

April 16, 1935.

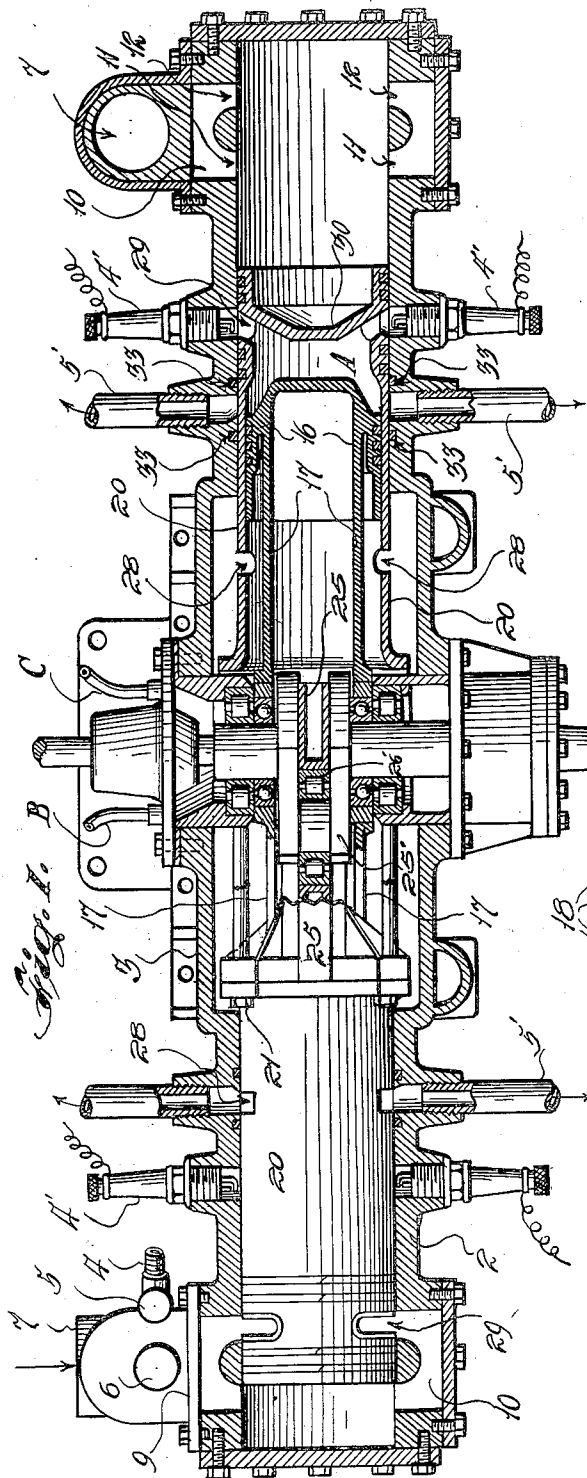
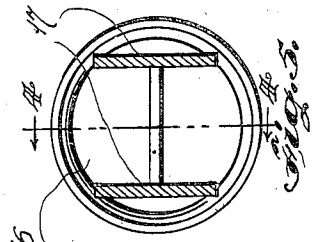
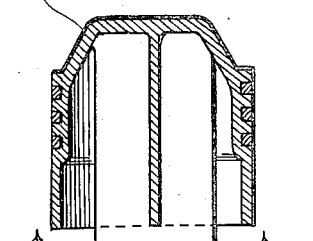
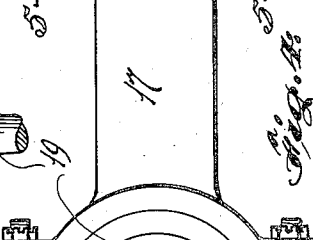
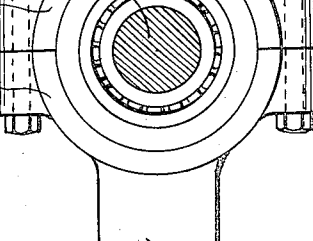
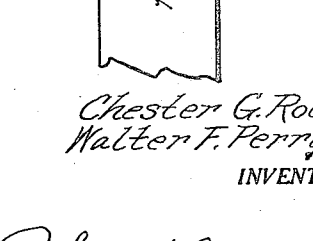
C. G. ROOT ET AL

1,997,834

TWO-CYCLE ENGINE

Filed Feb. 15, 1932

5 Sheets-Sheet 1



Chester G. Root,
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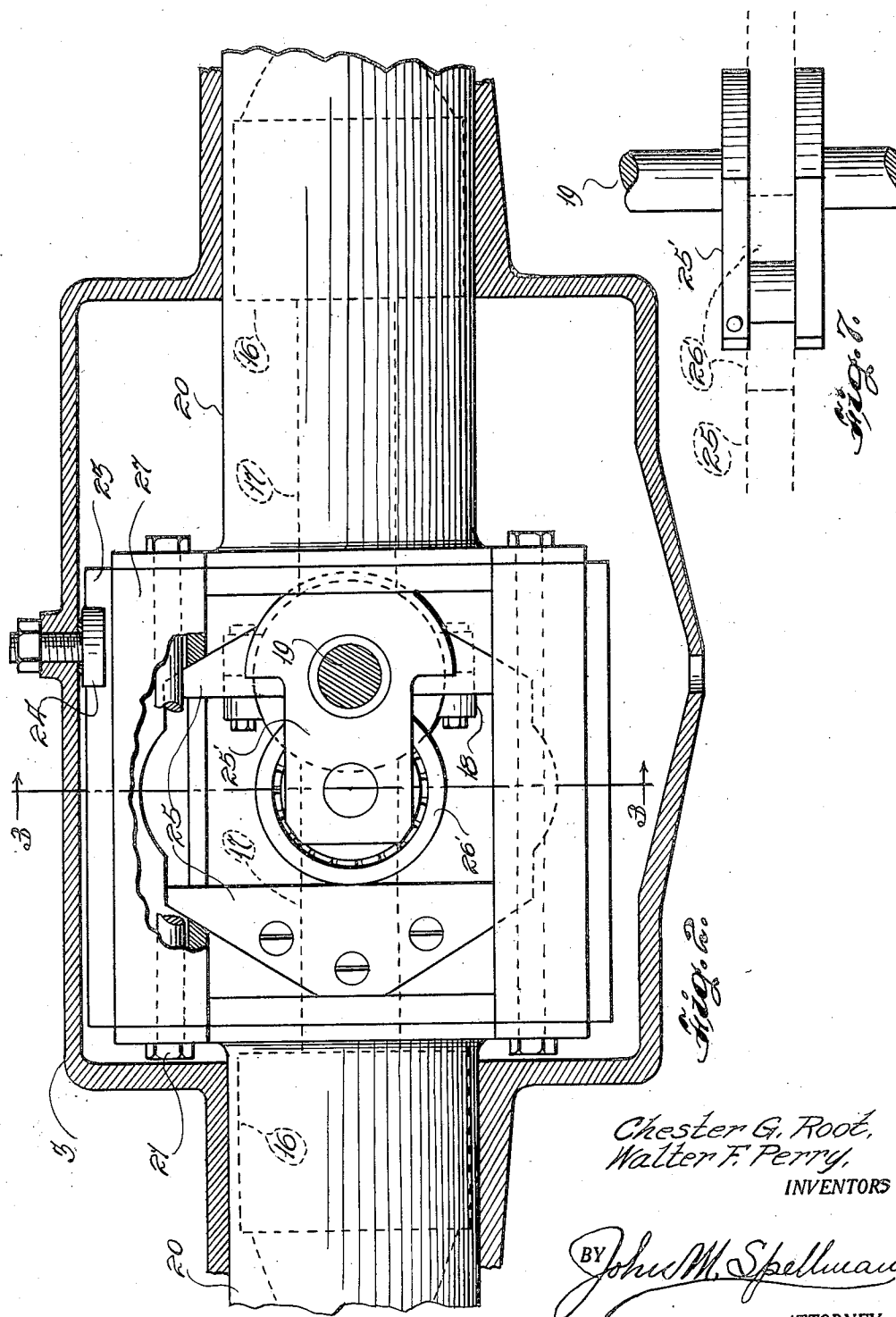
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5 Sheets-Sheet 2



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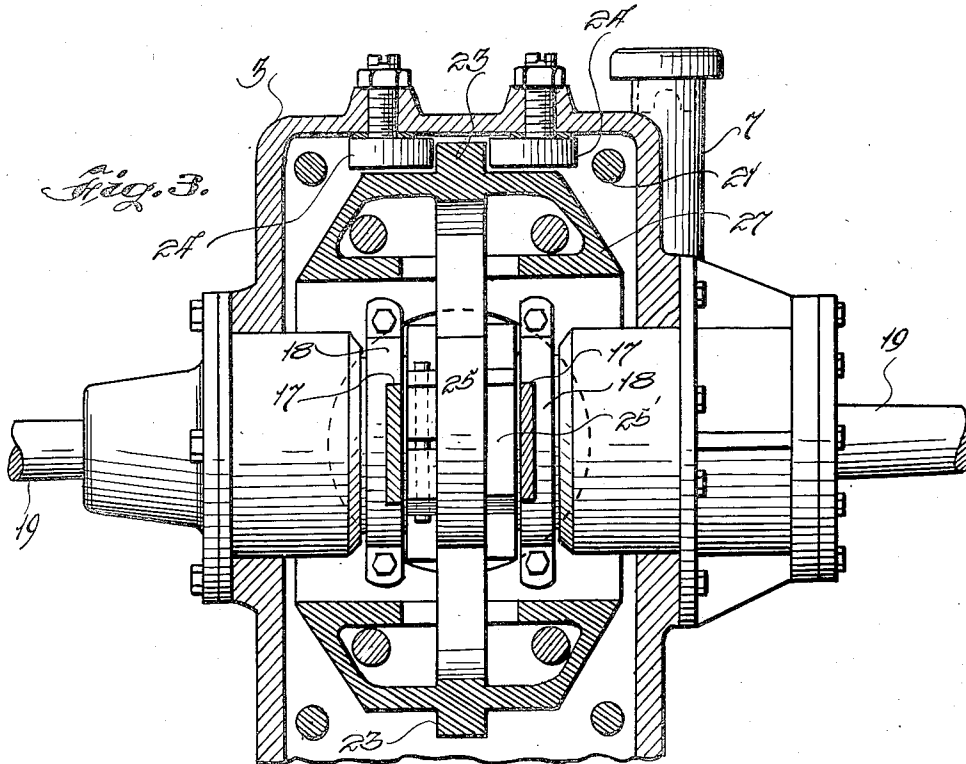
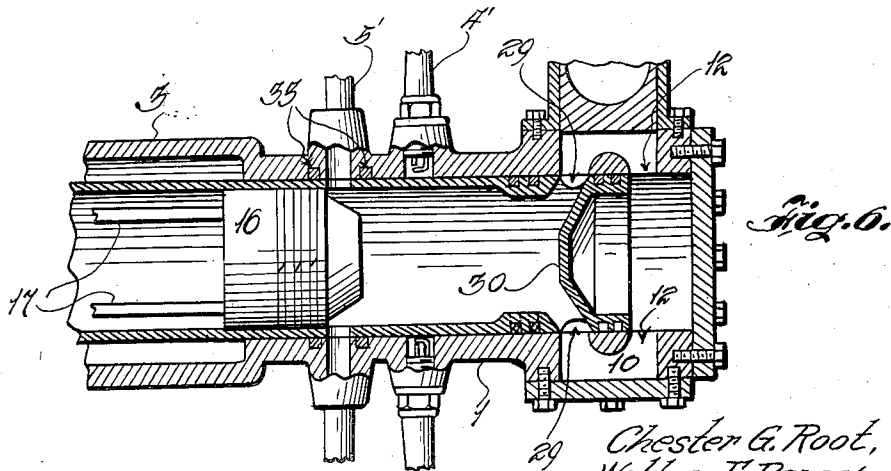
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TWO-CYCLE ENGINE

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5 Sheets-Sheet 3



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TWO-CYCLE ENGINE

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5 Sheets-Sheet 4

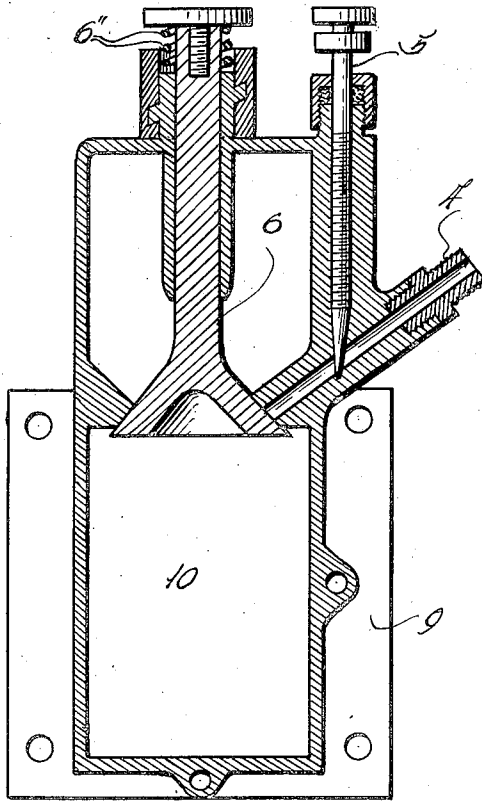


Fig. 8.

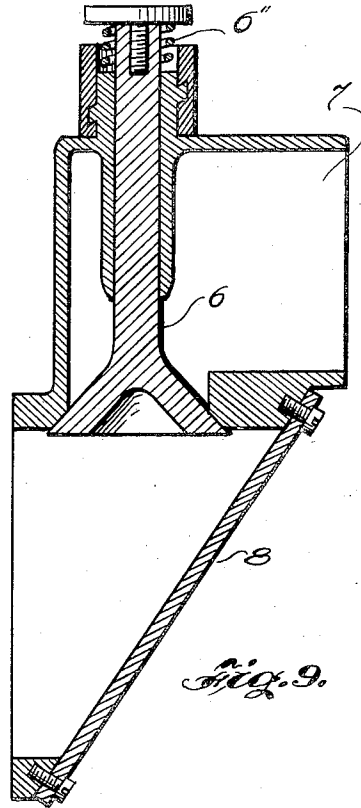


Fig. 9.

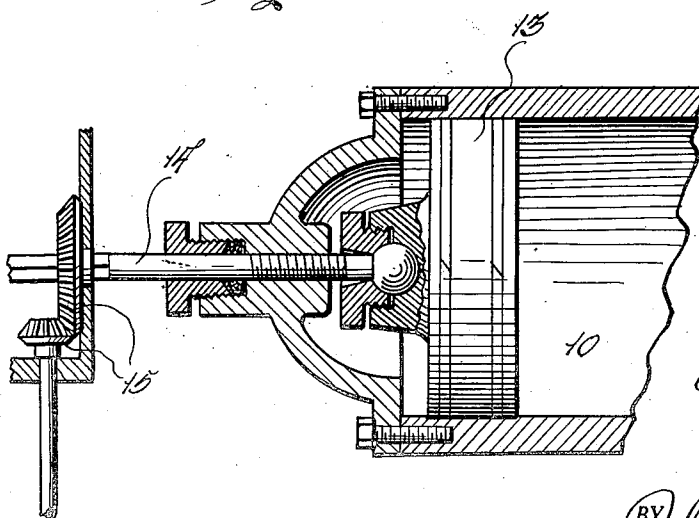


Fig. 10.

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5 Sheets-Sheet 5

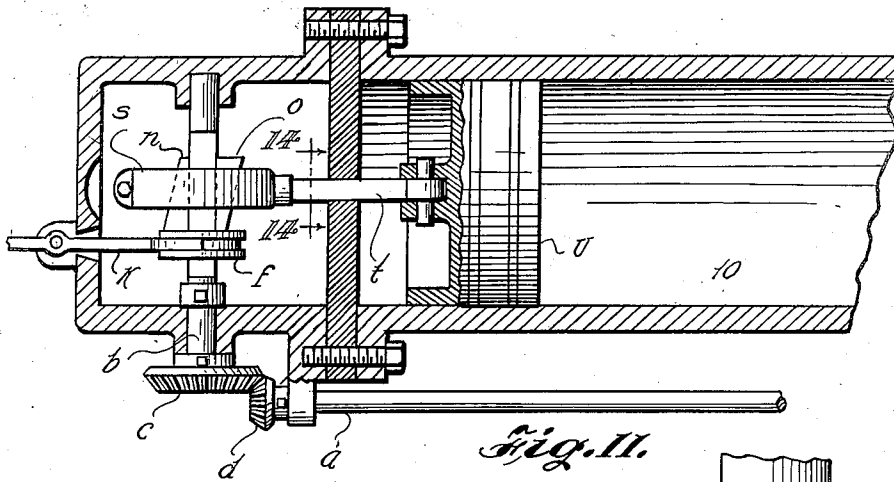


Fig. 11.

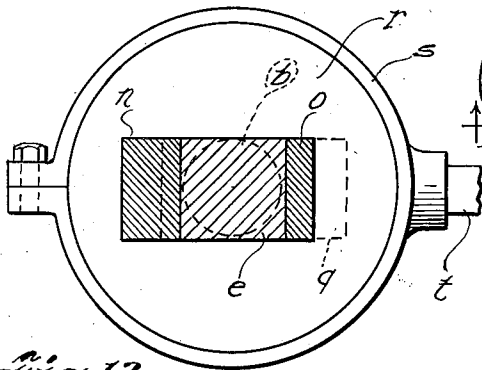


Fig. 13.

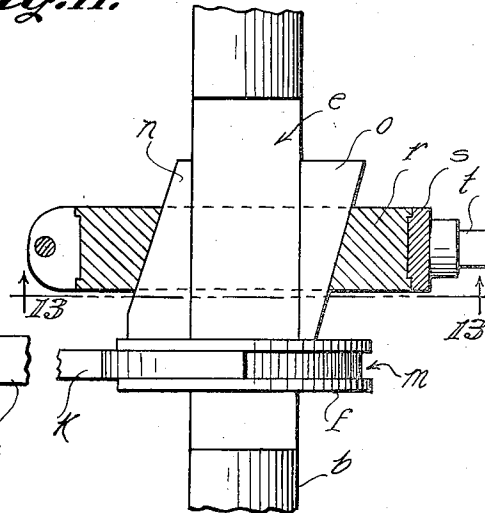


Fig. 12.

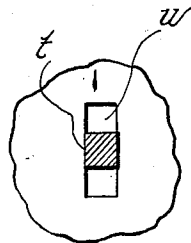


Fig. 14.

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UNITED STATES PATENT OFFICE

1,997,834

TWO CYCLE ENGINE

Chester G. Root and Walter F. Perry, Paris, Tex.

Application February 15, 1932, Serial No. 593,024

3 Claims. (Cl. 123—50)

Our invention relates to two-cycle engines operated by combustion of liquid fuel.

Generally our invention resides in the novel construction and design of the stationary pistons and their connecting rods which are made integral and mounted on the straight portions of the crank shaft, for universal movement. In other words so that they automatically center in the piston sleeve valves, eliminating the use of piston pins and crossheads. These being located inside the piston sleeve valves and connected directly together around the straight portion of the crank shaft and on each side of the crank throws with suitable bearings mounted in the connecting rod portions of the stationary pistons, and in which bearings the straight portion of the crank shaft rotates. This construction permits the bulkheads to be flexible as to any rocking movement of the piston sleeve valves in the cylinders, as the stationary pistons are pivoted by bearings on the straight portion of the crank shaft, these pistons and rods can also move forward and backward on the crankshaft for perfect alignment with the piston sleeve valves. This arrangement and construction also makes a more compact engine with less weight, and which mounting on the crankshaft is a radical departure from engines using a bulkhead or stationary piston inside the engine reciprocating piston.

In connection with the foregoing, one of the principal objects of our invention resides in the novel construction and arrangement of parts, by means of which we use a crank shaft with only one throw or crank, operated or driven by pistons directly opposed, and bolted together, reciprocating in cylinders directly opposed, with crank bearing rails or driving plates centrally located and bolted to the bottom portion of the pistons, with spacer and driving block intermediate the piston sleeve valves.

Another of the principal objects of our new and improved two-cycle engine is the unique and novel means for providing an air cushion for the reciprocating action of the piston valve sleeves, thereby providing a much smoother running operation.

A further object of the invention is the elimination of all connecting rods and piston pins and the substitution of head compression instead of ordinary crank-case compression.

Another important object of our invention is the provision of an engine of this class having two intake and two exhaust ports and two spark plugs for each cylinder, and including, we believe, an entirely new construction of cylinder piston and sleeve valve arrangement.

A further object of our invention is the provision of a super-charger for the compression chamber where the gaseous fuel, previous to its entrance into the firing chamber, is compressed,

including means for adjusting the supercharger to any amount of supercharging or compression.

While our invention includes the combined instrumentalities above mentioned, we wish it to be understood that we consider the aforesaid means not only combinatively novel, but in so far as we are advised, certain of the devices going to make up such means are new in less combinations than the whole, and some capable of individual use, as will more clearly appear herein-after.

With the above and other important objects in view, our invention will be clearly understood from a perusal of the following detailed description, taken in connection with the accompanying drawings, forming a part of this specification, and in said drawings:

Figure 1 is a horizontal sectional plan view of a two-cycle engine and embodying our invention.

Figure 2 is an enlarged detail transverse vertical sectional view of the crank case and crank shaft, including sleeve spacer and driving block and guide bearings.

Figure 3 is a vertical cross-sectional view of Figure 2, had on the line 3—3 thereof.

Figure 4 is a detail sectional view of one of the stationary pistons showing the connection of both stationary pistons to the crank shaft, the view being had on the line 4—4 of Figure 5.

Figure 5 is a view on line 5—5 of Figure 4.

Figure 6 is a detail sectional view of a portion of one of the cylinders, showing one of the stationary pistons, piston sleeve valve, intake and exhaust ports, spark plugs, firing chamber, and compression or supercharging chamber.

Figure 7 is a detail view of the crank shaft, showing the connection thereto of the driving block and sleeve spacer.

Figure 8 is a vertical detail sectional view of the mixing chamber and its valves.

Figure 9 is a view similar to Figure 8, but taken from another position.

Figure 10 is a fragmentary detail sectional view of the cylinder and compression chamber with its piston adjustably mounted on a worm screw with reduction gears.

Figure 11 is a fragmentary detail sectional view of the cylinder and supercharging or compression chamber showing a supercharging piston and its control means.

Figure 12 is an enlarged detail sectional view of the shaft, eccentric and wedge members for moving the piston in the supercharging or compression chamber.

Figure 13 is a cross-sectional view of Figure 12, the view being taken on the line 13—13 thereof, and

Figure 14 is a view taken on line 14—14 of Figure 11.

Proceeding in accordance with the drawings

and referring to Figure 1, the engine consists of a casing having two cylinders 1 and 2, formed integrally with a crank-case portion 3. The engine is of the two-cycle opposed type and one of its principal advantages is the novel means for making two cylinders perform the work of four cylinders, or of a four-cycle engine. The engine is thus designed so as to fire on each one-half revolution of the crank shaft, and to bring this about we provide each cylinder with a gas inlet 4, a gas control valve 5 and a mixing valve 6. These valves, 5 and 6, are shown in detail in Figures 8 and 9 with a housing which includes a breather opening 7 and a cover plate 8, also a plate 9, by means of which the parts are secured to the cylinder casings 1 and 2. This breather opening is to admit air through the mixing valve to the compression chamber 10, which chamber is the space in the cylinder and between the heads of the piston sleeve valves and the cylinder heads.

The mixing valve 6 is lifted or opened by the suction of the piston sleeve valve when the piston sleeve valve is going inward on compression against the stationary piston head 16. This valve 6 has a light spring 6' which increases the closing action of the valve when pressure is built up in the compression chamber after the piston sleeve valve has reached its maximum inward travel or stroke, which spring forces the valve to a tighter seal, holding gas in the compression chamber.

There is also provided a compression chamber 10 previously referred to with gas by-pass and inlet ports 11 and 12. These ports communicating with the mixing valve and to transfer the compressed charge from the compression chamber 10 through the ports 29 into the combustion chamber *a*, and one end of this compression chamber and cylinder are shown in detail in Figure 10, and includes an adjustable closure or piston 13, associated with a worm screw 14 and reduction gears 15, whereby the pressure in this chamber can be regulated by forcing the piston in and out of the chamber or cylinder as the case may require. The clearance between the engine piston sleeve valve head and the head of the piston 13 regulates the pressure in the chamber 10.

A modification of the means for controlling the volume and pressure of the compression chamber is shown in Figures 11 to 14, inclusive. In this form the rod *a* is geared to the crank shaft and also geared to a shaft *b* having its bearings in the eccentric housing walls. This shaft carries a bevel gear *c*, meshing with a similar gear *d* on the shaft *a*. Shaft *b* is square at *e* to receive in slidable fashion a slotted circular plate *f* and which is made to move along the shaft *b* by means of a shifting fork *k*, working in an annular groove *m* of the plate, as will be apparent from Figure 12. Connected to one face of the plate *f* are two wedge-shaped members *n* and *o*. These wedge members are adapted to slide in a slot *q* in an eccentric *r*, having a strap *s*. An eccentric arm *t* is connected to a piston *u* and by this means the piston *u* is adjusted to a reciprocatory action in the engine cylinders. The arms *t* is square in cross-section and a slot *w* in the eccentric housing wall is provided to hold the eccentric rod and eccentric arm in line on the shaft, otherwise they would move with the wedge members. By moving the shifting fork, the wedge members cause the eccentric to move from center in relation to the shaft *b*

which in turn causes the piston to reciprocate to the extent the eccentric is moved from the center. This thereby increases the volume of the compression chamber 10, and also increases the pressure when the piston *u* is in operation, as the engine piston valve sleeve and the piston *u* have both affected the amount of fuel drawn into the compression chamber 10.

The piston cylinders at each end of the engine are alike in all respects and include the compression chamber, valves, gears and ports. Each cylinder has two spark plugs 4' and two exhaust ports 5'.

In Figure 4 is shown one of the stationary pistons which includes a head 16 with integrally-formed connecting rods 17 with forks 18 whereby the stationary pistons are connected to the crank shaft 19, so they will be flexible to move with the piston sleeve valves if they rock in the cylinders, and are also flexible to move backward or forward on the crank shaft for perfect alignment within the piston sleeve valves. Each piston is associated with and is stationary inside a piston sleeve valve 20, each piston sleeve valve being bolted to the other by the bolts 21 through a spacer and driving block. This block includes the guide bearings 23 which are adjusted by the eccentric members 24 at the top of the crank case and these guides and eccentric elements keep the driving face 25 of the block 27 square with the crank throw 25', with its bearings and race 26' and also keep the ports 22 and 29 in the valve sleeve in line with the ports in the cylinder casing.

The piston sleeve valves 20 also include a head 30 and in Figure 6, likewise in Figure 1, this head of the piston sleeve valve is shown in a position at the end of the cylinder and has forced the gas and air in the compression chamber under compression through the port 29. In Figure 1 to the right in the drawings, the stationary piston and the piston sleeve valve are shown in position where a compression of the charge has taken place and ready for a firing operation, the two heads, that of the stationary piston and the piston sleeve valve, being close together and the space in between forming a firing chamber as indicated as *A*, and the port 29 in the sleeve valve being in register with the spark plug. The stationary piston and the piston sleeve valve at the left end of Figure 1 is in the same position as that shown in more detail in Figure 6, i. e., taking in or compressing a charge of compressed air and gas and exhausting burnt charge.

In Figure 1 at *B* we show an oil pump discharge pipe and at *C* we show a similar pipe for the purpose of oil pump suction. Also we show two oil control rings or wiping rings on the outside of the cylinder piston sleeve valve, which rings are indicated at 33 and located one on each side of the exhaust ports which channels are drilled for drain back into the crank case, thereby eliminating oil wastes at exhaust ports, and also stops bow-by to the crank case. The inside edges of these rings are bevelled on each side to allow for assembling and dismantling over the cylinder piston valve sleeve rings.

In the operation of the engine, a charge of cold gas is taken in through the mixing valve into the compression chamber (and supercharging chamber) which gas is drawn in as that cylinder piston sleeve valve goes on compression, when this piston sleeve valve is forced out on the power stroke, this forces the gas under pressure into the firing chamber when the intake ports are open.

The pressure in this compression chamber can be regulated as heretofore explained by the reduction gearing, worm screw and by the eccentric and wedge members, thereby increasing or reducing the compression chamber pressure or supercharging pressure and controlling same as desired. We also take a larger volume of gas into this compression chamber because the diameter of this chamber is larger than the firing chamber. With the stationary piston and the forked rods which are clamped around the crank shaft (the pistons being stationary) in respect to reciprocating in the cylinders and a power pressure on the cylinder piston valve sleeves through the spacer and driving block to the crank throw 25' there is provided a push and pull power directly on the crank shaft, which reduces torque or thrusts of piston or sleeves against the crank case or outside cylinders. With this construction we can keep the piston under power longer by opening the exhaust port later, as the gas is forced into the firing chamber under supercharging pressure which cleans out the burnt gas from the top to the bottom of the firing chamber.

With cylinder piston sleeve valves continually running against air pressure or the air cushion we have provided a real mechanical improvement as this makes a much smoother running engine, which will be apparent to those familiar with this class of engines.

Likewise the spark plugs are also shut off from the heat of the explosion except for a fraction of the piston sleeve valve travel and this gives a cooler running spark plug. It will also be apparent that the cold air and gas taken in at the compression chamber is pre-heated by the hot piston sleeve valve head before it is by-passed into the firing chamber and upon entering the firing chamber this gas is again expanded and heated as this chamber is hot from the previous explosion.

The engine was designed for air-craft use and by being made horizontal it gives a better view over the nose of the air ship and less head resistance in the air as compared with radial engines. It should be borne in mind that the engine has no blowers or crank case compression as in other types of engines of this class, and we obtain cylinder and piston head compression. The piston sleeve valves are stopped and started on air cushions, one of the novel features of our invention. Also that we do away with all connecting rods and piston pins. Being a two-cycle motor or engine the magneto runs at crank shaft speed, therefore with one magneto no gears are necessary. Finally, the engine can be made air-cooled, water-cooled or chemically-cooled.

While the foregoing description taken with the drawings reveal a practical working embodiment of our invention, it should be understood that considerable variations, alterations and changes are

possible, such as would be within the scope and meaning of the appended claims.

What we claim as new is:

1. An internal combustion engine comprising a casing of opposed cylinder type having opposed stationary pistons and a crank shaft with a single throw or crank, piston sleeve valves, directly opposed and reciprocating in the opposed cylinders for operating said crank shaft, said piston sleeve valves being secured together and reciprocating as one unit in said cylinders, each of said cylinders having exhaust ports with packing rings of the contracting type, said packing rings being located above and below said exhaust ports in the cylinders, the packing rings having their bearing surfaces in contact with the outer surfaces of the piston sleeve valves, said engine including a piston sleeve valve spacer and a driving block intermediate the piston sleeve valves, guide means for the driving block and means for establishing operable connection between said spacer and driving block and the crank shaft in the reciprocatory action of the piston sleeve valves in each cylinder.

2. An engine as claimed in claim 1 and wherein each of said cylinders includes a supercharging or primary compression chamber, said chambers being adaptable to and having a piston or adjustable head, manually controlled or adjusted to regulate the pressure in said chambers, said chambers also being adaptable to and including an engine-driven piston having driving and control means, whereby the stroke of this piston can be regulated from a non-stroke to a maximum stroke while the engine is running including a slotted eccentric member and wedge members to slide in the slot of the eccentric member, said wedge members being controlled by a shifting fork and its control lever, whereby the slotted eccentric member is moved from center in relation to its drive shaft, by the wedge and its shifting means, thereby causing the piston to reciprocate to the extent of the movement of the eccentric from the center, thereby increasing or decreasing the volume and pressure of the mixture drawn into said chambers as the case may require.

3. An engine of the class described and as claimed in claim 1 and wherein said spacer and driving block with its guide means permit the rod portions of the stationary pistons to be mounted to straight portions of the crank shaft, the rods mounted one on each side of the crank throws of the crank shaft, thereby permitting the stationary pistons to be flexible and universal in respect to rocking movement of said piston sleeve valves in the cylinders, and permitting lateral movement of the rods and stationary pistons on the crank shaft for correct alignment.

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