J. M. MEYER.

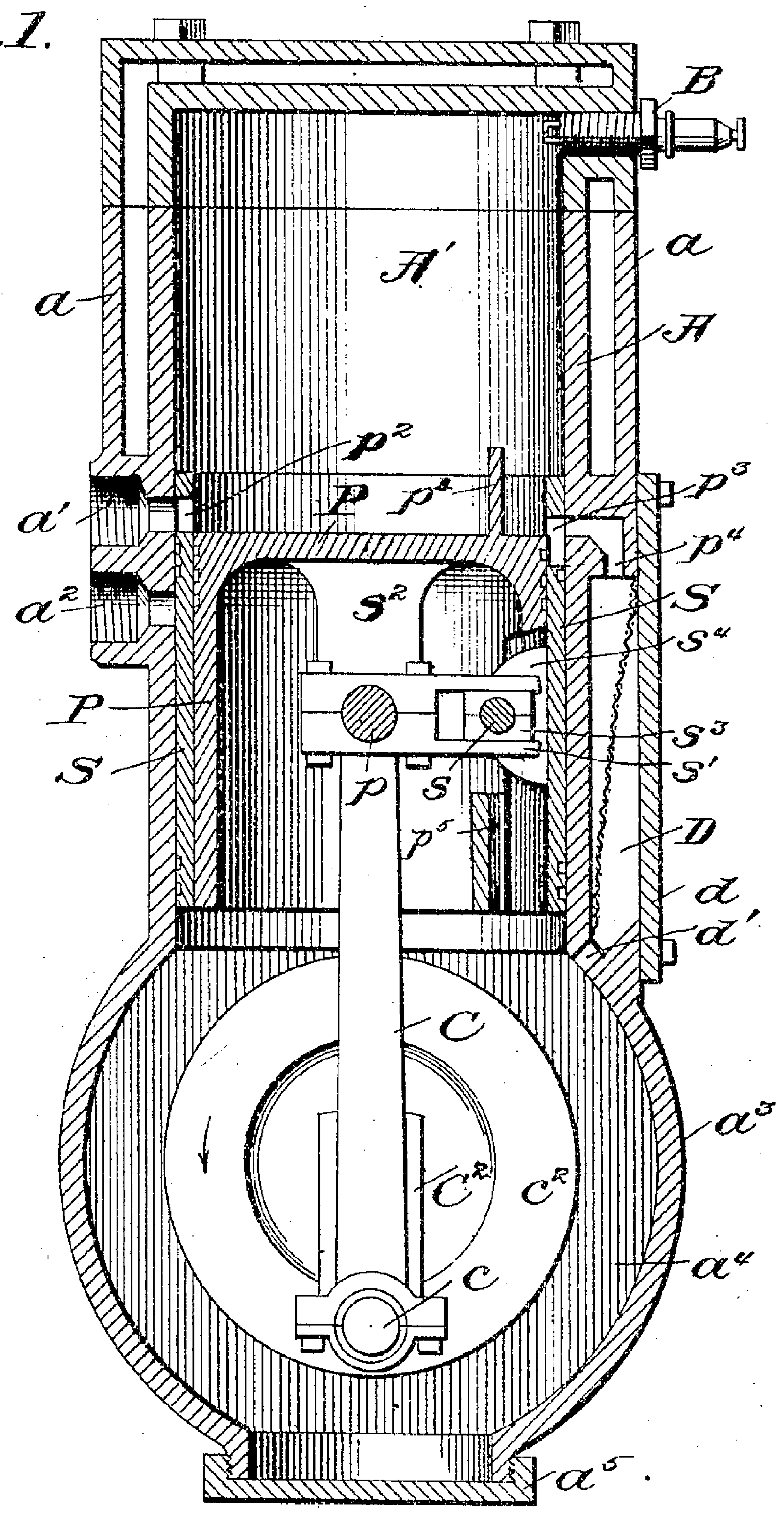
HYDROCARBON ENGINE.

APPLICATION FILED DEC. 22, 1906.

915,103. Patented Mar. 16, 1909.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

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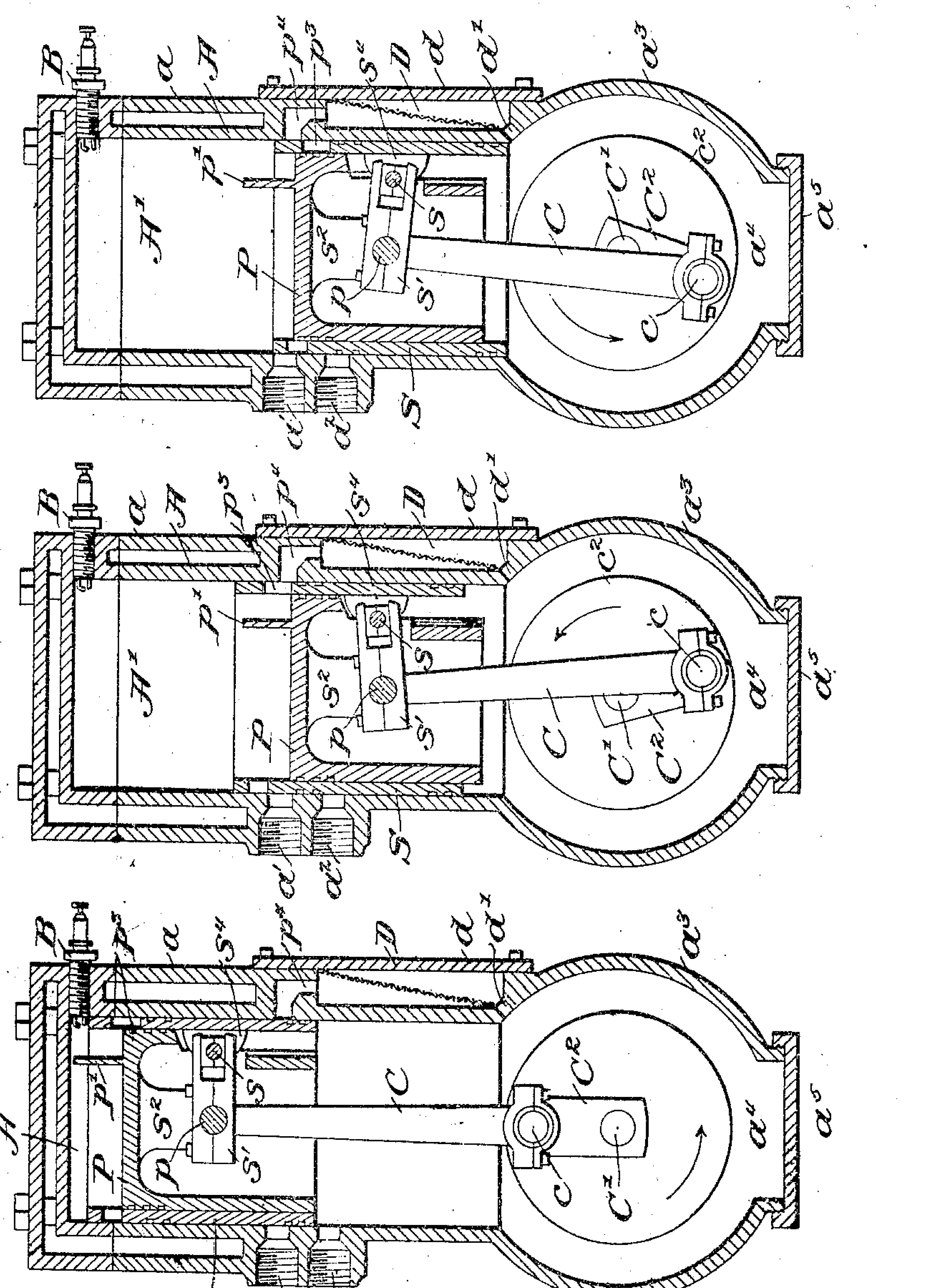
4 SHEETS—SHEET 2.

Fig. 3.

Fig. 4.

Fig. 2.



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4 SHEETS—SHEET 3.

Fig. 5.

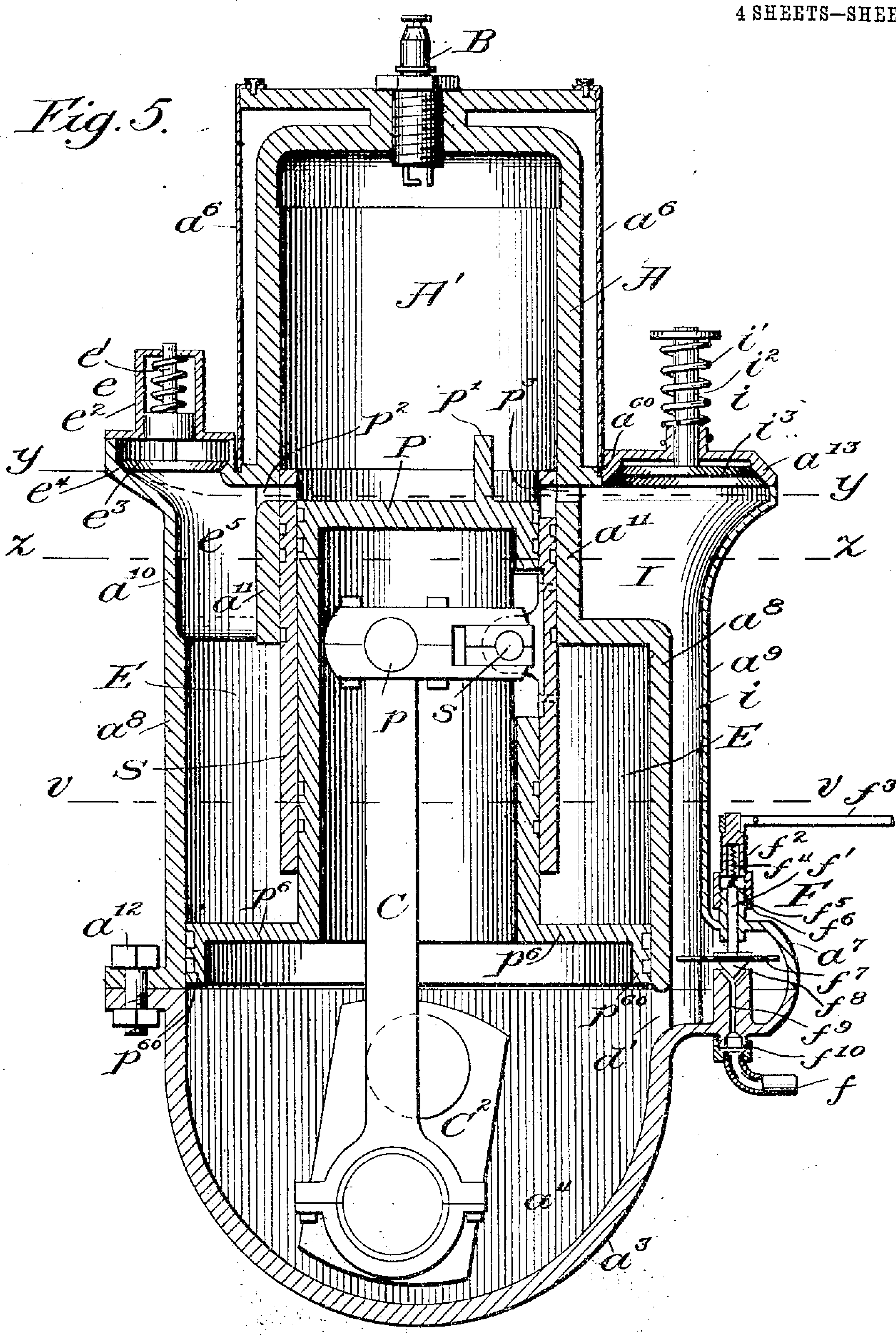
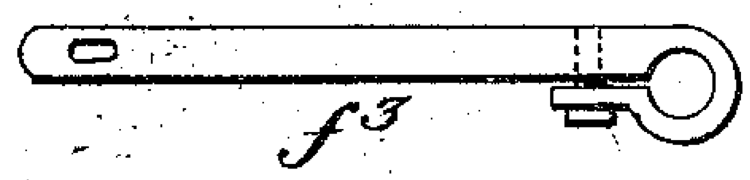


Fig. 7.



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4 SHEETS—SHEET 4.

Fig. 6.

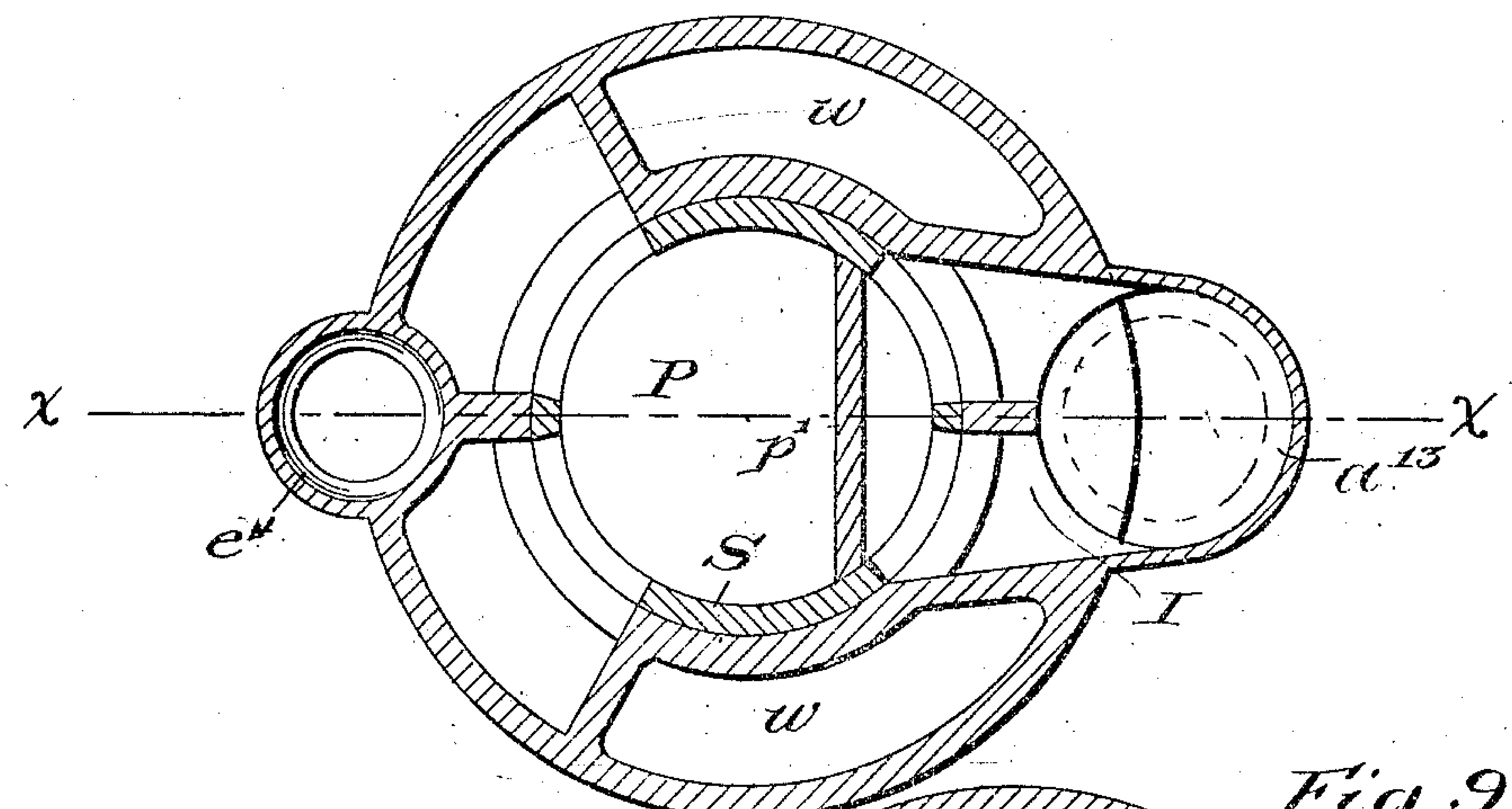


Fig. 9.

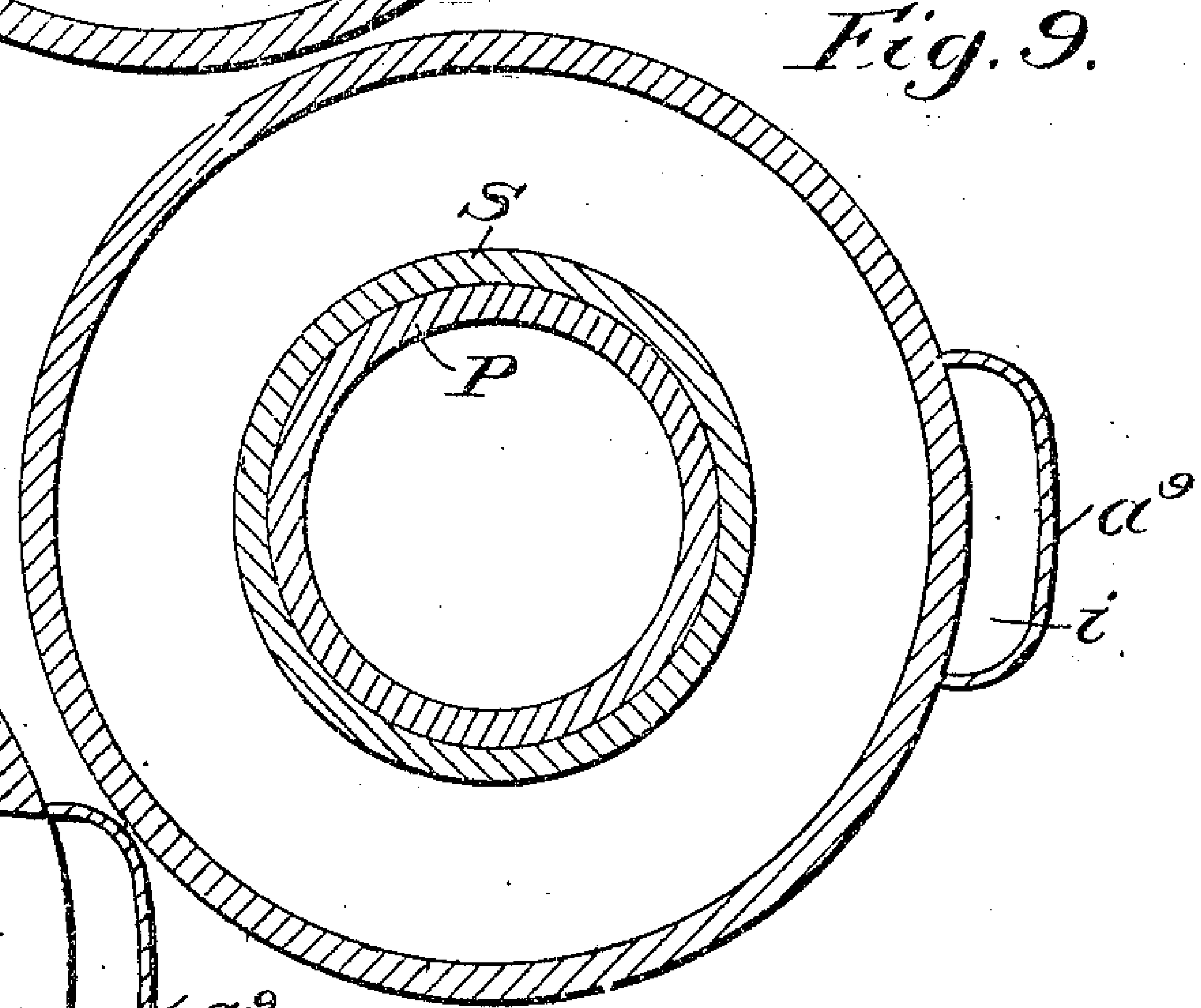
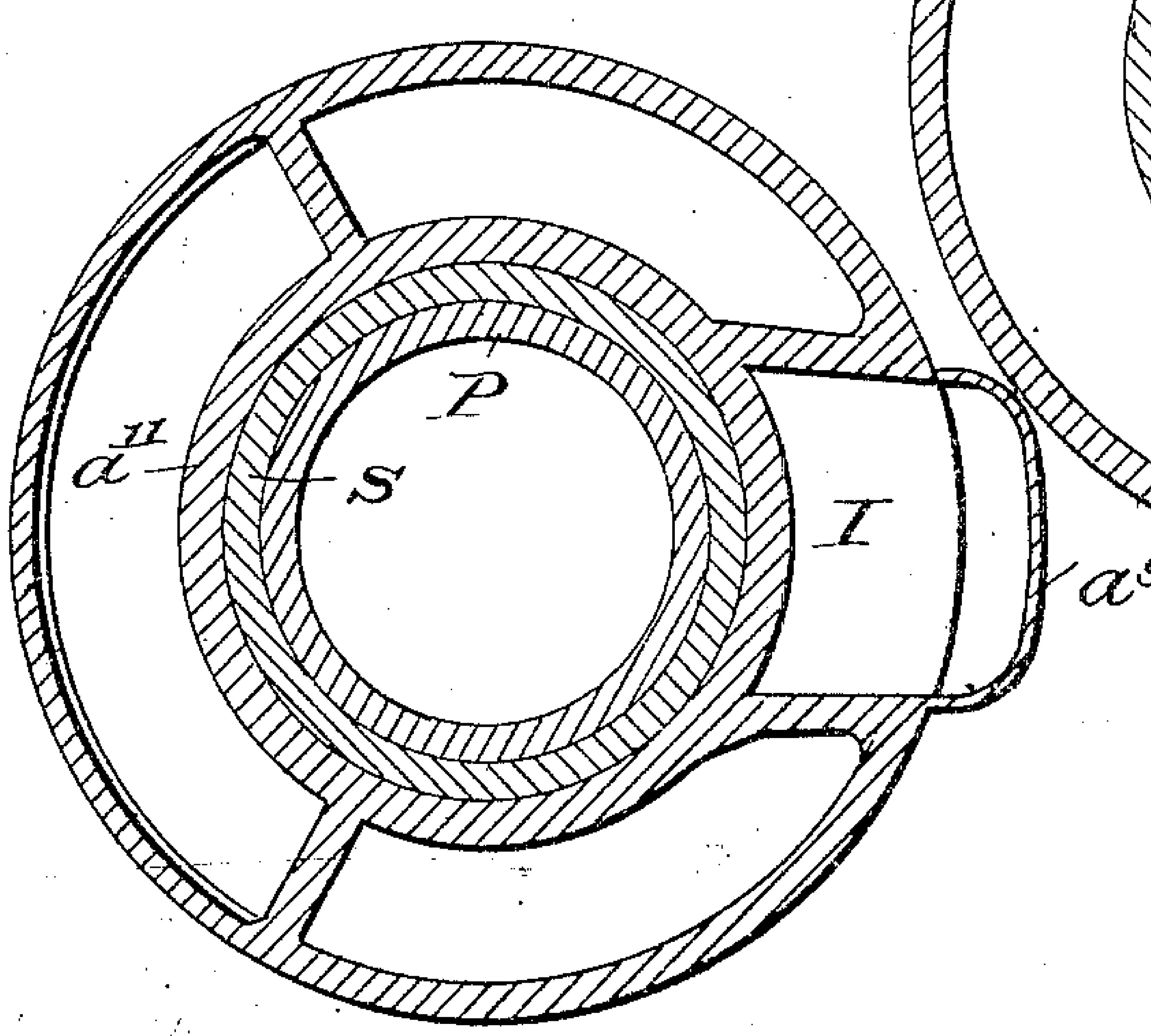


Fig. 8.



Witnesses:

[illegible]

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Inventor:

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UNITED STATES PATENT OFFICE.

JOHN MAX MEYER, OF WEST CHESTER, PENNSYLVANIA.

HYDROCARBON-ENGINE.

No. 915,103. Specification of Letters Patent. Patented March 16, 1909.

Application filed December 22, 1906. Serial No. 349,193.

To all whom it may concern:

Be it known that I, JOHN MAX MEYER, a citizen of the United States, residing at West Chester, in the county of Chester and State of Pennsylvania, have invented certain new and useful Improvements in Hydrocarbon-Engines, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to internal-combustion engines of direct acting explosion type and particularly to what are known as two cycle engines. This statement is one of definition and not of limitation, as I contemplate applying my improvements to any engine wherein they are economically applicable.

The invention has for its object to provide means whereby the efficiency of engines of the type stated may be increased, and the design thereof improved in divers particulars which will sufficiently appear from the detailed description hereinafter.

I attain my principal object, which is to increase the efficiency of engines of the type mentioned, by modifying the arrangement, relations, and controlling the operation of the several valve ports. Heretofore the hydrocarbon fuel has been admitted to the cylinder after being vaporized and mixed with air, then the residue of the explosion has been expelled through the exhaust opening by means of pressure wholly or partly created by the inrush of a fresh supply of fuel. It has been customary to leave both the inlet and the exhaust ports open during this process of sweeping out the products of combustion, both ports being succeedingly closed as the piston reverses its travel. Such an arrangement is highly inefficient for the reason that there can be absolutely no compression of the fuel gas in the cylinder beyond that produced by the movement of the piston itself. In all engines of this type of which I have knowledge, the hydrocarbon is first taken into some kind of a mixing and compressing chamber, usually the crank case, and is there placed under pressure by the piston in its forward or driven movement. Near the end of the direct forward stroke the ports are first opened and then closed, as I have already stated, but there can be no compression produced behind the piston when the fresh gas rushes into the cylinder because the exhaust port is open. In fact, unless the adjustment of ports and pressures is quite accurate, there is usually a waste of fresh hydrocarbon gas from the exhaust valve at each stroke.

The present invention enables me to produce an initial pressure behind the piston as it starts back on the return stroke. This is accomplished by means of a sliding piston ring or sleeve coupled to the connecting rod and so arranged that at the beginning of the return stroke it closes the exhaust port in advance of closing the inlet port. In other words, I arrange my ports so that the inrush of fresh air or fuel gas first sweeps out the products of combustion, and then continues to enter for a brief period after the exhaust port is closed. I have found it possible by this means to increase the quantity of gas in the cylinder at the beginning of the return stroke and consequently the efficiency of the engine over 50%.

A second feature of my invention, which is of great importance, lies in the shape and proportions of the piston, and the crank case or compression chamber. The area of piston surface exposed in the cylinder is less than one-half the area of the surface which produces the compression in the crank case. This relative proportion is not invariable, but an increased area for the compression surface is essential in order to force a larger volume of gas into the cylinder or explosion chamber than is displaced by the movement of the piston in its driven stroke.

A third feature of my invention, which is corollary or subsidiary to the second, is the formation of a vacuum chamber and suction inlet chamber around the walls of the cylinder and above the enlarged or flanged end of the piston. The vacuum chamber is connected to the exhaust pipe, and the exhaust port opens into it. A check valve opening outwardly is placed at the outer exhaust opening, and the result is that the cylinder exhausts into the vacuum chamber, and the latter into the air or any suitable receiver, with little or no noise. The explosion chamber is completely swept out at each exhaust, a careful examination and chemical test failing to show any residuum after the complete stroke. The suction inlet chamber enables me to dispense with any screen or other device for protecting each fresh charge from ignition by the heated products of combustion remaining after the last explosion. This inlet chamber opens into the crank casing or compression chamber at one end, and into the cylinder through the inlet port at the other end. An inwardly opening check valve is provided at a third opening communicating with the outer air, and the carbureter or fuel supply valve is connected directly with this air inlet chamber, in proximity to the compression chamber opening. In operation, as the piston moves up on its return stroke, it produces rarefaction in the air inlet chamber as well as in the compression chamber, a fresh supply of air is drawn in the latter, and at the same time a column of fresh air comes in past the check valve and fills the inlet chamber. As the piston reverses its stroke and is again driven forward by an explosion, the gas in the compression chamber and the air in the inlet chamber are both placed under compression, and at the end of the stroke when the inlet and exhaust ports are both open, the air from the inlet chamber is forced into the cylinder in advance of the fresh fuel gas, sweeping out the products of combustion and preventing the fresh charge from being ignited.

A fourth feature of my invention is a novel form of water jacket, and other subsidiary features will sufficiently appear from the detailed description hereinafter.

My invention is illustrated as two embodiments in the accompanying drawings, in which—

Figure 1 is a vertical section of a standard type of water cooled engine having a modification of my improved piston substituted for the ordinary piston. Figs. 2, 3 and 4 are diagrams of the same engine taken on the same section line, and showing the parts at different points in the stroke of the piston. Fig. 5 is a vertical section on the line $x—x$ in Fig. 6, showing a preferred embodiment of all the features of my invention. Fig. 6 is a horizontal section on the line $y—y$ of Fig. 5. Fig. 7 is a detailed view of the throttle lever removed. Fig. 8 is a horizontal section taken on the line $z—z$ of Fig. 5, and Fig. 9 is a similar section taken on the line $v—v$ of Fig. 5.

Referring to Figs. 1 to 4, inclusive, A is the engine cylinder having an explosion chamber A′ inclosed within its walls, and having outer walls a in order to provide for a circulation of water for cooling purposes. This forms no part of my invention in itself, the method of constructing and cooling the cylinder being a matter of indifference as long as the interior surface permits the necessary stroke. The cylinder is cast preferably in one piece with a crank casing a^3, closed at the bottom by a cap a^5, and containing within it the compression chamber a^4. The fly wheel c^2 is turned within this chamber by the crank arm C^2, coupled by means of the wrist-pin c and the connecting rod C to the pin p on the piston P. The connecting rod has a split crosshead the two halves of which are secured together by bolts spaced apart and lying on either side of the pin p. On one side of the connecting rod the crosshead is cut away equally in the two halves to provide a slide bearing s, which is journaled between brass blocks s^3 moving back and forth in the slide between the jaws s' of the crosshead. The stud s is attached to and projects from a lug s^4 cast or otherwise secured upon the inner face of the tubular sleeve S, whose function is that of a valve, acting in conjunction with the piston to open and close the several ports of the cylinder in predetermined order. This sleeve is carefully surfaced inside and out so that its outer face fits the cylinder perfectly, and its inner face fits the piston. Outer faces are provided with suitable packing rings of any desired construction, and since the movement of the sleeve on the piston is limited, as will presently appear, I have thus produced in effect a compound piston of which the two parts travel together in obedience to the pressure created by explosion of the fuel gas, and also travel relatively to each other. The exhaust port of the cylinder is indicated at a', the inlet port from the carbureter or supply tank to the compression chamber is marked a^2, and the inlet from the compression chamber to the cylinder is marked p^4, being part of a continuous channel or passage way commencing at an opening d' in the casing a^3, and continued at D by means of a cover plate d secured to the body of the engine and removable for the purpose of clearing the screen and ports of the engine. The piston P is hollow, as usual in this type of engine, and for convenience I have shown a lug s^2 projecting from the lower side of its crown or head, carrying the pin p. This may be changed in practice. On the upper side of the head I provide a deflector or baffle plate p' whose function is to deflect the mixture of gas and air entering through the passage way d', D, p^4, so that it will be thrown up into the explosion chamber A′ and effectually force out the products of combustion through the port a'. These inlet and exhaust ports are opened by means of the registering ports p^3 and p^2, respectively, which are cut in the walls of the sleeve S. The piston P moves within the sleeve so as to cut off these ports at the lower end of the stroke as will appear from the statement of operation. The invention in this form of engine resides particularly in the sleeve S and its arrangement with relation to the piston on the one hand and the cylinder on the other, the crank oscillating the connecting rod from side to side, and this in turn moving the sleeve by means of the crosshead extension, or jaws s', acting on the split bearing block s^3 through a changing angle. In order to assemble these parts readily I make a slot in one side or wall of the piston, so that the latter may be slid into the tubular sleeve from the top, the piston walls being stiffened by a connecting arch p^5.

I have shown the ordinary type of spark plug B at the upper end of the cylinder, but it is to be understood that this as well a many other non-essential details of construction may be varied as desired.

The operation of my improved engine will be fully understood by referring to the diagrammatic Figs. 2, 3, and 4, which show the parts as they appear at different points in the stroke. Fig. 1 shows the piston at the lower end of the stroke with the crank on center, and both inlet and exhaust ports fully opened. Fig. 2 shows the piston at the upper end of the stroke, the inlet and exhaust ports of the cylinder being closed, and the inlet port a^2 to the compression chamber being open. Fig. 3 shows the piston approaching the lower end of the stroke, with exhaust open and inlet still closed. Fig. 4 shows the piston still unmoved or very slightly moved from the lower end of the stroke, but with the sleeve S thrown up sufficiently to close the exhaust a' while leaving the inlet p^4 still open. We will first assume the ports to be in position of Fig. 2, the explosion chamber A′ containing a charge of gas under pressure, the ports a' and p^4 closed, and the inlet a^3 to the compression chamber a^4 open. A spark at the plug B produces an explosion, which drives down the piston, thereby turning the crank until the parts are in the position shown in Fig. 3, the fresh gas in chamber a^4 being compressed by the piston in its downward movement. As shown in Fig. 1, when the lower end of the stroke is reached, the exhaust port a' and the inlet port p^4 are both opened, and as the inlet port a^2 is closed, a fresh charge of gas will pass from the chamber a^4 by way of the channel a', D, p^4 into the explosion chamber A′, being thrown up by the deflector p' and driving the products of combustion out into the air or to the muffler. As the crank C^2 passes across center, from the position of Fig. 3 to the position of Fig. 4, the jaws of the crosshead are thrown up as the crosshead turns on the pin p, so as to lift the sleeve S with relation to the piston P, closing the exhaust a' by leaving the inlet p^4 still open through the registering port p^3. The inrush of fresh gas continues until the crank arm has moved through a sufficient angle to carry the sleeve S far enough to finally close the inlet port p^4. I would call particular attention to the fact that the length of time during which this inlet port will remain open is regulated entirely by the size of the port p^3, and this may be made anything desired.

Before passing to the other figures of my drawings I wish to call particular attention to one point which is of great importance in practice. This is, that I offset the pin p from the center line of the piston, toward the left in the figures to a distance of say $\frac{3}{8}''$ to $\frac{1}{2}''$. The purpose of this is to produce a more direct push on the crank pin, and also to give greater leverage for the crosshead in its action on the valve pin s. A further effect is to quicken the action in closing the exhaust port. I shall claim this feature broadly, as I believe it to be original with me. It is not clearly shown in Figs. 1 to 4, but is apparent in Fig. 5.

Figs. 5 to 9, inclusive, show the preferred form of my invention. The same reference letters are applied in these figures as in Figs. 1 to 4, with certain additional letters indicating additional parts not found in the preceding figures. The cylinder A has expanded extension walls a^8. The piston has its body extended down within these extended cylinder walls, and is provided at the lower end with a circular flange p^6 having an edge flange p^{60} fitted accurately to the extension cylinder walls a^8. The body of the piston, together with the sleeve S works up and down within the cylinder walls a^{11}, and it should be understood that the piston, the sleeve S, and the flanges p^{60}, are all provided with the usual piston packing rings. In this form of engine my cylinder and its extensions are cast in one piece, a water jacket extending around the upper end of the lower part of the cylinder, but stopping at the beginning of the extension walls a^8. The pockets of this water jacket are shown at w in Fig. 6. They do not show in Fig. 5 or the other figures. The upper part of the cylinder is jacketed in a different manner. A double head is provided, the spark plug B passing through both heads into the explosion chamber, and a proper jacket a^6 with an overturned head flange, is slipped over the cylinder head and forced down with its lower edge resting in a circular slot a^{60} formed in the offset or enlarged portion of the cylinder. By packing this edge tightly in the slot and screwing the upper flange tightly down on the cylinder head, I find that a very simple and efficient jacket is produced, and the casting of the cylinder is very much simplified.

The main body of the cylinder, where it is enlarged, has two valve openings with seats e^4 and a^{13}, respectively. e^4 is the seat of the exhaust valve, which is a check valve opening outwardly. This valve is indicated in its entirety by the letter e, its stem being shown at e', its casing at e^2, and its disk at e^3. The exhaust chamber from which it opens is lettered E, and this extends completely around the piston between the main cylinder and the jacket. It is circumscribed within the walls a^8 which I have called the extension walls of the cylinder, and the flange p^6 on the lower end of this piston works up and down within it so as to create a vacuum on the down stroke, the compression driving out the products of combustion through the valve e on the up stroke. A connecting rod C and the crank C^2 with the associated parts are the same in Fig. 5 as in the preceding figures. The crank casing is made differently, being cast in one piece and secured by bolts a^{12}, to a foot flange on the cylinder. The port d' opens out from this crank casing as before, and the inlet port p^3 for the explosion chamber on the cylinder is located as before. Between these two ports, however, I here extend a passage way composed of the chamber I and the channel i communicating therewith. These take the place of the channel D in Fig. 1, and enables me to dispense with the screen or grating used in that channel D. My air inlet valve i is located in the upper wall of the inlet chamber I, having a disk i^3, a stem i^2, and a spring i'. This valve opens inwardly, being influenced by suction or partial vacuum in the chamber I which is produced by the upward movement of the piston creating rarefaction in the crank casing a^4 and thereby withdrawing the air or gas from the channel i through the port d'. At the lower end of the passage or channel i and in direct proximity to the port d' I locate the carbureter or fuel supply valve F. This is of peculiar construction, its design constituting a feature of my invention, which I shall claim. It will be observed that the wall of the cylinder is extended at a^7 to form a lateral chamber, with vertical sleeves in its opposite walls, one containing an opening f^9 to receive the fuel supply from the feed pipe f, and the other receiving the stem f', of the valve f^8, which carries a circular disk f^7 for the purpose of controlling the valve through the movement of the air column in the passage i which will be described hereinafter. The sleeve or nipple f^5 formed on the wall a^7 in which the valve stem f' plays, is threaded to receive the cap f^6, within which a spiral spring f^4 is located, abutting at one end on the inside of the cap and at the other end on the head of the valve stem. By adjusting the tension of this spring, the flow of fuel may be absolutely controlled, and for this purpose I provide the throttle lever f^3, which is clamped upon the head of the cap by means of a friction band f^3, which is best shown in Fig. 7. The lever f^3 may be directly controlled by hand in the case of a stationary engine, and in the case of a mobile engine may be connected to any suitable operating handle or lever for which purpose I show an eye f^{11} to receive a link.

The operation of this improved form of engine is as follows: We will assume the piston to be nearing the lower end of its stroke, substantially as shown in Fig. 5 but with the ports p^2 and p^3 still closed. The explosion chamber A' is filled with the products of combustion, while the crank chamber a^4, the passage way i and the inlet chamber I are all filled with fresh air previously drawn in through the valve i, (as the piston goes up). The valve F of the carbureter is tightly closed, and no fuel as yet has been admitted for any fresh charge. A vacuum has been created in the chamber E by the downward movement of the flange p^6 on the piston, and this vacuum, or rather the external atmospheric pressure maintains the exhaust valve e tightly closed. With these conditions we will assume the piston to continue its travel and the ports p^2 and p^3 to be open as shown in Fig. 5. Since the chambers I—i—a^4 contain air under compression, the chamber E contains a vacuum and the explosion chamber A' contains products of combustion, a sudden movement is immediately produced in the fresh air through the port p^3 into the combustion chamber, and sweeping all the products of combustion from it through the port p^2 into the vacuum chamber E. During the movement of this column of fresh air through the passage way i, pressure on the under side of the disk f^7 of the valve F opens the same, and permits a certain amount of fuel to enter and mingle with the air in the passage way i. Since the valve F is located at the lower end of this passage way, however, it is obvious that the entire column of air above the valve, that is to say all the air in the passage way i and the chamber I, will pass into the chamber A' without any admixture of fuel gas whatever. Since all of this air is under heavy compression, the volume of pure air thus forced into the cylinder in advance of any charge, is amply sufficient to sweep out every vestige of the products of combustion. In addition to this mechanical effect in sweeping out these products, I may add that this expansion of compressed air into the chamber A' absorbs heat therefrom, and cools the chamber and its walls, just at the instant when this action is most beneficial. This rush of fresh air through the cylinder is followed by the air which was in the casing a^4, mingled with fuel gas as it passes the valve F, but by the time this charging vapor reaches the chamber A', the exhaust port p^2 is closed, and an initial pressure is immediately produced in the chamber A' which is directly proportional to the ratio of the surfaces of the piston head above, and the same with the flanges p^6 added below. To put this in another way, it may be said that the volume of gas or air in the compression chamber a^4 is much greater than the volume of the chamber A'; and it should be noted that all the conditions are favorable for a maximum initial compression since the ratio is not against the atmospheric pressure, but is based upon another ratio, viz., that between the volume of the chamber A′ and that of the crank chamber a^4 the pressure remaining in the chamber A′ after exhaustion being brought to any desired point by simply making the vacuum pump large enough. As the crank turns and the piston reverses its movement, the inlet valve p^3 is also closed and of course the charge in the chamber A′ is still further compressed in the usual manner by the piston in its upward movement. As the piston moves upward, its lower flanges p^6 traveling with it produce rarefaction in the crank chamber a^4, while they also produce compression in the vacuum chamber E. The effect of the rarefaction in the chamber a^4 is to draw in fresh air through the valve i, the downward movement of this air keeping the valve F closed by means of pressure on the disk f^7. The effect of the compression in the vacuum chamber E, on the other hand, is to force out the products of combustion through the valve e into the outer air.

It will be observed that many changes can be made in details of construction in this engine without departing from the spirit of my invention. The engine is not only more efficient in the actual production of power for a given amount of fuel than any of its predecessors within my knowledge, but it is an improvement in many other ways. For example, the cycle of operations is such as to give the engine a strong tendency toward self-cooling, and the cooling at each step occurs at a place and time when it is most required. I have found that by exhausting into the vacuum chamber as described, no muffler is required, and the engine is almost noiseless.

It is my intention to claim herein both broadly and specifically all the improvements I have described, as well as the method of operating, and I wish it distinctly understood that all changes which do not affect the main characteristic features of the invention are intended to be included within the scope of these claims.

Having thus described my invention what I claim and desire to secure by Letters Patent is:

1. In an internal combustion engine, the combination of a cylinder having inlet and exhaust ports, a piston traveling therein, a connecting rod extending from said piston to the driven parts, and a valve traveling with the piston and controlled by the connecting rod to open and close the exhaust and inlet ports.

2. In an internal combustion engine, a cylinder, a piston, and an intermediate ring or slide, a connecting rod for the piston, and an extension thereon engaging the ring or slide so as to move the same differentially with respect to the piston, together with valve ports controlled by said ring or slide.

3. In an internal combustion engine, a cylinder, a piston traveling therein, valve ports for inlet and exhaust, and means controlling said ports which permits both to be open simultaneously for a predetermined time.

4. In an internal combustion engine, a cylinder, a piston traveling therein, valve ports for inlet and exhaust, a valve, and means directly connecting the piston and valve for operating the latter in the movement of the former to control said ports.

5. In an internal combustion engine, a cylinder, a piston, a connecting rod having a crosshead, a slide valve intermediate the piston and cylinder, inlet and exhaust ports controlled thereby, and a connection between the connecting-rod-crosshead and the inlet valve whereby said valve and the piston travel as a unit, with a supplemental or differential motion of the valve on the piston.

6. In an internal combustion engine, a cylinder, a hollow piston, and an extension to said cylinder inclosing a compression chamber, an inlet port for the cylinder connected with the compression chamber, an exhaust port for the cylinder, and a supply port for the compression chamber, together with a differential slide valve carried by and movable on the piston, the arrangement being such that the exhaust from the cylinder is closed by said valve while the inlet from the compression chamber remains open.

7. In a hydrocarbon engine, a cylinder, a piston traveling in said cylinder, a slide valve traveling with the piston, a crank shaft and connecting rod with a lateral connection from the crank shaft to the slide valve, and a wrist pin for the connecting rod on the piston offset from the axis thereof on the side away from the slide valve connection.

8. In an internal combustion engine, the combination with a reciprocating piston, of a crank shaft operated thereby, an exhaust port, an inlet port, and a connecting rod for the crank shaft centrally offset at its piston end from the axis of the piston, as and for the purposes intended.

9. In an internal combustion engine, a cylinder, a piston traveling therein, valve ports for exhaust and inlet, and means directly connected to the piston for controlling said ports whereby they are both simultaneously open for a predetermined time and closed in sequence.

10. In an internal combustion engine, a cylinder, valve ports for exhaust and inlet, and means for controlling said ports whereby they are both open simultaneously for a predetermined time and closed in sequence,

said means acting to close the exhaust port first so as to produce initial compression in the explosion chamber.

11. In an internal combustion engine, a cylinder, a piston traveling in said cylinder, a crank shaft and connecting rod, and a valve traveling with the piston and positively moved in relation thereto, both to open and to close, by said connecting rod in its travel.

12. In an internal combustion engine, a cylinder, a piston traveling therein, a source of supply for said cylinder, a crank shaft and connecting rod driven by the piston, and an inlet valve traveling with the piston having separate motion thereon and operated by the said connecting rod in its travel.

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

JOHN MAX MEYER.

Witnesses:
H. B. CAMPBELL,
EDWARD E. CLEMENT.