No. 871,319. PATENTED NOV. 19, 1907.

P. R. BISSELL.

GAS ENGINE.

APPLICATION FILED FEB. 20, 1906.

6 SHEETS—SHEET 1.

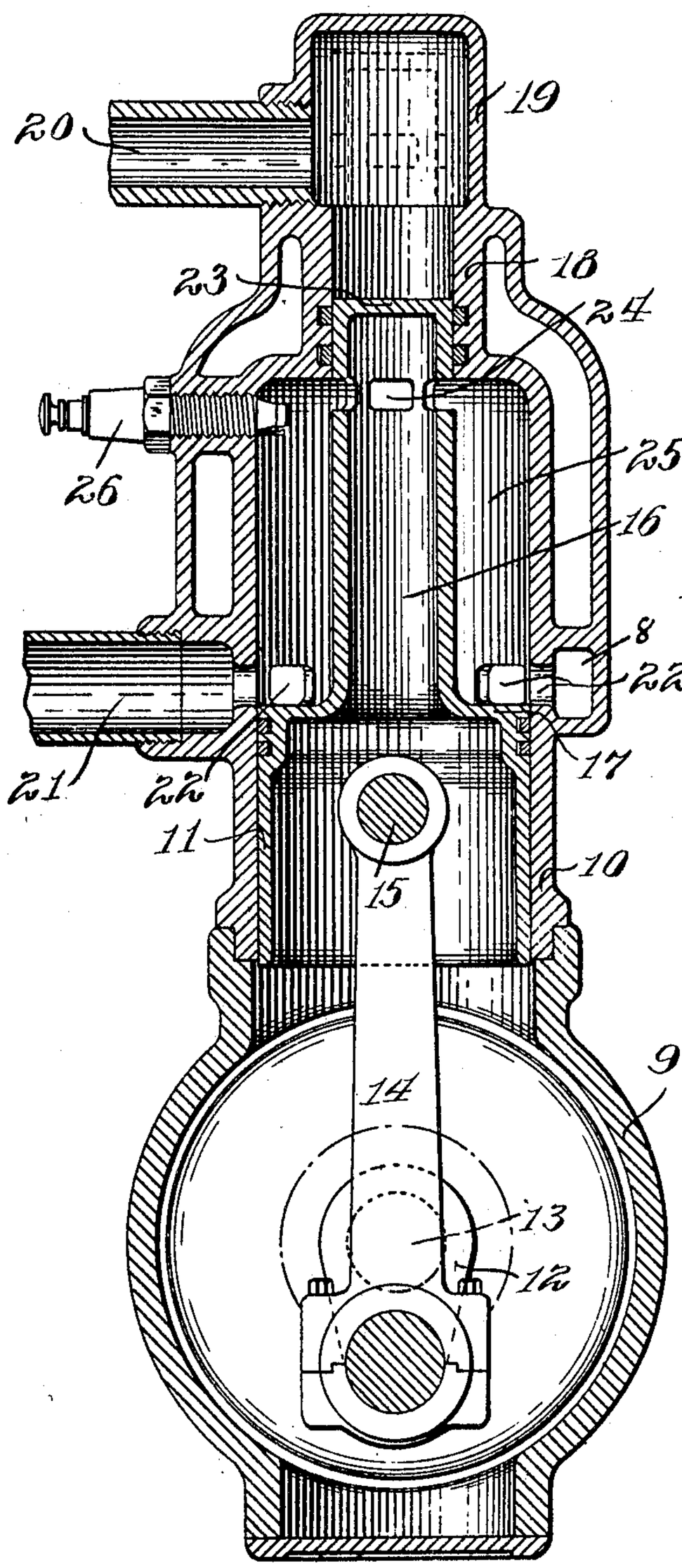

Fig. 1.

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Robert Adt

Inventor.
Percy R. Bissell;
By his Attorneys;
F. H. Richards.

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6 SHEETS—SHEET 2.

Fig. 2.

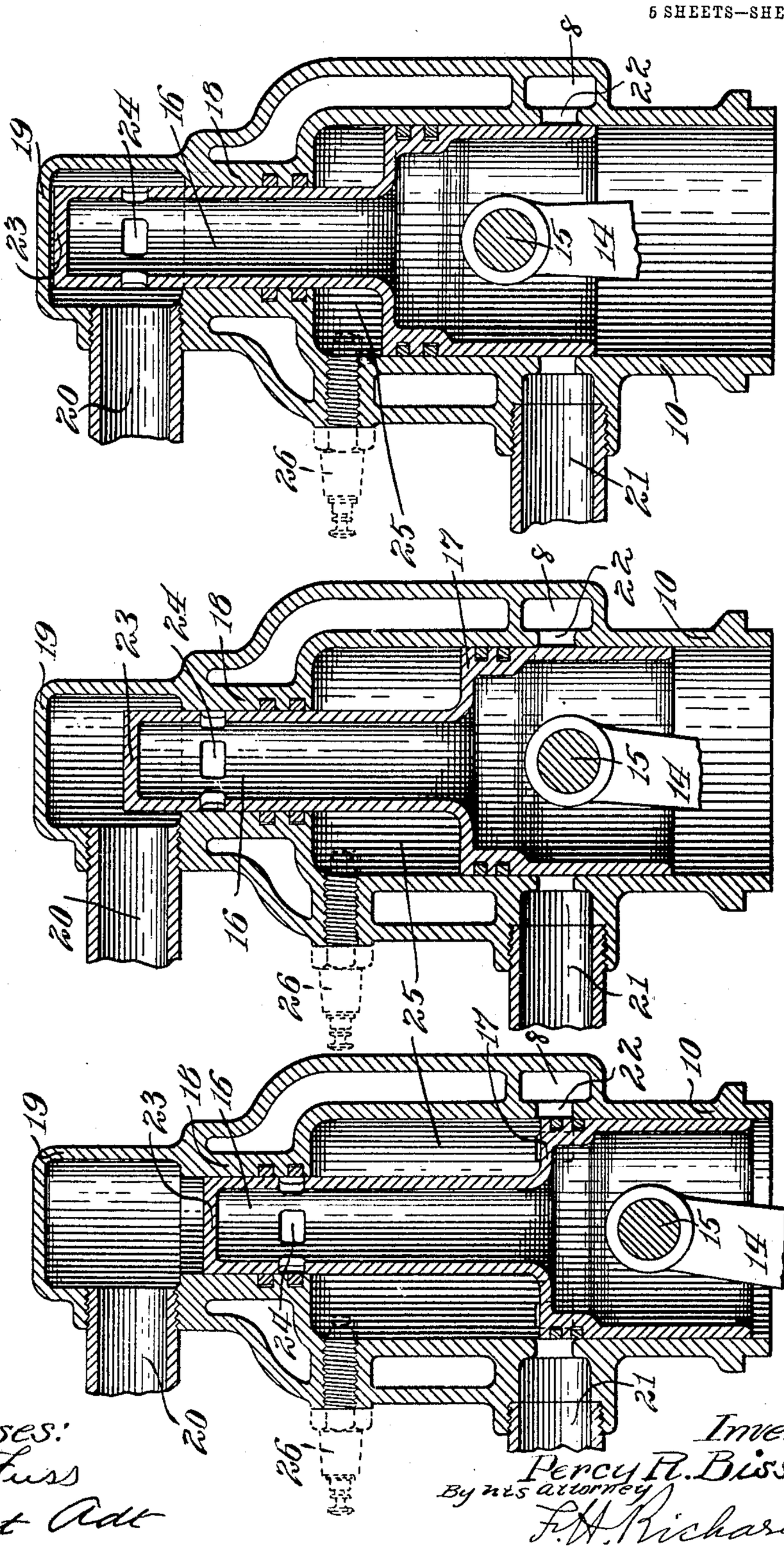

Fig. 3.

Fig. 4.

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5 SHEETS—SHEET 3.

Fig. 5.

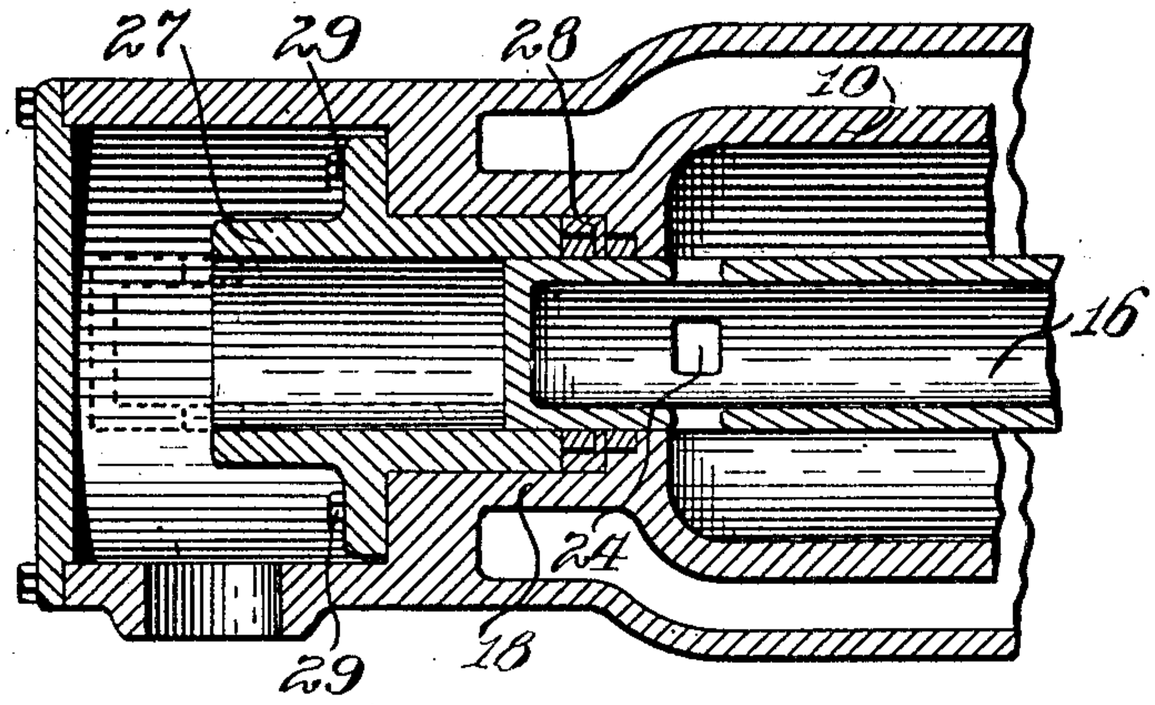


Fig. 7.

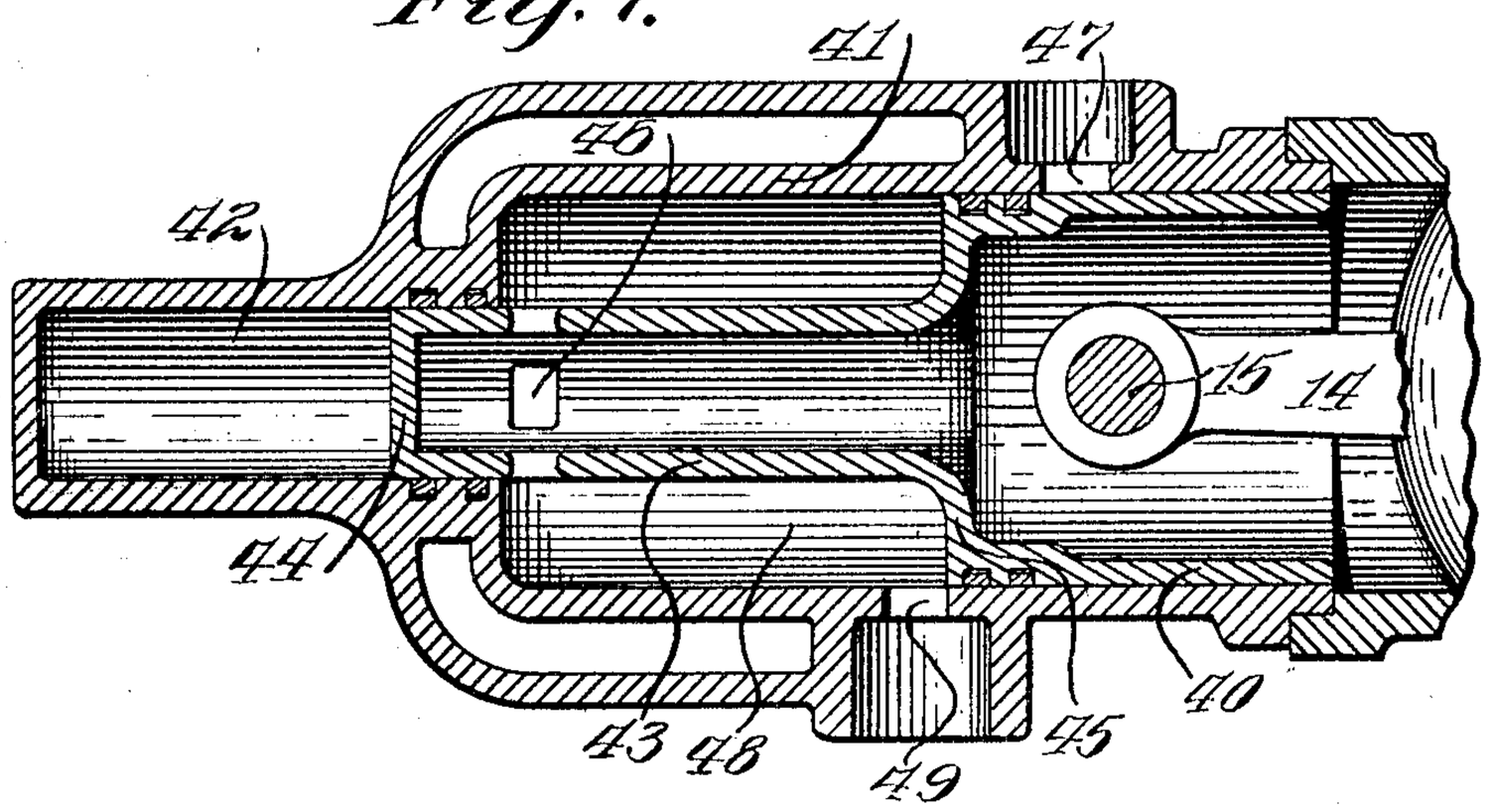
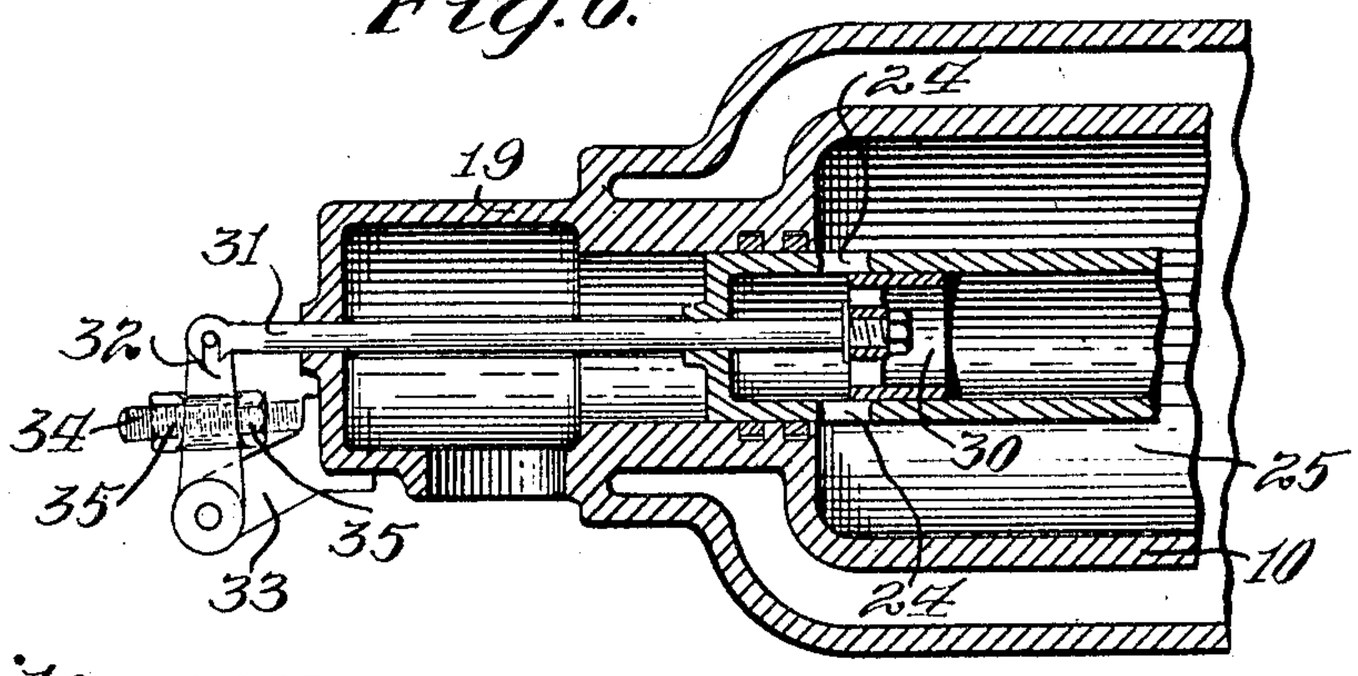


Fig. 6.



Witnesses
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5 SHEETS—SHEET 4

Fig. 8.

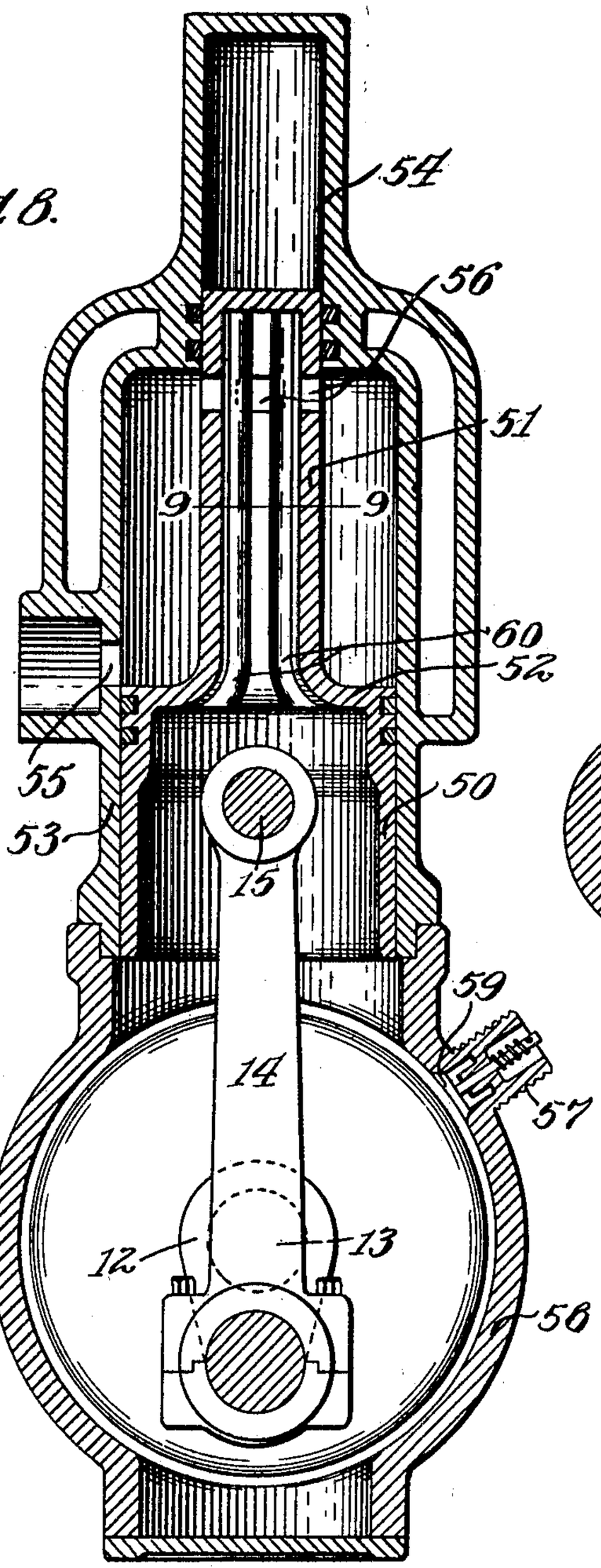
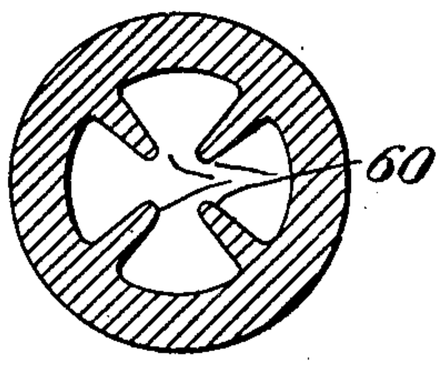


Fig. 9.



Witness:
C. C. Tuss.
Robert Adt.

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5 SHEETS—SHEET 5.

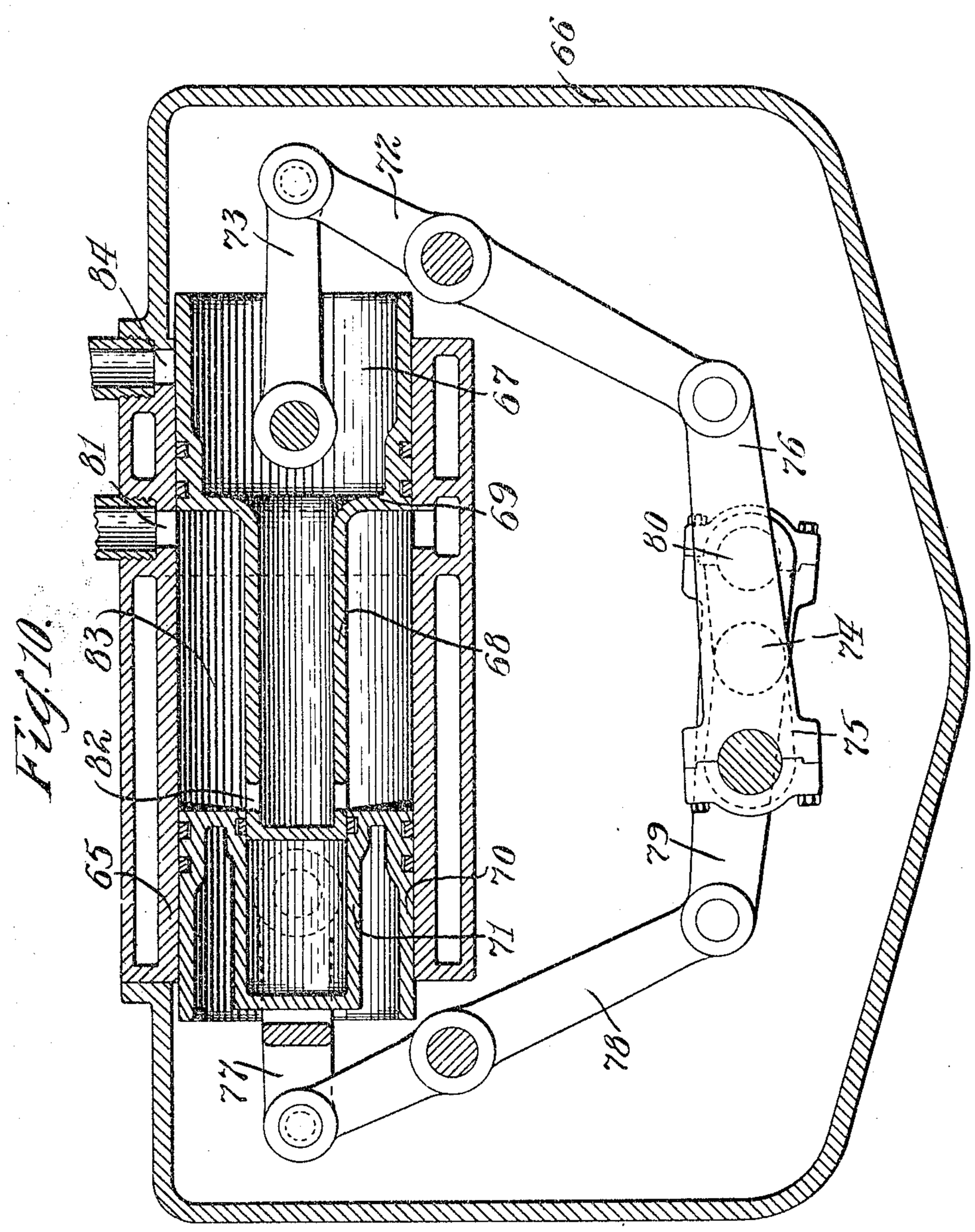

Fig. 10.

Witnesses
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UNITED STATES PATENT OFFICE.

PERCY R. BISSELL, OF NEW YORK, N. Y.

GAS-ENGINE.

No. 871,319. Specification of Letters Patent. Patented Nov. 19, 1907.

Application filed February 20, 1906. Serial No. 301,990.

To all whom it may concern:

Be it known that I, PERCY R. BISSELL, a citizen of the United States, residing in New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

This invention relates to gas engines or engines known as explosive or internal combustion engines.

It further relates to the type of gas engines known as two cycle, in which there is one explosion for each revolution of the crank shaft or one complete reciprocation of the piston in the cylinder.

One object of the invention is to provide an improved form of engine in which there is absolutely no movable valve device, but the admission and exhaust ports are opened and closed by means of registering portions of the piston and cylinder walls or extensions rigidly connected with said two members.

Another object of the invention is to provide in such a valveless structure, an organization whereby the explosive mixture will be admitted to the cylinder chamber at one end thereof and exploded or exhausted at the opposite end thereof.

A further object is to provide in the latter structure, means for drawing in the explosive gas, thereupon compressing such gas, and delivering the compressed explosive gas to the said end of the cylinder opposite the exhaust end thereof; whereby the exploded charge in the cylinder from the previous active stroke will be thoroughly expelled and displaced by a fresh mixture.

Another object of this invention is to provide in a two cycle engine of the valveless type, means for admitting to the cylinder proper at the end of the active stroke, a fresh charge of greater volume than the then available area of the cylinder and also under pressure whereby to effectually displace the exploded charge by an explosive mixture under compression.

Another object of the invention is to provide improved means for varying the timing or area of the so-called valveless ports.

Another object of the invention is to provide in a gas engine of the character above set forth an organization of two pistons in one cylinder connected with a single crank shaft and operating reactively in opposite directions. With these objects in view and others as will hereinafter appear, my invention comprehends the construction and combinations of parts substantially as hereinafter set forth.

In the drawings representing forms of gas engines embodying the principles of the present invention, Figure 1 represents a vertical section of a complete engine showing the piston in the lowermost position. Figs. 2, 3 and 4 are fragmentary views similar to Fig. 1 but showing the piston in different successive positions, Fig. 2 showing the piston in the uppermost position, Fig. 3 showing the piston in a somewhat lower position and Fig. 4 showing the piston in a position intermediate of Figs. 1 and 3. Fig. 5 shows a modification in which a removable sleeve is attached for varying the admission timing to the compression chamber. Fig. 6 shows the attachment of an adjustable sleeve for the purpose of varying the admission of the compressed charge into the main cylinder, which adjustment can be effected from the outside of the engine and during the operation thereof. Fig. 7 shows a modified form of the admission portion of the cylinder in which the mixture or gas is admitted on the opposite side of the piston from its working side instead of at the other end and passing through the piston. Fig. 8 is another modification similar to Fig. 7 but having an admission port in the crank casing which is closed; this figure also showing the cylinder extension provided with internal ribs providing greater surface for imparting heat to the mixture that is being compressed; and Fig. 9 is a transverse section through the piston extension on the line 9—9 indicated in Fig. 8. Fig. 10 shows a modification employing two connected pistons in one cylinder.

In the structures of Figs. 1 to 4, the engine comprises a main cylinder 10 having a crank case 9 that is connected therewith and which is closed against escape of the gas. In the cylinder 10 operates the main piston 11 which is shown as cylindrical and is of the trunk type and connected with a crank 12 on a shaft 13 by a connecting rod 14 by means of a wrist pin 15, in the usual manner. The hollow piston 11 has a cylindrical extension 16 connected with its head 17 which head is thus annular or of the differential type. The piston extension 16 extends throughout the length of the cylinder 10 and projects into the bore of a reduced extension 18 of the cylinder 10, the extension 16 fitting

snugly into this cylinder extension, thereby forming a differential piston working in an annular chamber in the cylinder, the effective portion of the piston 11 being the annular portion 17. Extension 18 of the cylinder terminates in a head 19 into which leads the admission pipe 20 from the gas supply or mixture.

The exhaust from the main cylinder portion 11 is through an exit pipe 21 and chamber 8 having one or more ports 22 leading into the cylinder. These ports 22 are uncovered when the main piston 11 is in its lowermost position as shown in Fig. 1, but when the piston rises to the position shown in Fig. 4, these exhaust ports are closed and remain closed as the piston travels upward, as shown in Figs. 3 and 2.

The piston extension 16 has its upper end 23 closed, but is provided with one or more side ports 24, that when the piston is in the uppermost position as shown in Fig. 2 will admit the gas from the inlet pipe 20 into the hollow piston, and therefore into the crank chamber space below the hollow piston. As the piston descends from the position shown in Fig. 2 to that of Fig. 3 it will be seen that the piston admission ports 24 are automatically closed by means of the walls of the cylinder extension 18. When the piston descends to the position of Fig. 1, it will be observed that the ports 24 therein are open to the annular cylindrical space which is denoted by 25. Any desired means may be employed for exploding the charge or mixture in this annular space 25 at the proper period, a spark plug 26 being indicated whose circuit is closed at the proper time by any preferred means, not shown.

The operation of the parts described is as follows: Supposing the engine to be standing idle without any gas mixture therein, the crank shaft is operated to start the engine. Beginning with the position of Fig. 2, with the piston uppermost, the downward stroke of the piston from the position of Fig. 2 to that of Fig. 4, will compress the atmospheric air contained in the hollow piston and in the crank case; at the same time whatever atmosphere or gas was in the cylinder space 25 will be expanded and upon reaching the position of Fig. 1, the air compressed in the cylinder and crank case will now be opened to the cylinder space 25 through ports 24 and the latter will be opened to the exhaust through the ports 22. The compressed air will obviously find relief through the cylinder space 25 and entering it at one end will drive the contained gas whatever it may be ahead of it out through the other end at 22; thus performing a scavenging act. Upon the return upward stroke of the piston, the ports 22 and 24 will very soon be covered as indicated in Fig. 4. This will cause a compression in the cylinder space 25; but will cause an expansion in the crank case chamber since the ports 24 are closed and no admission port is now open. But as soon as the ports 24 pass upward from the position of Fig. 3 to open to the admission pipe 20, the partial vacuum therein will cause the explosive mixture to be sucked in through the pipe 20 into the entire space of the hollow piston and the crank case. Then upon the return or downward stroke of the piston, the piston ports 24 will be at once closed by the adjacent walls, thus causing a compression of the explosive gases in the crank case and hollow piston. And when the piston reaches the lower position opening the ports 24, the compressed explosive mixture in the crank case will have exit into the upper end of the cylinder chamber 25, and will naturally drive out the gas or atmosphere in this space through the ports 22 at the other end of the cylinder space 25. In this way an explosive charge is drawn into the cylinder proper. Now upon the upward stroke of the piston, the port 22 is closed and the explosive charge retained in the cylinder chamber and compressed during the entire upward stroke of the piston. The ports 22 are closed by the cylinder extension preventing escape of the explosive mixture and at the same time causing a rarefication in the crank case and hollow piston. When the piston reaches the limit of its upward stroke, the ports 24 will uncover to the admission pipe 20 and draw into the crank case a new charge of gas. And at this period, the ignition device is caused to operate to explode the compressed explosive mixture in the piston chamber 25. This latter will obviously drive the piston downward and constitute the active stroke of the engine. As the piston is driven downward, the ports 24 will be covered and the charge in the crank case and hollow piston will be again compressed. At the end of this active stroke as shown in Figs. 4 and 1, the exhaust ports 22 will uncover permitting the exploded charge to escape through the exhaust pipe 21. But at this period, the ports 24 will be uncovered admitting the compressed charge in the crank case and hollow cylinder into the piston chamber 25 at the end opposite to the exhaust ports 22. The effect of this will be to drive out the exploded charge through the port 22 and to displace the same by a fresh mixture under compression in the crank case. The momentum of the fly wheel and engine parts from the active downward stroke will in the usual manner move the piston upward. As above explained, this upward stroke, closing the exhaust port and admission port 24 will compress the fresh charge in the cylinder chamber 25, and will draw in a fresh charge into the crank case and hollow piston. At the end of the upward stroke, the ignition device as before will ignite the compressed charge

that will drive the piston downward repeating the operation. From this it will be seen that at the upward stroke of the piston or at one half of each revolution of the crank shaft, a fresh charge is compressed for ignition and at the same time a supply is drawn into the crank case and piston to be compressed, while during the downward stroke or second half of the revolution, the compressed charge is exploded causing the advancement of the piston, and at the same time the fresh charge is placed under compression. Furthermore, at the end of the active stroke, the exploded gases are expelled from the working chamber, and are replaced by a fresh charge to be compressed during the upward stroke.

In Fig. 5 is shown a removable sleeve 27 arranged in the extension 18 of the cylinder that acts as a gland or follower to compress a packing ring 28 around the piston extension 16; the sleeve being clamped by bolts 29 tapped into the extension. This sleeve serves to more or less throttle the ports 24 in the extension and thus control the amount of gases admitted according to its adjustment.

Means are provided for throttling or adjusting the size of the admission passage of the compressed charge into the cylinder chamber 25, which means is shown as adjustable from the outside of the engine, and may even be adjusted during this operation. One form of such means is illustrated in Fig. 6 comprising a sleeve 30 secured to the rod 31 passing through the end of the head 19 and pivotally connected with a link 32 that is hinged to a bracket 33 fast on the head. A bolt 34 also fast on the bracket passes through the link 32 and carries jam nuts 35, 35 serving to clamp the link in its adjusted positions. The sleeve 30 is thereby adjustably secured in engagement with the bore of the piston extension 16 as shown in Fig. 6. And when this extension is in its lower position causing the ports 24 to be opened to the working chamber 25, the sleeve will project more or less over these ports and thus restrict their opening in the manner shown. By adjusting the jam nuts 35, the sleeve 30 is raised or lowered to vary the amount of the throttling of these ports 24 when in this position. But obviously when the extension moves upward to the position of Fig. 2, the collar 30 in no wise interferes with the admission of the explosive gas into the piston extension.

It will be observed in these several forms of the invention that the exploded charge is driven out at one extremity of the explosion chamber while the fresh charge of explosive mixture is admitted at the opposite end of such explosion chamber. And the explosive gases are admitted to such end of the chamber under pressure above atmospheric, which two conditions will result in a thorough scavenging or cleaning out of all traces of the exploded gases, which will be replaced by a fresh charge of explosive mixture. It will be further observed that the volume of the space in the explosion chamber that is traversed by the annular piston therein, is considerably less than the volume of the space traversed by the other portion of the piston including its extension when performing the operation of compressing the explosive gas to be introduced into the explosion chamber at the completion of the working cycle or stroke. As a result of this latter preponderance of effective areas, it is always assured that the exploded gases will be entirely driven out of the explosive chamber at the end of the stroke and replaced by an explosive gas to be compressed on the return or second stroke of the engine. Furthermore the structure herein set forth insures that the explosive gas or mixture will be drawn in through the admission port at every working stroke into the proper chamber to be compressed and then admitted into the explosion chamber under more or less pressure.

What I claim is:

1. In an explosive engine, a cylinder having a chambered extension, a hollow piston working in the cylinder and provided with a chambered extension working in the cylinder extension, the piston extension having its free end closed and being provided with a lateral port normally closed by the wall of the cylinder extension, a side port at the end of the cylinder extension arranged to open to the port in the piston extension at one end portion of the piston stroke, said piston extension ports being arranged to open to the cylinder when the piston is at the other end of its stroke, and a closed crank case opening into the cylinder, the piston being open to said extension providing a passage through the piston by means of the ports in such extension.

2. In an explosion engine, a cylinder having a chambered extension at one end the said extension having an enlarged chamber at its free end, an admission port in said enlarged chamber, a hollow piston working in the cylinder and provided with a closed chambered extension operating in the said cylinder extension, one or more side ports in the piston extension normally closed by the walls of the cylinder extension, but arranged to open to the cylinder at one limit of the piston stroke and to open to the said enlarged cylinder extension chamber at the other limit of the piston stroke, and a closed crank case opening into the cylinder, the piston being open to said extension providing a passage, through the piston by means of the ports in such extension.

3. In an explosion engine, a cylinder hav-

ing a chambered extension, a hollow piston working in the cylinder and provided with a chambered extension working in the cylinder extension, the piston extension having its free end closed and being provided with a lateral port normally closed by the wall of the cylinder extension, a side port at the end of the cylinder extension arranged to open to the port in the piston extension at one end portion of the piston stroke, said piston extension ports being arranged to open to the cylinder when the piston is at the other end of its stroke, a closed crank case opening into the cylinder, the piston being open to said extension providing a passage through the piston by means of the ports in such extension, the cylinder being provided with exhaust ports normally covered by the piston but uncovered at the end of its active stroke when the said extension ports are opened to the cylinder.

4. In an explosive engine, a cylinder having a chambered extension at one end, the said extension having an enlarged chamber at its free end, an admission port in said enlarged chamber, a piston working in the cylinder and provided with a closed chambered extension operating in the said cylinder extension, one or more side ports in the piston extension normally closed by the walls of the cylinder extension, but arranged to open to the cylinder at one limit of the piston stroke, and to open to the said enlarged cylinder extension chamber at the other limit of the piston stroke, the cylinder being provided with exhaust ports normally covered by the piston but uncovered by the piston at the end of its active stroke when the said extension ports are opened to the cylinder, and a closed crank case opening into the cylinder, the piston being open to said extension providing a passage through the piston by means of the ports in such extension.

5. In an explosive engine, the combination with a cylinder, a closed crank case opening to the cylinder at one end, a reduced chambered extension on the other end of the cylinder provided with an enlarged chamber at its outer end, an admission port for said latter enlarged chamber, a chambered piston working in the cylinder and provided with a chambered extension working in said cylinder extension, the piston extension having its free end closed and provided with one or more lateral ports adjacent said end that are alternately open to the cylinder at one end of the stroke and to the said enlarged chamber at the other end of the stroke, the cylinder being provided with exhaust ports normally covered by the piston but uncovered at the end of its active stroke when the said extension ports are opened to the cylinder.

6. In an explosive engine, a cylinder having a chambered extension, a hollow piston working in the cylinder and provided with a chambered extension working in the cylinder extension, the piston extension having its free end closed and being provided with a lateral port normally closed by the wall of the cylinder extension, a port at the end of the cylinder extension arranged to open to the port in the piston extension at one end portion of the piston stroke, said piston extension ports being arranged to open to the cylinder when the piston is at the other limit of its stroke, said piston extension having an aperture in its closed end, a closed crank case opening into the cylinder, the piston being open to said extension providing a passage through the piston by means of the ports in such extension, an alining aperture in the end of the cylinder extension, a rod projecting into the cylinder and piston through said apertures, an open tubular member secured to the lower end of said rod, mechanism on the outside of the cylinder for locking said rod in adjusted positions whereby said tubular member will more or less register with the lateral ports in the piston extension when the latter are open to the cylinder.

7. In an explosive engine, a cylinder having a chambered extension at one end, the said extension having an enlarged chamber at its free end, an admission port in said enlarged chamber, a piston working in the cylinder and provided with a closed chambered extension operating in the said cylinder extension, one or more side ports in the piston extension normally closed by the walls of the cylinder extension, but arranged to open to the cylinder at one limit of the piston stroke, and to open to the said enlarged cylinder extension chamber at the other limit of the piston stroke, the cylinder being provided with exhaust ports normally covered by the piston but uncovered by the piston at the end of its active stroke when the said extension ports are opened to the cylinder, a closed crank case opening into the cylinder, the piston being open to said extension providing a passage through the piston by means of the ports in such extension, said piston extension having an aperture in its closed end, an alining aperture in the end of the cylinder extension, a rod projecting into the cylinder and piston through said apertures, an open tubular member secured to the lower rod in adjusted positions whereby said tubular member will more or less register with the lateral ports in the piston extension when the latter are open to the cylinder.

Signed at Nos. 9 to 15 Murray St., New York, N. Y., this 17 day of February, 1906.

PERCY R. BISSELL.

Witnesses:
F. E. BOYCE,
WILLIAM H. REID.