No. 877,818. PATENTED JAN. 28, 1908.

H. W. ADAMS.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED NOV. 21, 1906. RENEWED DEC. 31, 1907.

Fig. 1.

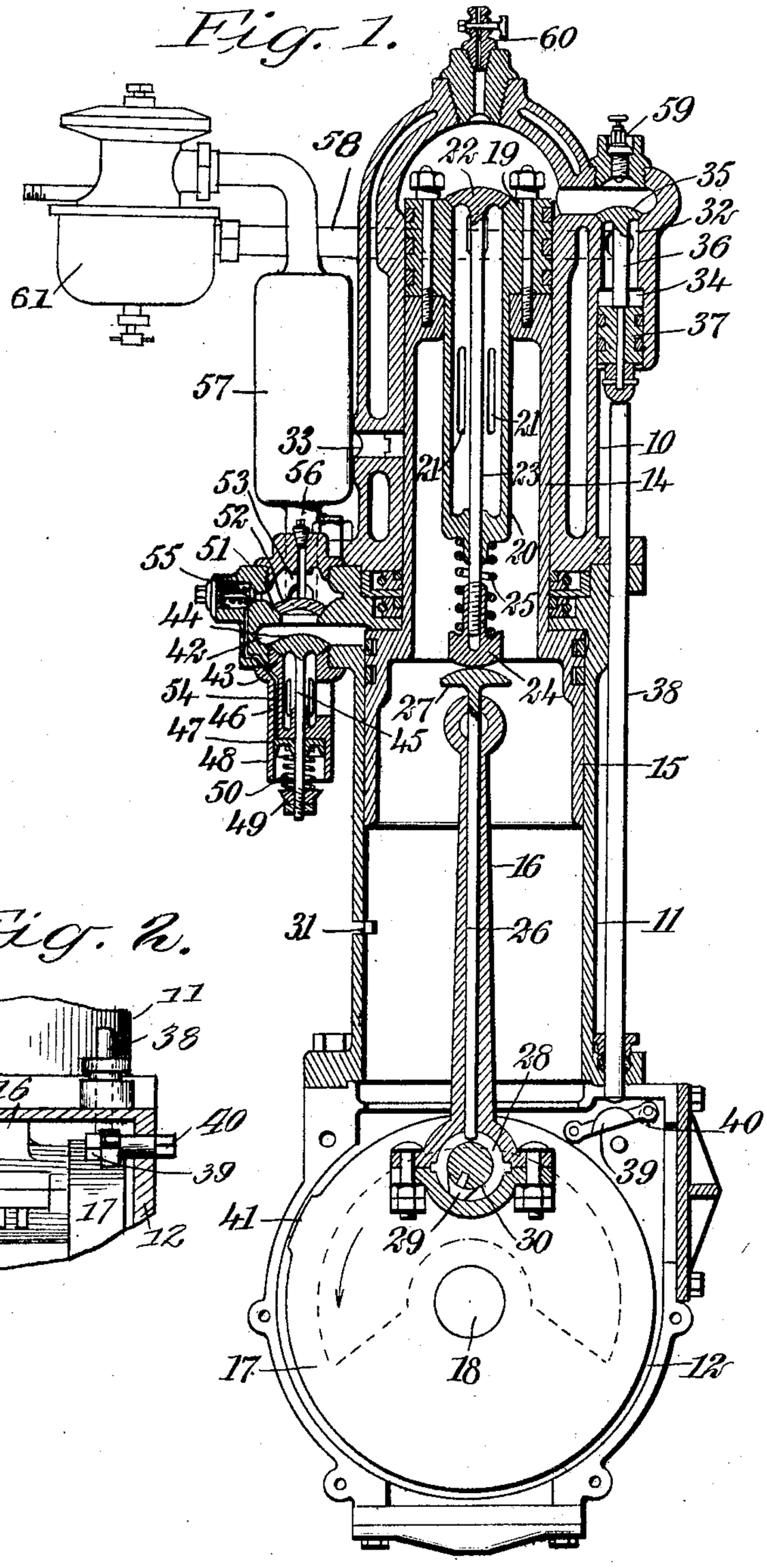

Fig. 2.

WITNESSES

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HARRY WALTER ADAMS, OF FARGO, NORTH DAKOTA, ASSIGNOR OF ONE-HALF TO PHILIP W. FARNHAM, OF FARGO, NORTH DAKOTA.

INTERNAL-COMBUSTION ENGINE.

No. 877,818. Specification of Letters Patent. Patented Jan. 28, 1908.

Original application filed July 11, 1905, Serial No. 269,154. Divided and this application filed November 21, 1906, Serial No. 344,393. Renewed December 31, 1907. Serial No. 408,795.

To all whom it may concern:

Be it known that I, HARRY WALTER ADAMS, a citizen of the United States, and a resident of Fargo, in the county of Cass and State of North Dakota, have invented a new and Improved Internal-Combustion Engine, of which the following is a full, clear, and exact description.

This invention relates to certain improvements in internal combustion engines, and more particularly to means for scavenging the cylinder of two-cycle engines; this application being a division of my previous application, Serial No. 269,154, filed July 11, 1905.

The object of the invention is to provide means whereby after the main body of the exhaust gases have been permitted to escape from the working cylinder, a further portion of said exhaust gases is forced out by the admission of a blast of compressed air, and after the exhaust port is closed, the gases still remaining in the working cylinder are removed by opening communication between said working cylinder and the chamber in which a more or less perfect vacuum exists. The flow of the fresh charge into the working cylinder is produced by the previous compression of the air going to make up said charge, and by the rarefied condition existing within the working cylinder after the communication with the vacuum chamber has been closed.

Various other objects are contemplated, all of which will be fully set forth hereinafter.

In attaining these ends, I provide an engine with a differential piston having a valve-controlled port therein, and operating with a differential cylinder and closed crank chamber in such a manner that at the end of the expansion or working stroke the said piston valve will be opened and the compressed air in the crank case admitted to the working cylinder to scavenge the same, so that upon the in stroke of the piston the air in the crank case will be rarefied, and upon the opening of the piston valve by means provided for this purpose, atmospheric pressure will force into the crank case such products of combustion as may still reside in the working cylinder of the engine. Simultaneously with these operations the larger diameter of the differential piston serves in connection with certain devices constituting no portion of the invention herein claimed, to compress a body of air which is lead to the admission port of the working cylinder, and during the in stroke after the piston valve is closed, the valve controlling the admission port is opened, and the whole or a part of this compressed air, mixed with the fuel, is admitted into the working cylinder, the charge being compressed during the later portion of the instroke of the piston and ignited and burned in the usual manner.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in both the figures, and in which

Figure 1 is a central longitudinal section of an engine embodying my invention; and Fig. 2 is a detail section on the line 2—2 of Fig. 1.

My improved engine is provided with a working cylinder 10 having an enlarged extension forming the compressor cylinder 11, the latter in open communication with the closed crank case or chamber 12. Within the working cylinder is a working piston 14, and within the compression cylinder 11 is the compressor piston 15, which pistons are formed as one but are of different diameters, as indicated in the drawings. The pistons are connected by a rod 16 with the crank disks 17 of the shaft 18, and the working piston 14 has a cap 19 bolted thereto, said cap being formed with a tubular stem guide 20 which projects through an opening in the piston toward the crank case. Said guide has openings 21 therein placing it in communication with the crank case, and the upper end of the guide 20 is open and commanded by a valve 22 which opens into the working cylinder. The stem 23 of this valve passes through the guide 20, and has a nut 24 on its lower end engaged by a spring 25 between the nut and the lower end of the guide 20, so as to yieldingly seat the valve 22. Fitted loosely in and extending longitudinally through the connecting rod 16 is a valve-operating rod 26 having a button 27 on its upper end which engages the nut 24. The lower end of the connecting rod is formed with an annular channel 28 which receives loosely a cam 29 fastened to the wrist pin 30 and adapted to engage the lower end of the valve-operating rod 26. It will thus be seen that the valve 22 is yieldingly seated is capable of opening automatically upon superior pressure, and is periodically opened mechanically by the cam 29 striking the valve rod 26, lifting the

same, and opening the valve 22 through its stem 23. This periodical mechanical operation of the valve 22 occurs once during each revolution of the crank shaft.

The enlarged compressor cylinder 11 has an air admission port 31 therein, said port being located near the top center or innermost position of the piston, so that it is uncovered only when the piston is at or near the top center position. Upon the downward stroke of the piston air is compressed in the crank case, and when pressure is relieved in the working cylinder, the valve 22 is automatically opened, permitting this air to flow into the working cylinder to scavenge it. Upon the upward movement of the piston the air in the crank case is rarefied, and during the inward stroke the valve 22 is mechanically opened through the action of the cam 29 and its coacting parts, thus permitting such products of combustion as may yet reside in the working cylinder to flow into the crank case.

The working cylinder 10 is provided with an admission port 32 and an exhaust port 33, the former being located adjacent the end of the cylinder and communicating with the compression space of the working cylinder, while the latter is at the outer or bottom center position of the piston so as to be uncovered only adjacent the end of the working stroke and communicate with the atmosphere. The admission port 32 communicates with a small cylindrical chamber 34, and is commanded by a valve 35 which opens into the working cylinder. The stem 36 of the valve projects into the cylindrical chamber 34 and contacts with a piston 37 fitted fluid-tight within said cylinder. As the piston 37 is larger than the under surface of the valve 35, the said valve is balanced against any pressure tending to move it into open position. The lower end of the stem 36 is engaged by a valve operating rod 38 which passes down into the crank case and has its lower end engaged by a lever 39 fulcrumed on an eccentric pin 40, said pin being mounted in the crank case and having a portion extending to the outside thereof, to permit turning the pin. By means of this pin the position of the fulcrum of the lever 39 may be adjusted at will, and consequently adjusting the movement which is imparted to the valve rod 38 through said lever. The free end of the lever is engaged by a cam 41 which is formed on the periphery of one of the crank disks 17, so as to periodically lift the lever and throw the rod 38 and stem 36 to open the valve 35. As the specific means employed for opening and controlling the inlet valve 35 does not aid in the scavenging of the working cylinder, the specific construction of the inlet valve-operating device above described, constitutes no portion of the invention herein claimed, and it is evident that various other means may be employed for operating this valve at the desired time during the working of the engine.

Communicating with the upper end of the compressor cylinder 11 is a chambered extension 42 which has an air admission port 43 therein, said port being commanded by an inwardly opening valve 44, the stem 45 of which passes through a cage 46 projecting from the port 43 and extends loosely through a piston 47. This piston is mounted in a cylindrical extension 48 of the cage 46, and at the lower extremity of the stem 45 is provided a stop nut 49 and a coil spring 50 which tends to yieldingly seat the valve 44. The chambered extension 42 has a discharge port 51 commanded by a check valve 52 and opening against pressure in the compressor cylinder 11. Said valve 52 permits the discharge from the chamber 42 into a chamber 53, which latter chamber communicates through a duct 54 with the upper or inner surface of the piston 47 and between said piston and the cage 46. The entrance to said duct is controlled by a spring-pressed valve 55; and by means of this duct and the spring-pressed valve, the piston 47 and the valve 44 may be controlled in a manner more fully described in my previous application above referred to. The chamber 53 delivers the main body of the air compressed in the cylinder 11 through a pipe 56 and a cooler 57 to any suitable carbureter, 61, and from said carbureter through a pipe 58 to the cylindrical chamber 34 adjacent to the inlet port. In connection with the parts above described may be employed any suitable form of igniting device 59, and the end of the working cylinder 10 may, if desired, be provided with a relief cock 60.

The operation of the engine as far as it relates to the scavenging of the working cylinder may be traced as follows: Assuming the parts to be in the position shown in the drawings and the crank shaft revolving in the direction indicated by the arrow, upon a down stroke or working stroke of the piston the port 31 is covered and compression takes place in the crank case. This continues until the piston reaches a point adjacent the end of its working stroke, that is, until the exhaust port 33 of the working cylinder is opened. At this time the pressure in the working cylinder falls to that of the atmosphere, due to the escape of the exhaust gases through the port 33, and as the pressure within the crank case is now considerably greater than that of the atmosphere, the compressed air within the crank case overcomes the action of the spring 25 and blows into the working cylinder to scavenge it. The pressure of the air within the crank case then drops merely to that of the atmosphere, and as soon as the inward movement of the piston begins, the valve 22 is closed and the

air within the crank case is rarefied. The cam 29 now serves to positively open the valve 22 and permit such products of combustion as may yet reside in the working cylinder to flow into the crank case. As the cross sectional area of the compressor cylinder 11 is greater than the cross sectional area of the working cylinder 10, it will be noted that the return movement of the piston toward the working cylinder 10 serves to rarefy the air, and the products of combustion will thus be almost completely withdrawn into the crank case. At or approximately at the middle of the in stroke the valve 22 is permitted to close, and at this time the admission valve 35 is opened and the air which has been highly compressed between the two pistons 14 and 15 and charged with the fuel at the carbureter, is admitted to the working cylinder. The explosive charge thus enters the cylinder under high pressure, and its entrance to the cylinder is facilitated by the rarefied condition within the working cylinder. During the remainder of the in stroke of the piston the charge is still further compressed, and at or near the end of said stroke the charge is ignited and burned in the usual manner.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. An internal combustion engine having a working cylinder provided with an exhaust port, a closed crank chamber, means movable in relation thereto and forming with said crank chamber a suction exerting means, and a valve controlling the passage of fluid between the crank chamber and the working cylinder of the engine.

2. A two-cycle internal combustion engine having a working cylinder provided with an exhaust port, a closed crank chamber, means movable in relation thereto with said crank chamber and forming a suction exerting means, means forming a passage from said crank chamber to the working cylinder of the engine, and a valve for controlling the flow of fluid through said passage.

3. An internal combustion engine having a working cylinder provided with an exhaust port, a closed crank chamber, means movable in relation thereto and forming with said crank chamber a suction exerting means, and a working piston having a valve-controlled passage leading from the working cylinder to the crank chamber.

4. An internal combustion engine having a closed crank chamber, a working cylinder provided with an exhaust port, a working piston having a port therein and forming with the crank chamber a suction exerting means, and a valve commanding said port.

5. An internal combustion engine having a closed crank chamber, a working cylinder provided with an exhaust port, a working piston having a port therein and forming with the crank chamber a suction exerting means, a valve commanding the port, and means for periodically operating the valve.

6. An internal combustion engine having a closed crank chamber, a working cylinder provided with a main exhaust port, a working piston adapted to close said exhaust port and having a port therein, said piston forming with the crank chamber an air rarefying means, a valve commanding the port in the piston, and means for periodically operating said valve to close the same after the main exhaust port is closed.

7. An internal combustion engine having a compressor adapted to compress air on one stroke and rarefy air on the other stroke, a valve adapted to automatically open to admit compressed air from the compressor to the working cylinder, and means for periodically opening the valve during the rarefication of air to said compressor.

8. An internal combustion engine having a closed crank chamber forming a compressor and adapted to compress air on the out or working stroke of the piston, and to rarefy air on the in stroke of the piston, and means establishing communication between the crank chamber and the working cylinder of the engine.

9. An internal combustion engine having a closed crank chamber adapted to compress air on the out or working stroke of the piston, and to rarefy air upon the in stroke of the piston, a valve adapted to automatically open to admit pressure from the crank chamber into the working cylinder, and means for periodically opening the valve during the rarefication of air in the crank chamber.

10. An internal combustion engine having a closed crank chamber, a working cylinder, a working piston, the parts being arranged to compress air in the crank chamber on the working stroke of the piston, and to rarefy air in the crank chamber on the in stroke of the piston, said piston having a port therein establishing communication between the working cylinder and crank chamber, and a valve controlling said port.

11. An internal combustion engine having a closed crank chamber, a working cylinder, a working piston, the parts being arranged to compress air in the crank chamber on the working stroke of the piston, and to rarefy air in the crank chamber on the in stroke of the piston, said piston having a port therein establishing communication between the working cylinder and crank chamber, a valve controlling said port, said valve automatically opening to admit pressure from the crank chamber to the working cylinder, and a gear for periodically opening the valve during the rarefication of air in the crank chamber.

12. An internal combustion engine having a working cylinder, a compressor cylinder in alinement therewith and of greater diameter than said working cylinder, a closed crank case in communication with the compressor cylinder, a differential piston having portions thereof in the working cylinder and in the compressor cylinder, a valve in the piston, whereby the working cylinder may communicate with the crank case, and means for opening said valve, whereby upon the in stroke of the piston a partial vacuum is created in the crank case and the exhaust gases removed from the working cylinder.

13. An internal combustion engine having a working cylinder, a compressor cylinder of greater diameter than said working cylinder, a closed crank case in communication with the compressor cylinder, a hollow differential piston in communication with the crank case and having portions thereof operating within the working cylinder and within the compressor cylinder, and a valve in said piston whereby the interior thereof may communicate with the working cylinder, the parts being so constructed that during a portion of the inward stroke of the piston the air within the crank case is rarefied, and thus causes the removal of the exhaust gas from the working cylinder.

14. An internal combustion engine having a closed crank chamber, a compressor cylinder in open communication therewith, a working cylinder in alinement with the compressor cylinder and of smaller diameter than said compressor cylinder, and a differential piston having portions thereof operating within the two cylinders, said piston being provided with a valve-controlled passage connecting the working cylinder and the compressor cylinder and adapted to permit the passage of compressed air into the working cylinder at the end of the working stroke thereof and the passage of the remaining exhaust gases into the compressor cylinder during a portion of the return stroke, the passage of the gases into the compressor cylinder being due to the reduction in pressure therein.

15. An internal combustion engine having a working cylinder, a compressor cylinder larger than said working cylinder and in alinement therewith, a differential piston having portions thereof operating within both of said cylinders, said piston being hollow and in open communication with the compressor cylinder at all times and provided with a valve-controlled passage between the interior thereof and the working cylinder, and means for positively opening said valve during a portion of the inward stroke.

16. An internal combustion engine having a compressor adapted to compress air upon the working stroke of the piston, and to rarefy air upon the in stroke of the piston, a valve controlling the communication between said compressor and the working cylinder, said valve opening automatically at the exhaust period to admit the air from the compressor into the working cylinder, means for mechanically opening the valve during the in stroke of the working piston to draw gas from the working cylinder into said compressor, a second compressor operating in unison with the engine and communicating with the admission port thereof, a valve commanding the admission port, and mean for periodically operating the valve.

17. In a two-cycle internal combustion engine, the combination of a working cylinder, a differential piston, a closed crank case, the parts being arranged to compress air in the crank case upon the working stroke of the piston, and to rarefy air upon the in stroke of the same, means establishing a valve-controlled communication between the crank case and the working cylinder, the valve opening automatically at the exhaust period to admit air from the crank case to the working cylinder, means for mechanically opening the valve during the in stroke of the piston to allow gas to pass from the working cylinder into the crank case, the larger diameter of the piston forming with the cylinder walls a second compressor, means establishing communication between said second compressor and the admission port of the working cylinder, a valve controlling said port, and means for periodically operating said valve.

18. In a two-cyclei nternal combustion engine, the combination of a working cylinder, a differential piston, a closed crank chamber, the posts being arranged to compress air in the crank chamber upon the working stroke of the piston, and to rarefy air upon the in stroke of the same, means establishing a valve-controlled communication between the crank chamber and the working cylinder, said means comprising a port passing through the working piston and a valve commanding the port, the valve opening automatically at the exhaust period to admit air from the crank chamber to the working cylinder, means for mechanically opening the valve during the in stroke of the piston to allow gas to pass from the working cylinder into the crank chamber, the larger diameter of the piston forming with the cylinder walls a second compressor, means establishing communication between said second compressor and the admission port of the working cylinder, a valve controlling said port, and means for periodically operating said valve

19. In a two-cycle internal combustion engine, the combination of a working cylinder, a differential piston, a closed crank chamber,

the parts being arranged to compress air in the crank chamber upon the working stroke of the piston and to rarefy air upon the in stroke of the same, means establishing a valve-controlled communication between the crank chamber and the working cylinder, the valve opening automatically at the exhaust period to admit air from the crank chamber to the working cylinder, means for mechanically opening the valve during the instroke of the piston to allow gas to pass from the working cylinder into the crank chamber, the larger diameter of the piston forming with the cylinder walls a second compressor, means establishing communication between said second compressor and the admission port of the working cylinder, a valve controlling said port, means for periodically operating said valve, said means establishing valve-controlled communication between the crank chamber and the working cylinder comprising a port passing through the working piston and a valve commanding the port, and the said means for mechanically operating the valve-controlling communication between the crank chamber and the working cylinder comprising a member carried by and slidable relatively to the connecting rod of the engine, and a cam on the wrist pin of the engine crank and adapted periodically to engage said member.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HARRY WALTER ADAMS.

Witnesses:
T. A. MARTINSON,
L. O. MCDONALD.