F. A. SEITZ.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JUNE 9, 1915.

1,174,624.

Patented Mar. 7, 1916.

4 SHEETS—SHEET 1.

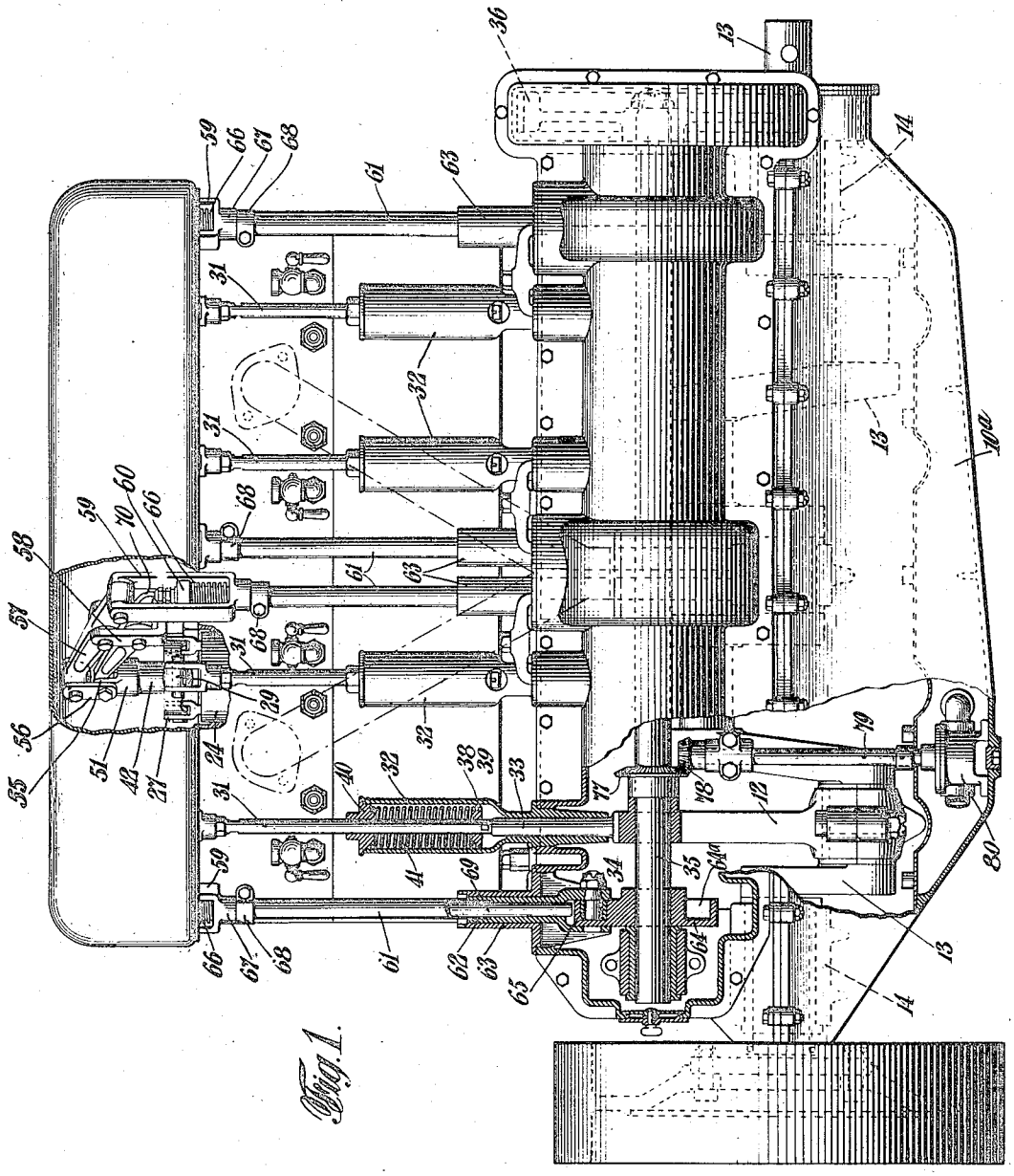


Fig. 1.

WITNESSES

Anna Ross

J. G. Dunn Jr.

INVENTOR

Frederick A. Seitz

BY

Conrad H. Peters

his ATTORNEY

F. A. SEITZ.

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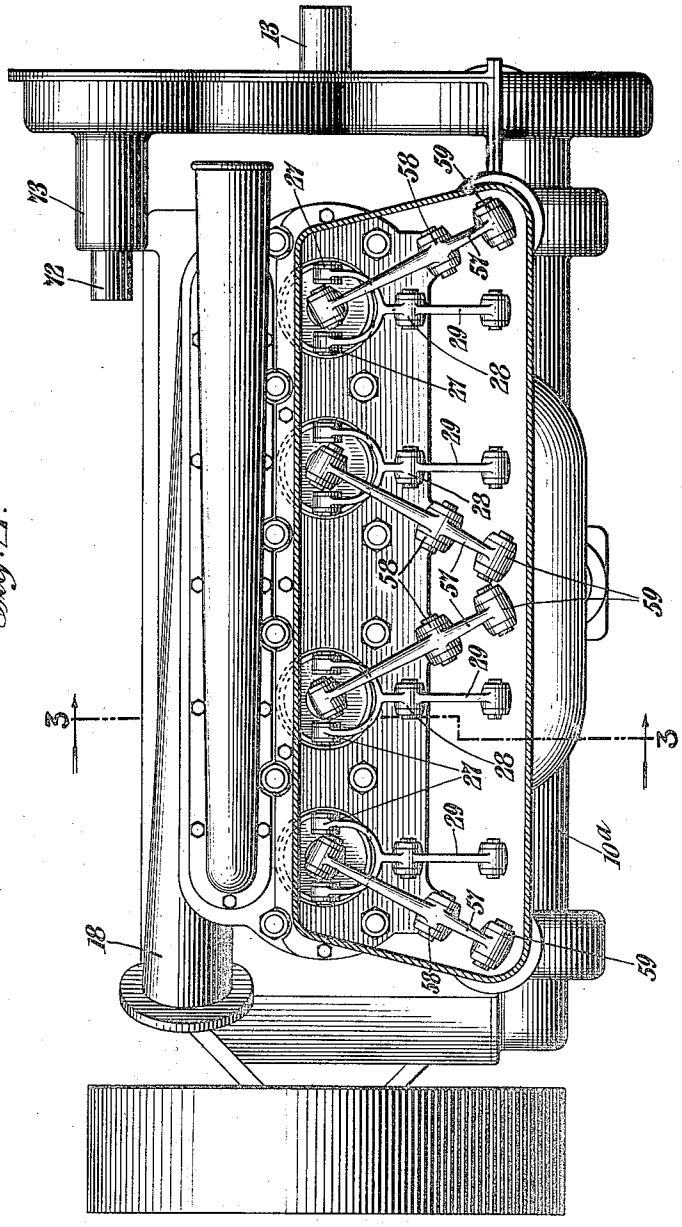
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4 SHEETS—SHEET 2.

Fig. 2.




WITNESSES

Anna Ross.

J. G. Winn Jr.

INVENTOR

Frederick A. Seitz

BY

Conrad A. Dieterich

his ATTORNEY

F. A. SEITZ.

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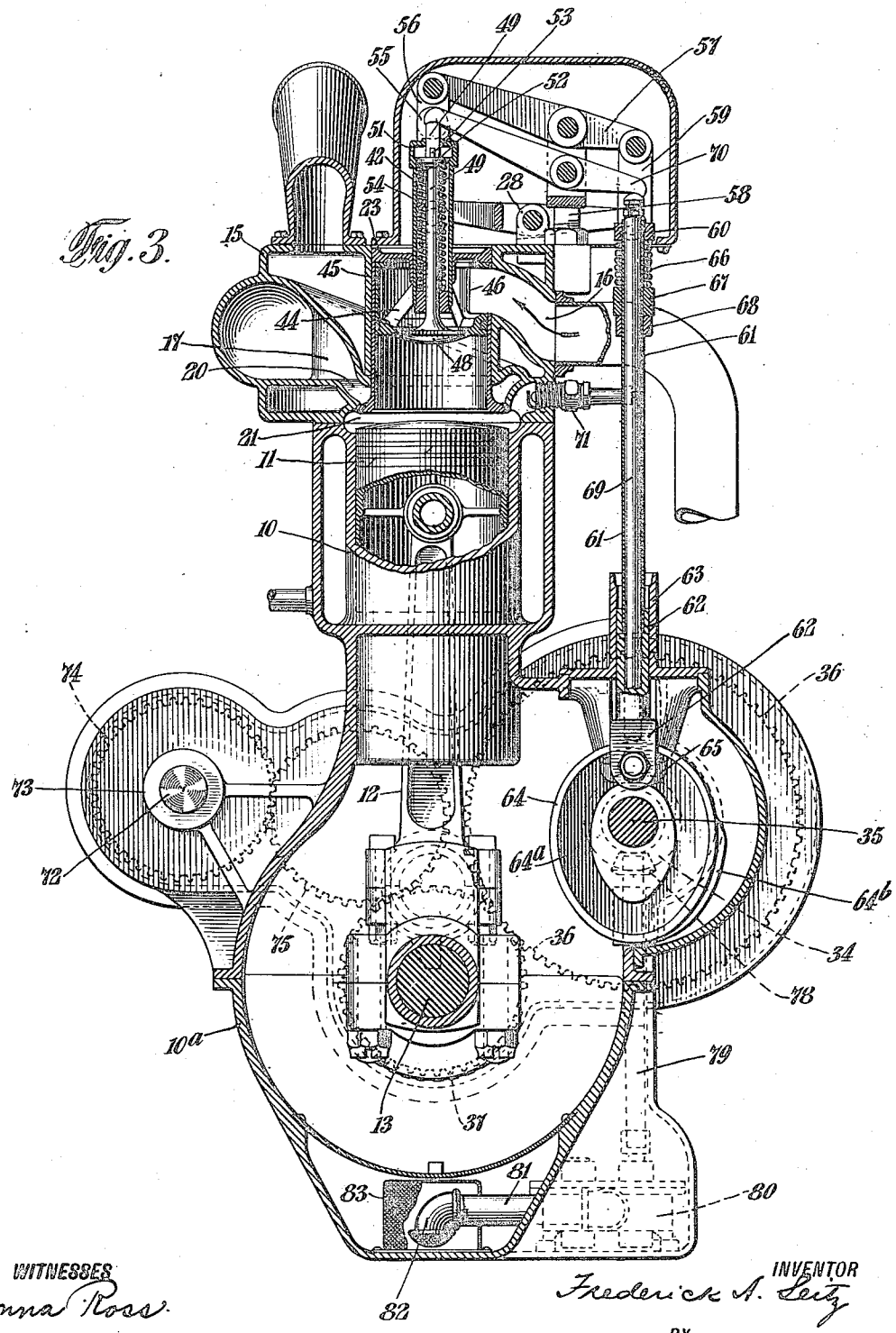
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4 SHEETS—SHEET 3.

Fig. 3.




WITNESSES

Anna Ross.

J. G. Zumm Jr.

INVENTOR

Frederick A. Seitz

BY

Conrad A. Ouland

his ATTORNEY

F. A. SEITZ.

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4 SHEETS—SHEET 4.

Fig. 6.

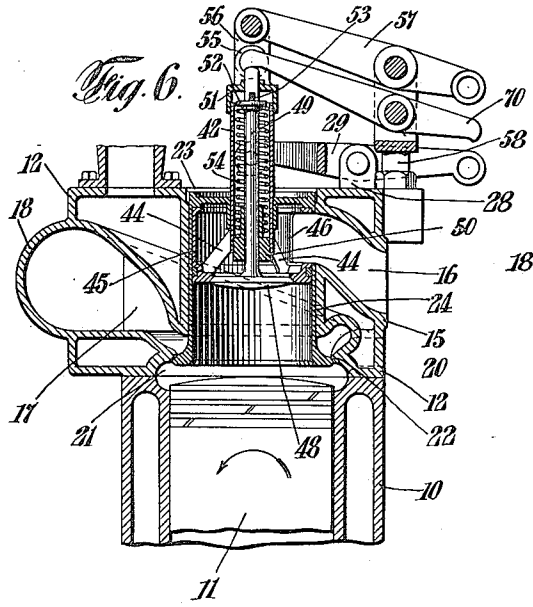



Fig. 7.

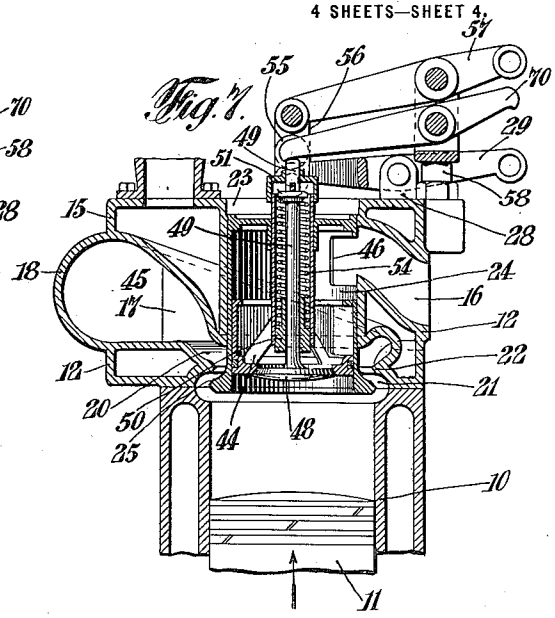



Fig. 4.

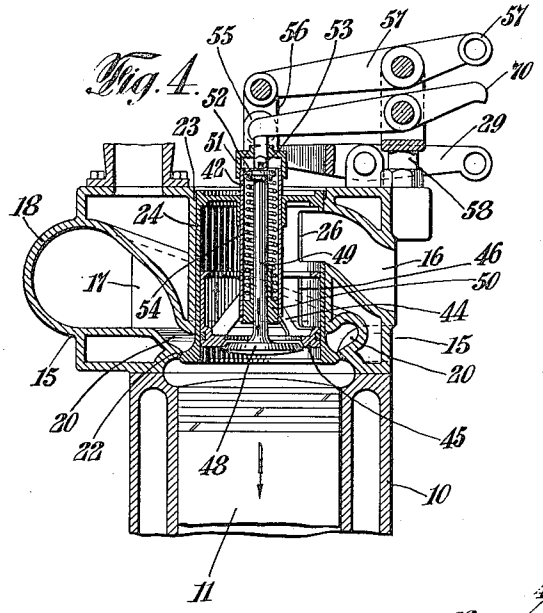



Fig. 5.

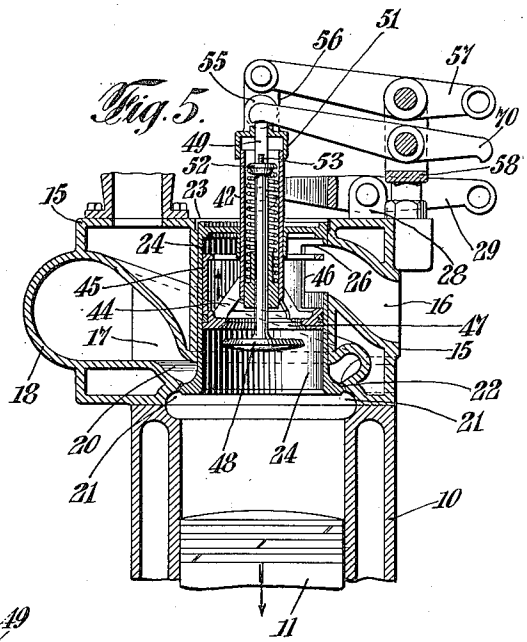
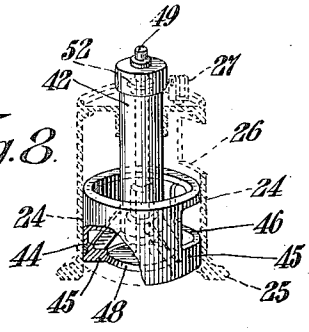



Fig. 8.




WITNESSES

Anna Ross.

J. G. Winn Jr.

INVENTOR

Frederick A. Seitz

BY

Conrad A. Walters

His ATTORNEY

# UNITED STATES PATENT OFFICE.

FREDERICK A. SEITZ, OF NEWARK, NEW JERSEY.

## INTERNAL-COMBUSTION ENGINE.

1,174,624. Specification of Letters Patent. Patented Mar. 7, 1916.

Application filed June 9, 1915. Serial No. 33,022.

*To all whom it may concern:*

Be it known that I, FREDERICK A. SEITZ, a citizen of the United States, residing at the city of Newark, Essex county, in the State of New Jersey, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a full, clear, and exact specification.

My invention relates to improvements in internal combustion engines, and the same has for its object more particularly to provide a simple, efficient and reliable engine which is capable of taking in a larger charge of mixed gas and air than other engines now in use having the same piston displacement.

Further, said invention has for its object to provide an engine which will completely discharge all burned gases from the cylinder after each explosion, and thus prevent of the explosive mixture being diluted by any burned gases which would otherwise remain in the cylinder.

Further, said invention has for its object to provide an engine with means for automatically increasing the cylinder area during the suction period without causing any alteration in the normal area of said cylinder during the compression and explosion periods.

Further, said invention has for its object to provide an engine having a comparatively simple valve mechanism which will offer but a minimum obstruction to the incoming gases.

Further, said invention has for its object to provide an engine which will offer a higher efficiency, and at the same time effect a saving of 10 to 20% in fuel consumption over engines now in use rated at the same capacity.

Other objects will in part be obvious, and in part be pointed out hereinafter.

To the attainment of the aforesaid objects and ends, my invention consists in the novel details of construction, and in the combination, connection and arrangement of parts hereinafter more fully described and then pointed out in the claims.

In the accompanying drawings forming part of this specification wherein like numerals of reference indicate like parts, Figure 1 is a side view, partly broken out, showing a four-cylinder engine constructed according to, and embodying my said invention; Fig. 2 is a plan view thereof with a portion of the casing in section to show the valve operating mechanism; Fig. 3 is a transverse vertical section taken on about the line 3—3 of Fig. 2; Fig. 4 is a detail sectional view showing the upper portion of the cylinder with the valve mechanism therefor; the intake valve being shown about to open, and the main piston about to begin its downward or suction stroke; Fig. 5 is a similar view showing the piston at about the completion of its suction stroke, and the intake valve fully open; Fig. 6 is a similar view showing the intake and exhaust valves closed, and the main piston in position at about the moment of firing the explosive charge and ready to descend; Fig. 7 is a similar view showing the exhaust valve open and the main piston moving upwardly to expel the burned gases, and Fig. 8 is a detail perspective view, partly in section, showing the exhaust valve, the displacer piston working therein, and the inlet valve arranged within said displacer piston.

In said drawings the engine is shown as comprising a main cylinder 10 to the lower end of which is secured a crank casing $10^a$. Within the cylinder 10 works a piston 11 which is connected by a piston rod 12 to a main crank shaft 13 supported longitudinally of the engine in bearings 14. To the upper end of the cylinder 10 is secured a head 15 which is provided at its right hand side, as seen at Figs. 3 to 7 inclusive, with an inlet port 16, and at its left hand side with an exhaust port 17 which communicates at ts outer end with a manifold 18, and at its inner end with an annular passage 20.

The head 15 is provided at its lower end, which is secured to the upper end of the main cylinder 10, with an annular recess 21 along the upper edge of which is provided a valve seat 22. The head 15 is also provided with a central circular opening 23 which extends entirely through said head and is open at its upper and lower ends. Within said circular opening 23 is disposed a cylindrical member 24 which is closed at its upper end and open at its lower end, and provided at its said lower end with a valve face 25. The said cylindrical member 24 and the valve face 25 at the lower edge thereof constitute the exhaust valve of the engine. The said cylindrical member 24 is provided in its side adjacent to its upper end with a rectangular opening 26 which extends about one-third of the circumference of said cylindrical member, and is adapted to register

with the inlet port 16 when said cylindrical member 24 is in its uppermost position. The head of said cylindrical member 24 is provided upon its upper surface with oppositely disposed bifurcated lugs 27, 27. (See Fig. 2.)

Upon the top of the head 15, adjacent to its right hand side, is provided a bearing 28 within which is pivotally supported an exhaust valve lever 29, having its inner end forked and pivotally connected to said oppositely-disposed bifurcated lugs 27, 27 provided upon the top of said cylindrical member 24. The outer end of said exhaust valve lever 29 is pivotally connected to the upper end of a rod 31 whose lower end extends into a housing 32. The lower end of said rod 31 is supported upon a push rod 33 disposed within the lower end of said housing 32, and the lower end of said push rod 33 extends through said housing 32, and bears upon an eccentric 34 fixed upon a countershaft 35. The countershaft 35 is rotated by a gear 36 fixed thereon, and meshing with a gear 37 fixed upon the crank shaft 13.

The rod 31 is provided adjacent to its lower end with a washer 38 which is secured in position thereon by a pin 39, and between said washer 38 and the head 40 of the housing 32 is disposed a coil spring 41 which serves to maintain said rod 31 normally depressed, and the exhaust valve comprising the member 24 and valve 25 normally raised with its valve 25 firmly seated upon its seat 22 at the base of the head 15. The head of said cylindrical member 24 is provided with a central opening wherein is movably disposed a hollow stem 42 to the lower end of which are arranged a plurality of radially extending inclined arms 44 located within said cylindrical member 24, and to the lower ends of which is secured a displacer piston 45 adapted to work within said cylindrical member 24. The said displacer piston 45 is provided adjacent to its upper edge with a rectangular opening 46 which is adapted to register with the opening 26 in said cylindrical member 24 and the inlet port 16 of the engine when said displacer piston is in its uppermost position.

The upper end of the displacer piston 45 is open so that the interior thereof may at all times be in communication with the intake opening 16 of the engine, while the lower end of said displacer piston is closed and provided with an opening 47 whose lower edge forms a valve seat for the inwardly opening inlet valve 48 whose stem 49 extends upwardly therefrom and through a bushing 50 in the lower end of the hollow stem 45, and has its upper end extending through the head 51 on the upper end of said hollow stem 42.

The valve stem 49 is provided adjacent to its upper end with a washer 52 secured in place by a pin 53 extending through said valve stem 49. The inlet valve 48 is maintained normally seated by a coil spring 54 disposed about the valve stem 49 intermediate the bushing 50 at the lower end of said hollow stem 42, and the washer 52 secured upon said valve stem 49.

Upon the upper end of the head 51 are provided lugs 55 to which are pivotally secured the lower ends of links 56. 57 denotes a displacer piston lever which is pivotally supported intermediate its ends within a bearing 58 secured upon the upper end of the head 15. The inner end of said displacer piston lever 57 is pivotally secured to the upper ends of links 56, and has its outer end pivotally secured between bearings 59 extending upwardly from the head 60 secured to the upper end of a tubular rod 61. The said tubular rod 61 has its lower end screw-threaded and secured to a bearing member 62 which has its lower end guided within a bushing 63 secured within the crank case at one side thereof. The lower end of said bearing member 62 is bifurcated and embraces a cam 64 secured upon the countershaft 35. To the forward member of the bifurcated end of said bearing member 62 is pivotally secured a block 65 which is disposed within the groove $64^a$ of the cam 64, while the rear member of the bifurcated end of said bearing member 62 loosely engages the rear, flat surface of said cam 64. The tubular rod 61 is provided adjacent to its upper end, below the head 60 thereon, with a spring 66 which is maintained at a proper degree of compression by a collar 67 disposed upon said tubular rod and held in place by a compression band 68 clamped to said tubular rod directly below said collar 67. The head 60 at the upper end of said tubular rod 61, and the bearing member 62 at the lower end of said tubular rod are both provided with centrally-disposed openings which are arranged in line with each other and in register with the opening through said tube, and within said tubular rod 61, head 60 and the openings in said bearing member 62 thereon, is disposed a solid rod 69 whose lower end extends through said bearing member and between the bifurcated lower end thereof, and is adapted to ride upon the surface of the cam 64, and to be reciprocated within said tubular rod 61 by the cam projection $64^b$ provided upon the surface of said cam 64. The upper end of said rod 69 is maintained in contact with the outer end of the inlet valve lever 70 which is supported in the bearing 58 directly below the displacer piston lever 57 therein. The said inlet valve lever 70 has its inner end extending between the lugs 55 on the head 51 secured to the upper end of the tubular stem 42, and in contact with

and bearing upon the upper end of the inlet valve stem 49 which projects through said head 51.

71 denotes a spark plug located in the side of the head 15 adjacent to the annular recess 21 therein.

At the left hand side of the crank casing $10^a$ is arranged a shaft 72 which is supported parallel to the crank shaft 13 in bearings 73.

74 denotes a gear fixed upon said shaft 72 which is in gear with the gear 37 on the crank shaft 13 through an intermediate gear 75. The said shaft 72 is designed to transmit power to a magneto, not shown.

On the countershaft 35 is fixed a bevel gear 77 which meshes with a similar gear 78 fixed upon the upper end of a vertical shaft 79 extending from a pump 80 located in the base of the crank casing $10^a$. From the pump 80 extends an intake pipe 81 having a screened nozzle 82 disposed within a strainer 83 provided in the base of the crank case. The pump 80 is designed to circulate the oil for lubricating the operating parts located within the crank casing $10^a$.

The operation of the engine is as follows:—At Fig. 4 the valve mechanism is shown at the beginning of a suction stroke, that is to say, the exhaust valve 25 is seated upon its seat 22; the displacer piston 45 is in its lowermost position, and the inlet valve 48 thereon just opening. The main piston 11 is just about to descend upon its suction stroke and draw in the explosive charge through the inlet port 16, rectangular intake opening 26, and through the interior of the displacer piston 45, past the valve 48 and into the cylinder 10. At the same time that the valve 48 begins to descend the displacer piston 45 also begins to move upwardly. The movement of the valve 48, and its stem 49 is effected through the medium of the inlet valve lever 70, rod 69, cam 64, and the projection $64^b$ thereon contacting with the lower end of said rod 69.

At Fig. 5 the valve mechanism and its related parts are shown in a half way position. That is to say, the main piston 11 is shown at about the middle of its descent while the displacer piston 45 is shown as having traveled about three quarters of the distance during its ascent and the inlet valve 48 as having been opened completely. As the engine continues to operate the displacer piston 45 will continue to rise until it reaches its uppermost position. The parts will then remain in that position until the main piston 11 has reached the lower limit of its movement, and is about to begin its up or compression stroke. As the main piston 11 is about to begin its up or compression stroke the inlet valve 48 closes and the main piston 11 thereafter continues to rise. All the other parts arranged in the head 15 of the engine remain stationary during the compression and firing periods. The positions of the parts at the moment of firing are shown at Fig. 6. As the main piston 11 is about to descend during the explosion period the inlet valve 48, the exhaust valve 25, and displacer piston 45 remain in the position indicated at Fig. 6. As the main piston 11 about reaches the lowermost limit of its movement during the explosion period the cylindrical member 24 will be caused to descend and unseat the exhaust valve 25 at the lower end thereof. As the exhaust valve 25 opens, as above stated, the displacer piston 45 with the inlet valve 48 at the base thereof will continue to descend until the main piston 11 about reaches the upper limit of the exhaust stroke at which moment the exhaust valve 25, displacer piston 45 and inlet valve 48 will have about assumed the position indicated at Fig. 7. In the position of the parts as here illustrated the exhaust gases will, with said upward movement of the main piston 11, be forced from the main cylinder 10 through the annular recess 21, and enter the exhaust opening and be discharged into the manifold 18, thus completely scavenging the main cylinder. The movement of the displacer piston 45 is effected by means of the tubular stem 42, displacer piston lever 57, tubular rod 61, block 65, and the cam groove $64^a$ in the cam 64.

With the operation last above described the fourth-cycle of the operation is completed, and the operation first above described in connection with Fig. 4 will be repeated.

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

1. In an internal combustion engine, the combination with the main cylinder and the piston thereof, of an exhaust valve normally communicating with the intake opening of the engine, a piston working within said exhaust valve, an inlet valve carried by said last-named piston, and means for conjointly advancing said piston and said inlet valve, while seated, toward the advancing main piston whereby to force the burned gases from said main cylinder, substantially as specified.

2. In an internal combustion engine, the combination with the main cylinder and the piston thereof, of an exhaust valve normally communicating with the intake opening of the engine, a piston working within said exhaust valve, an inlet valve carried by said last-named piston, and means for retracting said last-named piston and opening the inlet valve therein as the main piston is retracted whereby to draw an explosive charge into said main cylinder, substantially as specified.

3. In an internal combustion engine, the combination with the main cylinder and the piston thereof, of an exhaust valve normally communicating with the intake opening of the engine, a piston working within said exhaust valve, an inlet valve carried by said piston, means for conjointly advancing said piston and the inlet valve, while seated, toward the advancing main piston, and means for retracting said second-named piston and opening the inlet valve therein as the main piston is retracted whereby to draw an explosive charge into said main cylinder, substantially as specified.

4. In an internal combustion engine, the combination with the main cylinder and the piston thereof, of a member secured to said main cylinder having an opening therein communicating therewith, and an intake opening and an exhaust opening, an exhaust valve working within said opening and normally communicating with said intake opening, a piston working within said exhaust valve, an inlet valve in said second-named piston, means for maintaining said inlet valve normally seated, means for opening said exhaust valve during the exhaust period and simultaneously advancing said second-named piston and inlet valve during said exhaust period, and means for retracting said exhaust valve and said inlet valve and opening said inlet valve as said exhaust valve is caused to close, substantially as specified.

5. In an internal combustion engine, the combination with the main cylinder and the piston thereof, of a member secured to said main cylinder having an opening therein communicating therewith, and an intake opening and an exhaust opening, an exhaust valve working within said opening and normally communicating with said intake opening, a piston working within said exhaust valve, an inlet valve disposed in said second-named piston, means for maintaining said inlet valve normally seated, means for advancing said second-named piston and the inlet valve carried thereby in closed position relative thereto and opening said inlet valve as the same and its said piston about reach the limit of their inward movement, and means for maintaining said exhaust valve normally retracted during the suction period and means for maintaining said second-named piston and inlet valve carried thereby seated during the explosion, substantially as specified.

6. In an internal combustion engine, the combination with the main cylinder and the piston thereof, of a head secured to said main cylinder having an opening extending therethrough and communicating with said main cylinder, and an intake opening and an exhaust opening, an exhaust valve working within said opening and normally communicating with said intake opening, a displacer piston working within said exhaust valve, an inlet valve arranged in the base of said displacer piston, means for opening said exhaust valve, means for conjointly moving said displacer piston and the inlet valve carried thereby, and means for separately operating said inlet valve when said displacer piston reaches predetermined positions within said exhaust valve, substantially as specified.

7. In an internal combustion engine, the combination with the main cylinder and the piston thereof, of a head secured to said main cylinder having an opening therein in line with the opening in said main cylinder, an intake opening and an exhaust opening, an exhaust valve working in said opening normally communicating with said intake opening, a displacer piston working within said exhaust valve, an inlet valve carried by said displacer piston, spring means for maintaining said inlet valve normally seated, means for retracting said displacer piston and the inlet valve carried thereby to permit of the main piston drawing in a charge of explosive mixture through the intake port and into said main cylinder, and means for retracting said displacer piston and the inlet valve carried thereby and maintaining the same in retracted position during the explosion, substantially as specified.

8. In an internal combustion engine, the combination with the main cylinder and the piston thereof, of a head secured to said main cylinder having an opening therein communicating with said main cylinder, and an intake opening and an exhaust opening, a cylindrical exhaust valve working within said opening and normally communicating with said intake opening, a hollow displacer piston working within said exhaust valve and communicating with said intake opening, an inlet valve carried by said displacer piston, spring means for maintaining said inlet valve normally seated upon said displacer piston, means for conjointly detracting said displacer piston and the inlet valve carried thereby during the suction period, means for separately actuating said exhaust valve independently of said displacer piston during the suction period, and means for closing said inlet valve at about the end of the suction period, substantially as specified.

9. In an internal combustion engine, the combination with the main cylinder and the piston thereof, of a head secured to said main cylinder having an opening extending therethrough and communicating with said main cylinder, a valve seat in the base of said head and surrounding the inner end of the opening therein, an intake opening and an exhaust opening communicating with said first-named opening, an exhaust valve working within said first-named opening

having an inlet port therein communicating with the intake opening in said head, a valve face provided at the lower end of said exhaust valve adapted to close upon the seat in the base of said head, a displacer piston working within said exhaust valve having an opening at its top and an inlet port at its side adapted to register with the inlet port in said exhaust valve, a hollow stem extending from said displacer piston through the upper end of said exhaust valve, a valve seat in the base of said displacer piston, an inlet valve adapted to seat upon the valve seat in the base of said displacer piston, a stem extending from said inlet valve through the hollow stem of said displacer piston, spring means disposed upon said stem for maintaining said inlet valve normally seated, a lever having one end pivotally connected to said exhaust valve, a second lever pivotally connected at one end to said displacer piston, a third lever engaging said inlet valve stem, and means engaging the outer ends of said levers whereby to actuate said exhaust valve, and to actuate said displacer piston and the valve therein independently of said exhaust valve, substantially as specified.

10. In an internal combustion engine, the combination of an exhaust valve, a displacer piston working therein, an inlet opening in said displacer piston, and a valve adapted to close the inlet opening in said displacer piston, substantially as specified.

11. In an internal combustion engine, the combination of an exhaust valve, a displacer piston working therein, an inlet opening in said displacer piston, a valve adapted to close the inlet opening in said displacer piston, and means for severally actuating the same, substantially as specified.

12. In an internal combustion engine, the combination of a hollow exhaust valve having an inlet port therein, a hollow displacer piston adapted to work within said exhaust valve and having an inlet port therein adapted to register with the inlet port in said hollow exhaust valve, said displacer piston having an opening in its base, and a valve normally sealing the opening in the base of said displacer piston, substantially as specified.

13. In an internal combustion engine, the combination of a hollow exhaust valve having an inlet port therein, a hollow displacer piston adapted to work within said exhaust valve and having an inlet port therein adapted to register with the inlet port in said hollow exhaust valve, said displacer piston having an opening in its base, a valve normally sealing the opening in the base of said displacer piston, and means for severally actuating said exhaust valve, displacer piston and the valve in said displacer piston, substantially as specified.

14. In an internal combustion engine, the combination with a head having an opening therein communicating with the main cylinder of the engine, an inlet opening and an exhaust opening, and a valve seat in the base of said head, of a hollow-cylindrical exhaust valve adapted to seat upon the valve seat in the base of said head and having its upper end open and communicating with said intake opening, a hollow displacer piston working within said exhaust valve, a hollow stem extending therefrom and through the top of said exhaust valve, a valve seat at the base of said displacer piston, an inlet valve adapted to seat thereon, a stem on said inlet valve extending through the hollow stem on said displacer piston, and a spring disposed within said hollow stem, and surrounding the stem of said inlet valve whereby to maintain said inlet valve normally seated, substantially as specified.

15. In an internal combustion engine, the combination with the main cylinder and the piston thereof, of a head secured to said main cylinder having an opening extending therethrough and communicating with said main cylinder, a valve seat in the base of said head surrounding the inner end of the opening therein, an intake opening and an exhaust opening communicating with said first-named opening, an exhaust valve working within said first-named opening having an inlet port therein communicating with the intake opening in said head, a valve face provided at the lower end of said exhaust valve adapted to close upon the seat in the base of said head, a displacer piston working within said exhaust valve having an opening at its top and an inlet port at its side adapted to register with the inlet port in said exhaust valve, a hollow stem extending from said displacer piston through the upper end of said exhaust valve, a valve seat in the base of said displacer piston, an inlet valve adapted to seat upon the valve seat in the base of said displacer piston, a stem extending from said inlet valve through the hollow stem of said displacer piston, spring means disposed upon said stem for maintaining said inlet valve normally seated, an exhaust valve lever having one end pivotally connected to said exhaust valve, a displacer piston lever pivotally connected at one end to said displacer piston, an inlet valve lever engaging said inlet valve stem, a driven shaft, a cam thereon, a rod having one end engaging said eccentric and its other end pivotally secured to the outer end of said exhaust valve lever, a second cam fixed upon said driven shaft, a hollow rod having its lower end forked and in engagement with a groove in said cam and its other end pivotally secured to the outer end of said displacer piston lever,

and a rod disposed within said hollow rod having its lower end in engagement with the surface of said second-named cam and its other end in contact with the outer end of said inlet valve lever, substantially as specified.

Signed at the city of New York, in the county and State of New York, this 26th day of May, one thousand nine hundred and fifteen.

FREDERICK A. SEITZ.

Witnesses:

CONRAD A. DIETERICH,

LOUIS B. HASBROUCK.