectively.

When the piston is at its innermost position, passages 45 across the upper portion of the plunger 44 permit the spent gases to escape into the compartment 35, above the plunger 44, whence they have access to the open air through ports 46. This scavenging of the combustion chamber is greatly facilitated and accelerated by centrifugal force. The outer movement of the plunger 44 positively evicts whatever gas may remain. The hot gases in passing out heat the cylinder head and the intermediate wall between the compartments 35 and 36, and this heat is absorbed by the fresh charge of gas which enters the compartment directly after the spent gases are expelled. This feature of my invention is important in that it assists in the vaporization of the fuel. In addition to this heating, the gas also absorbs heat while held against the inner surface of the hot piston head by centrifugal force prior to the time when it is permitted to move outward through the ports 48, and again when it is introduced into the combustion chamber just above the piston head through the port 50.

Engines involving my invention, which have more than two cylinders are like the two cylinder engine just described in most of its essential particulars. While it is possible to use more than one crank pin in engines of three or more cylinders, I believe that a single crank pin is most desirable. In a two cylinder engine the use of a single crank pin produces heavy vibration, but this effect is lessened in engines of three cylinders and decreases still more as the number of cylinders is increased. In the illustration of Figs. X, XI and XII, a single crank pin is shown at 56 and has mounted thereupon a central connecting rod 57 and two outer connecting rods 58. The rods 58 have outer bearings 59, the centers of which are offset from the center lines of the rods in order to provide bearings for the middle portions of the piston pins 30. The outer bearing 60 for the connecting rod 57 has its median line coinciding with the median line of the connecting rod. There is no sleeve valve surrounding the pipe 14 in this three cylinder engine. The necessity for such a valve is not present because there are no strong pulsations within the crank case, no two of the pistons moving inwardly at the same time. The stationary shaft 14 has two opposed openings 61, through which the gas flows from the passage 19 into the annular passage 23 and thence through the ports 25 into the crank case. The operation of this modification of the invention is like that of the first modification and needs no further explanation.

I claim as my invention:

1. In a revolving cylinder gas engine having a crank case, a cylinder, an auxiliary compression chamber, a piston having a valve sleeve slidable within the cylinder, said sleeve carrying a plunger slidable within said auxiliary compression chamber, and means for feeding gas into said crank case and auxiliary compression chamber and from the latter to the space within said sleeve.

2. In a revolving cylinder gas engine having a crank case, a cylinder having an auxiliary compression chamber, the head of said cylinder being set into the barrel thereof and being of smaller diameter than the inside diameter of the cylinder, a piston having a valve sleeve slidable within the cylinder and outside of said head, said sleeve carrying a plunger slidable within said auxiliary compression chamber, and means for feeding gas into said crank case and auxiliary compression chamber and from the latter to the space within said sleeve.

3. In a revolving cylinder gas engine having a crank case, a cylinder having an annular auxiliary compression chamber, the head of said cylinder being set into the barrel thereof and being of smaller diameter than the inside diameter of the cylinder, a piston having a valve sleeve slidable within the cylinder and outside of said head, said sleeve carrying an annular plunger slidable within said auxiliary compression chamber, and means for feeding gas into said crank case and auxiliary compression chamber and from the latter to the space within said sleeve.

4. In a gas engine, a cylinder having an auxiliary compression chamber comprising two interconnected compartments, a piston having a valve sleeve slidable within said cylinder, said sleeve carrying a plunger slidable within one of said compartments, and adpated when in one position to prevent communication between said compartments, means for feeding gas into said auxiliary compression chamber and from the latter to said cylinder, said plunger having a passage therein, normally covered, but uncovered in the aforesaid position of the plunger to provide an exhaust communication between the cylinder and one of said compartments, said last named compartment having an exhaust port.

5. In a gas engine, a cylinder having an annular auxiliary compression chamber comprising two interconnected compartments, a piston having a valve sleeve slidable within the cylinder, said sleeve carrying an annular plunger slidable within one of said

compartments, and adapted when in one position to prevent communication between said compartments, means for feeding gas into said auxiliary compression chamber and from the latter to said cylinder, said plunger having a passage therein normally covered, but uncovered in the aforesaid position of the plunger to provide communication between the cylinder and one of said compartments, said last named compartment having an exhaust port.

6. In a gas engine, a cylinder having an auxiliary compression chamber comprising two annular concentric interconnected compartments, a piston having a valve sleeve slidable within said cylinder, said sleeve carrying an annular plunger slidable within the inner one of said compartments, and adapted when in one position to prevent communication between said compartments, means for feeding gas into said auxiliary compression chamber and from the latter into said cylinder, said plunger having a passage therein normally covered, but uncovered in the aforesaid position of the plunger to provide an exhaust communication between the cylinder and one of said compartments, said last named compartment having an exhaust port.

7. In a gas engine, a cylinder having an auxiliary compression chamber comprising two annular concentric compartments provided with an intercommunicating passage at their lower ends, a piston having a valve sleeve slidable within the cylinder, said sleeve carrying at its outer extremity an annular plunger slidable within the inner one of said compartments, and adapted when in its lowermost position to close said intercommunicating passage, means for feeding gas into said auxiliary compression chamber and from the outer compartment thereof into said cylinder, said plunger having a passage therein normally covered, but uncovered in the lowermost position of the piston to provide an exhaust communication between the cylinder and said inner compartment, said inner compartment having an exhaust port at its upper end.

8. In a gas engine, a cylinder having a lower small bore and an upper large bore, a cylinder head set into said large bore portion, said head being smaller in diameter than the inside diameter of said smaller bore portion, a piston carrying above its head a valve sleeve slidable between said cylinder head and the small bore portion of the cylinder, the space below said head and enclosed by said sleeve constituting a combustion chamber, said sleeve carrying at its upper end an annular plunger slidable between said cylinder head and the large bore portion of the cylinder, an annular compartment surrounding said large bore portion of the cylinder, provided with an intercommunicating passage through the wall of the latter at its lower end, said passage being closed by the plunger when at the bottom of its stroke, means for feeding gas into said annular compartment and the space between the latter and said sleeve, when the sleeve is at the top of its stroke, and for feeding gas from the annular compartment into said combustion chamber when the piston is at the bottom of its stroke, said annular plunger having a passage therein providing an exhaust communication between the combustion chamber and the space above said plunger, the engine being provided with an exhaust port connected with said last named space.

9. In a gas engine, a cylinder having an auxiliary compression chamber, a piston having integral therewith above its head, a sleeve, said sleeve carrying a plunger slidable within said compression chamber, means for introducing fuel gas into the engine below the piston head, said piston having a port therethrough just beneath the piston head, said cylinder having in its wall a passage leading to said compression chamber and adapted to be uncovered by said port, said piston having a fuel admission port just above the piston head, and said cylinder having another passage leading from said compression chamber and adapted to register with said fuel admission port, whereby the incoming fuel is passed over each of the surfaces of said hot piston head.

10. In a rotary gas engine, a crank case, a cylinder having an auxiliary compression chamber, a piston having integral therewith above its head, a sleeve, said sleeve carrying a plunger slidable in said compression chamber, means for introducing fuel gas into said crank case, said piston having a port therethrough just beneath said head, said cylinder having in its wall a passage leading to said compression chamber, and adapted to be uncovered by said port, said piston having a fuel admission port just above the piston head, and said cylinder having another passage leading from said compression chamber and adapted to register with said fuel admission port, whereby the incoming gases are thrown centrifugally against the under surface of the hot piston head, thence pass to the compression chamber, and thereafter back through the admission port over the hot upper surface of the piston head.

11. In a revolving cylinder internal combustion engine having a crank case, a cylinder having a power piston therein, an auxiliary compression chamber having a plunger therein carried by said piston, and means for feeding gas into said crank case and auxiliary compression chamber and thence into said power cylinder.

12. In a revolving cylinder internal combustion engine having an enclosed crank

case, a power cylinder and piston therein, an auxiliary compression chamber having a plunger rigidly attached to said piston, means for feeding gas into said crank case and thence into said auxiliary compression chamber, and means for transferring the compressed gas from said compression chamber to said cylinder.

13. In a revolving cylinder internal combustion engine, a cylinder having a head depressed into the barrel of said cylinder, the outer surface of said head forming a cup open to the outside air, and means for deflecting cooling air into said cup as the cylinder revolves.

14. In a revolving cylinder internal combustion engine a cylinder having a cup-shaped head end, the cup being open to the outside air, an air deflector for catching air as the cylinder revolves and causing a positive circulation within said cup.

15. In a gas engine having a crank case and cylinder, an auxiliary compression chamber, a piston having a valve sleeve slidable within the cylinder, said sleeve carrying a plunger slidable within said auxiliary compression chamber, and conduits interconnecting said crank case, chamber and cylinder, said conduits having ports adapted to be opened and closed by the movement of sleeve.

16. In a gas engine having a crank case and cylinder, an auxiliary compression chamber, a movable unit including a piston sleeve and plunger rigidly interconnected, and conduits interconnecting said crank case, chamber and cylinder, said conduits having ports adapted to be opened and closed by the motion of said movable element.

In testimony whereof, I affix my signature.

CARL P. BROCKWAY.