W. G. GERNANDT.

INTERNAL COMBUSTION ENGINE.

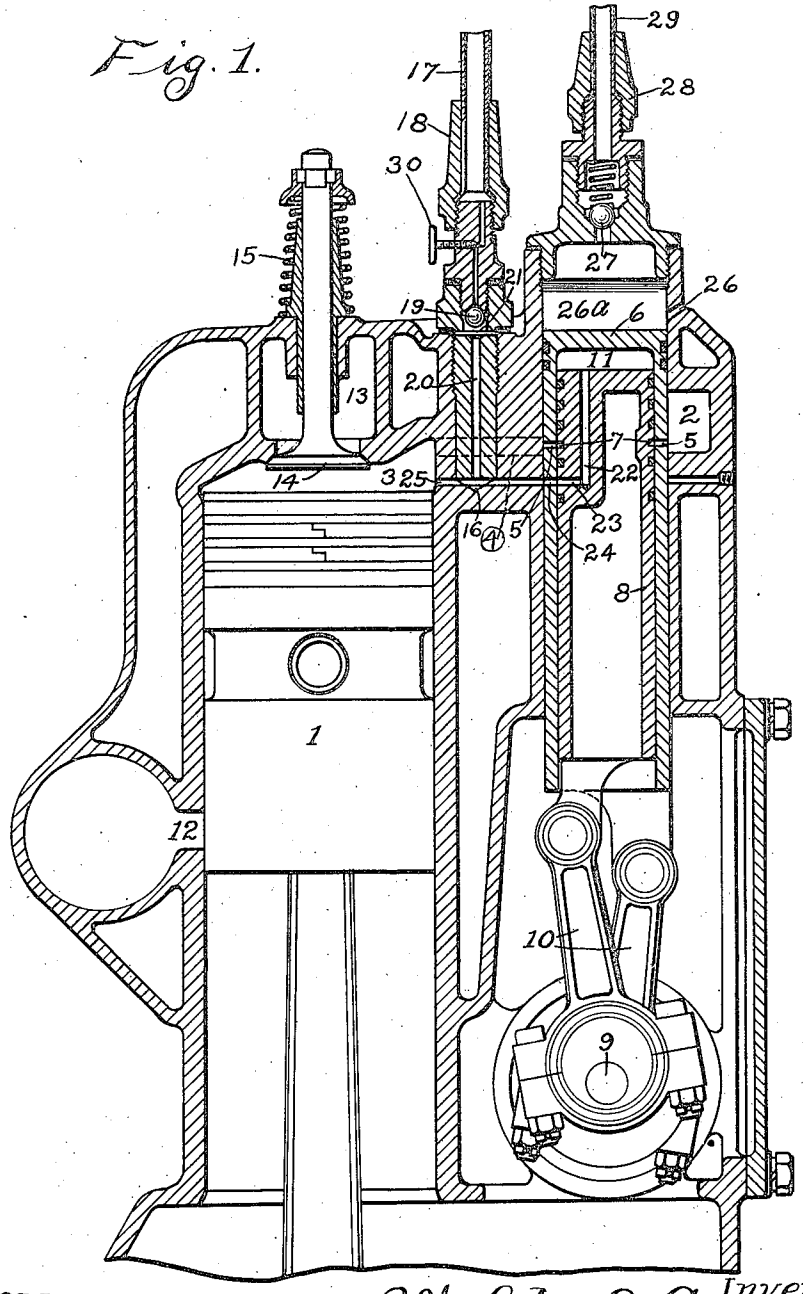
APPLICATION FILED JUNE 18, 1917.

1,305,894.

Patented June 3, 1919.

2 SHEETS—SHEET 1.

Fig. 1.



Witness:
E. G. Jaeker

Waldo G. Gernandt, Inventor.
By Charles Turner Brown, Atty.

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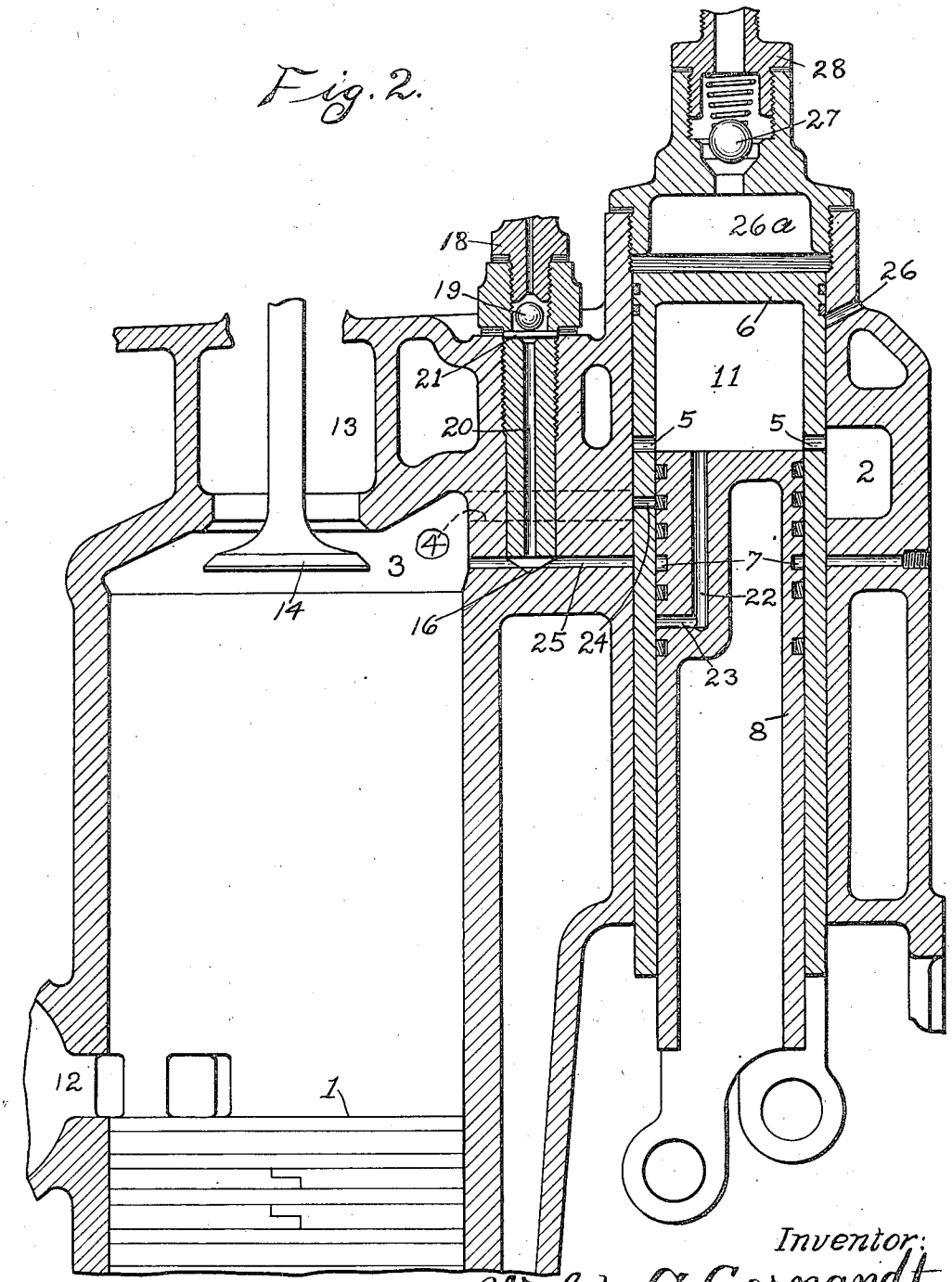
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2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

WALDO G. GERNANDT, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO GERNANDT MOTOR CORPORATION, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

INTERNAL-COMBUSTION ENGINE.

1,305,894. Specification of Letters Patent. Patented June 3, 1919.

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To all whom it may concern:

Be it known that I, WALDO G. GERNANDT, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following, when taken in combination with the drawings accompanying and forming a part hereof, is a full and complete specification.

This invention relates to an internal combustion engine of the high compression type.

And the objects of the invention are to obtain a construction which may be applied to a two cycle or four cycle engine of the type named, which is effective in operation, simple in construction, not liable to break or get out of order, and adapted to make use of any liquid hydrocarbon for fuel.

Further objects are, to obtain a high compression internal combustion engine which is operative without ignition and carbureting devices.

Further objects are to obtain a device of the type named wherein a variation of speed is obtained by a corresponding variation in the quantity of fuel supply, and a device wherein the quick combustion, producing movement of the engine, will at all times occur when the piston (or pistons) are substantially in a predetermined position without regard to the rapidity of travel of the piston.

Additional objects are hereinafter set forth and disclosed by the claims.

In the drawings referred to a two cycle engine is illustrated which embodies my present invention and in said drawings,

Figure 1, is a vertical sectional view with the several movable parts illustrated in proper relative position for ignition of a compressed charge in the combustion chamber and

Fig. 2, is a like vertical section with the piston at the extreme limit of its travel from its position as illustrated in Fig. 1, and with the movable parts of the engine in a corresponding relative position.

In the drawings the fuel tank is not illustrated, as any closed fuel tank which is adapted to receive pressure arranged to force fuel therefrom is usable with the constructions illustrated.

A reference character applied to designate a given part indicates said part throughout the several figures of the drawings wherever the same appears.

1 represents a piston; 2, a compression chamber; 3, the combustion chamber of the engine; and 4, a passageway from the compression chamber 2, to the combustion chamber 3. 5 represents ports in the cylindrical portion of the combined compression piston and sleeve 6. 7 represents an annular groove in pump piston 8. 9 represents an eccentric shaft, which is driven from the main shaft by suitable means, in timed relation thereto, and 10 represent eccentric rods driven by said eccentric shaft 9, and connected to the respective combined compression piston and sleeve valve 6 and pump piston 8. 11 represents a clearance or compression space through which a portion of the cylindrical part of the combined compression piston and sleeve valve 6, extends. 12 represents the exhaust port of the engine; 13 an inlet passage (for air); 14 an automatic valve to inlet passage 13, yieldingly held closed by spring 15. 16 represents a fuel pocket; 17 a tube communicating with pocket 16; 18 a connection adapted to be attached to a tube or pipe communicating at one end with a fuel supply tank; 19 a ball check valve adapted to permit fuel to flow therethrough on its way to and through hollow plug 20 and to pocket 16. 21 represents a pin arranged to limit the opening movement of the ball check valve 19, so that the passage way through hollow plug 20 is at no time closed by said ball. 22 represents a passageway from the compression end of piston 8 to port 23 on one side of said piston; 24 a port in the combined compression piston and sleeve valve 6, and 25 a passageway from pocket 16 to combustion chamber 3. 26 represents an air passageway arranged to discharge into the compression space or chamber 26^a; and 27 a check valve arranged to prevent a flow of air or fluid from the fuel tank, or from pipe 29 and connection 28, to said chamber 26^a. Pipe 29 is arranged to discharge air from chamber 26^a to a closed fuel tank, (not illustrated), and tube or pipe 17, hereinbefore identified, is in communication, at its receiving end, with said fuel tank. 30 represents a needle valve to control the supply of fuel in the operation of the engine.

The combined compression piston and

sleeve valve 6 and pump piston 8 are connected to the cams on cam shaft 9, by means of the connecting rods 10, and said cams are so positioned on said shaft, that when one thereof is moved in one direction the other one is moved in the opposite direction. Registration of ports 5 and annular groove 7; and of ports 23 and 24 is obtained as quickly, in the operation of the engine, because of said movement in opposite directions, as would be obtained were one of said parts stationary and the other one moving at double the rapidity at which, in the construction illustrated, said parts are moved.

Referring to Fig. 1, the relative position of the several parts is as follows: Piston 2 is in its extreme compression position, and the combustion chamber 3 is at its smallest dimension; with the contents thereof under compression and in condition to be ignited so soon as a suitable quantity of hydrocarbon fuel is injected thereinto. Prior to the injection of fuel into said combustion chamber the contents consist of compressed air. The combined compression piston and sleeve valve 6 is in its extreme forward (downward as viewed) position, and the pump piston 8 is in its extreme retracted (upward as viewed) position. The compression chamber or space 11 is reduced to its smallest dimension, and the compression chamber 26^a is enlarged to its greatest dimension, with port 26 open. The ports 5 register with passageway 4 (indicated by broken lines in Figs. 1 and 2) and with annular groove 7. Ports 23, 24 and passageway 25 register. By the registering of the above named ports and passageways compression chambers 2 and 11 are in communication with the combustion chamber 3.

Assuming the device to be in operation the contents of chamber 11, being at a greater pressure than are the compressed air contents of combustion chamber 3, will flow with rapidity through the passageway 25 into said combustion chamber, carrying along therewith the fuel contents of the pocket 16. Rapid combustion of the contents of combustion chamber 3 will at once occur upon the injection, as last above set forth, of the fuel contents of said pocket 16, because of the high temperature of the fluid in said combustion chamber. The contents of compression space or chamber 2 being at the same pressure as the contents of the combustion chamber 3, upon the sudden rise in pressure due to the combustion last above set forth, a like rise in pressure will be obtained or produced in said chamber 2, and is there trapped upon the upward movement of the combined compression piston and sleeve valve 6 and the downward movement of the pump piston 8, bringing ports 23, 24 and passageway 25 out of line.

Referring to Fig. 2, when the piston 1 has moved from the position thereof which is illustrated in Fig. 1, to the position which is illustrated in said Fig. 2, the exhaust port 12 is opened and the pressure in the cylinder of the engine is released. Air, under pressure from any suitable source of supply, in passageway 13 will force valve 14 off its seat, and will scavenge said cylinder. Upward movement of the piston 1 will trap air in said cylinder and when said piston has returned, (from its position in Fig. 2), to its position as illustrated in Fig. 1, will put said trapped air under heavy compression, say not less than several hundred pounds.

Piston 1 being in the position illustrated in Fig. 2, the ports 5 are open so that chamber 2 is in communication with chamber 11, and the contents of said chamber 2, (being at substantially initial combustion pressure in chamber 3) will flow from said chamber 2 to chamber 11, to be put under still higher pressure in said chamber 11 on the upward movement of the pump piston 8. The port 26 is closed and the contents of chamber 26^a are under pressure; the greater part of the contents of said chamber 26^a having been, however, forced through the seat of check valve ball 27, and through the connection 28 and pipe 29 to the fuel tank, to give pressure to the fuel contents thereof. Combustion chamber 3 being released from pressure the check valve ball 19 drops on to pin 21 and fuel, (the quantity thereof being determined by the position of needle valve 30) will flow to fuel pocket 16. Passageway 4 and port 24 are closed by the pump piston 8.

The operation of the device illustrated is as follows:

When piston 1 nears its upper dead center, chamber 2 is brought into communication with combustion chamber 3 through passageway 4, ports 5 and annular groove 7, filling said chamber with air at the highest pressure in said combustion chamber 3. As the piston 1 moves downward on its expansion stroke or travel, pump piston 8 moves downward and the combined compression piston and sleeve valve 6 moves upward, closing chamber 2 to passage 4, thereby trapping the high pressure fluid in said chamber 2. As piston 1 nears the bottom of its stroke, pump piston 8 uncovers ports 5 in sleeve valve 6 and allows the compressed air trapped in chamber 2 to flow into the chamber 11. At this time the exhaust port 12 has been uncovered by the piston 1, the pressure in the cylinder of the engine and combustion chamber 3 is released, and air which has been previously compressed to about fifteen pounds per square inch, say, by means of a suitable compressor which forms no part of this invention, is delivered to the cylinder and combustion chamber 3 through air inlet passage 13 and valve 14, and thoroughly scavenges

said cylinder and combustion chamber, and fills same with fresh air. Co-incident to the exhaust and inspiration period, fuel, which is under pressure in excess of the exhaust pressure, is deposited in pocket 16. As piston 1 moves upward on its compression stroke, the combined compression piston and sleeve valve 6 moves downward and piston 8 moves upward, thereby reducing the dimension of chamber 11, and increasing the pressure of the contents thereof. As piston 1 reaches its dead center said chamber 11 is brought into communication with combustion chamber 3, through passage-way 22 and ports 23, 24, and passageway 25, allowing the highly compressed fluid in said chamber 11 to enter the combustion chamber and to sweep along therewith the fuel which has been deposited in pocket 16. Ignition takes place upon the fuel entering the combustion chamber which is filled, as stated, with compressed air, which, by its rapid compression, is highly heated. The piston is forced downward by said ignition, on its expansion stroke, ports 5 close chamber 2 from the combustion chamber 3, and the highest pressure caused by the combustion in said chamber 3, obtains in the fluid which is trapped in said chamber 2, ready for additional compression in chamber 11, as before stated.

Compression chamber 11 provides means to restore any loss of temperature and pressure of the fluid in chamber 2 and also to increase the pressure thereof, above the initial combustion pressure of the contents of combustion chamber 3.

Attention is directed to the position of the pocket 16, which constitutes a fuel depository adapted to receive fuel from hollow tube 20. This depository being immediately adjacent to the compression chamber the liquid fuel deposited therein is vaporized by the sudden and great increase of temperature of the air which is forced thereto through passageway 25 on the compression stroke or travel of piston 1.

Prior to the vaporized fuel being swept from depository 16 and passageway 25 into the combustion chamber 3 by the release of the contents of compression chamber 11, as hereinbefore described, there is not sufficient air in contact or mixed with said vapor to support combustion thereof, and hence said combustion does not take place until said fuel, whether in a vapor or in a liquid form, is forced into the combustion chamber.

The foregoing described constructions are included in each unit of a two cycle engine embodying this invention, and where, as is usually the case, an engine comprises a plurality of said units the pipe or tube 29 from say, all but one of said units, may deliver air under pressure from chamber 26^a to an air chamber or tank in communication with air passageway 13.

I claim:

1. In an internal combustion engine comprising a combined cylinder and combustion chamber, a longitudinally movable piston in said cylinder, an air inlet port, a valve and means to yieldingly hold said valve closed on said inlet port, the combination of a fuel passageway, a fuel depository in said passageway and means to deposit fuel in said depository, a chamber adapted to contain fluid under pressure, a combined compression piston and sleeve valve and a pump piston arranged to obtain a compression chamber between them, said pump piston provided with an annular groove, a passageway communicating with said combustion chamber, said compression piston and sleeve valve provided with ports adapted to put said annular groove in communication with said fluid chamber and with said passageway communicating with said combustion chamber when said combined compression piston and sleeve valve, and said pump piston are in predetermined positions, a passageway in communication with said compression chamber and provided with a port at the discharge end thereof and an additional port in said combined compression piston and sleeve valve adapted to register with said discharge end port and with said fuel passageway, when said combined compression piston and sleeve valve and said pump piston are in said determined positions.

2. In an internal combustion engine comprising a combined cylinder and combustion chamber, a longitudinally movable piston in said cylinder, an air inlet port, a valve and means to yieldingly hold said valve closed on said inlet port, the combination of a fuel passageway, a fuel depository in said passageway and means to deposit fuel in said depository, a chamber adapted to contain fluid under pressure, a combined compression piston and sleeve valve and a pump piston arranged to obtain a compression chamber between them, said pump piston provided with an annular groove, means adapted to put said annular groove in communication with said fluid chamber and with said combustion chamber when said combined compression piston and sleeve valve, and said pump piston are in determined positions, a passageway in communication with said compression chamber and provided with a port at the discharge end thereof and an additional port in said combined compression piston and sleeve valve adapted to register with said discharge end port and with said fuel passageway, when said combined compression piston and sleeve and said pump piston are in said determined positions.

3. In an internal combustion engine which is provided with a cylinder, a combustion chamber, an air inlet port; a valve arranged to co-act with said port, an exhaust port, and a longitudinally movable piston adapted to apply pressure to the fluid contents of said cylinder, the combination of a fuel depository, a fuel passageway communicating with said depository and with said combustion chamber, means to supply fuel to said depository, a holding chamber adapted to hold fluid products of combustion under substantially initial combustion pressure, means to admit fluid under pressure to said holding chamber from said combustion chamber, a compression chamber, means to establish communication between said holding and said compression chambers, means to apply additional compression to fluid in said compression chamber, means to release additionally compressed fluid contained in said compression chamber, and means to convey said released fluid to said fuel depository and into said combustion chamber.

4. In an internal combustion engine comprising a cylinder and combustion chamber, means to introduce air to said cylinder and a movable piston adapted to put said air under high compression, the combination of means to trap highly compressed fluid products of combustion from said combustion chamber, means to additionally compress said trapped fluid, a fuel depository, means to deposit fuel in said depository, and means to release said additionally compressed fluid and direct it to said depository and into highly compressed air in said combustion chamber.

5. In an internal combustion engine comprising a cylinder and combustion chamber, means to introduce air to said cylinder and a movable piston adapted to put said air under high compression, the combination of means to trap highly compressed fluid products of combustion from said combustion chamber, means to additionally compress said trapped fluid, a fuel depository, means to deposit fuel in said depository, means to release said additionally compressed fluid and direct it to said depository and into highly compressed air in said combustion chamber, additional means to compress air comprising a cylindrical chamber having a movable wall, said wall being also an element of said means to additionally compress trapped fluid, and means to discharge air from said additional means to compress air at predetermined intervals.

6. In an internal combustion engine which is provided with a cylinder, a movable piston and a combined compression and combustion chamber, the combination of means to supply fluid to said chamber and means, including said piston, to compress said fluid, a fuel depository, a fuel passageway to said depository and a passageway from said depository to said chamber, a holding chamber, means to trap fluid at combustion pressure in said holding chamber, an additional compression chamber, means to discharge fluid contained in said holding chamber into said additional compression chamber, means to reduce the volume of said fluid contents of said additional compression chamber and means to discharge said reduced in volume contents of said additional chamber to said depository and into said compressed fluid contained in the combined compression and combustion chamber, said discharge of said fuel into said combined compression and combustion chamber adapted to produce combustion and combustion pressure in said chamber.

7. In an internal combustion engine which is provided with a cylinder, a combustion chamber, an air inlet port; a valve arranged to co-act with said port, an exhaust port, and a longitudinally movable piston adapted to apply pressure to the fluid contents of said cylinder, the combination of a fuel depository, a fuel passageway communicating with said depository and with said combustion chamber, means to supply fuel to said depository, a holding chamber adapted to hold fluid under pressure, means to admit fluid under pressure to said holding chamber from said combustion chamber, a compression chamber, means to establish communication between said holding and said compression chambers, means to apply additional compression to fluid in said compression chamber, means to release additionally compressed fluid contained in said compression chamber, means to convey said released fluid to said fuel depository and into said combustion chamber, and an additional compression chamber provided with an inlet and with an outlet and a check valve to said outlet, said combined piston and sleeve valve forming a movable wall in said additional compression chamber.

8. In an internal combustion engine which is provided with a cylinder, a movable piston and a combined compression and combustion chamber, the combination of means to supply fluid under pressure to said chamber and means, including said piston, to additionally compress said fluid, a fuel depository, a fuel passageway to said depository and a passageway from said depository to said chamber, a holding chamber, means to trap fluid at combustion pressure in said holding chamber, an additional compression chamber, means to discharge fluid contained in said holding chamber into said additional compression chamber, means to reduce the volume of said fluid contents of said additional compression chamber and means to discharge said reduced in volume contents

of said additional chamber to said depository and into said fluid under said additional pressure contained in the combined compression and combustion chamber, said discharge of said fuel into said combined compression and combustion chamber adapted to produce combustion and combustion pressure in said chamber.

9. In an internal combustion engine which is provided with a cylinder and a movable piston arranged to obtain a combined compression and combustion chamber in said cylinder, means to apply additional pressure to fluid products of combustion discharged from said chamber and to return said fluid under said additional pressure to said chamber, said means comprising a plurality of additional chambers, a port and means to close said port to control communication between said additional chambers, a passage way and an additional passage way respectively communicating with said additional chambers and with said combustion chamber, ports and means to close said ports to establish and obstruct communication through said passage way and additional passage way, said last named means to close said ports timed to alternate with said first named means to close said port and to establish said communication substantially simultaneously with the ignition and maximum pressure in said combined compression and combustion chamber.

10. In an internal combustion engine which is provided with a cylinder, a movable piston and a combined compression and combustion chamber, additional chambers, a passageway from said first named chamber to one of said additional chambers and a passageway from the remaining additional chamber to said first named chamber, means to obstruct said passageways, and a passageway and means to obstruct it between said additional chambers, said means to obstruct said passageways comprising movable walls provided with apertures arranged to register at predetermined intervals to substantially simultaneously discharge into and receive from said combustion chamber highly compressed fluid products of combustion, and during the obstruction of said passageways between said additional chambers and said combustion chamber to open said passageway between said additional chambers.

11. In an internal combustion engine which is provided with a cylinder, a movable piston and a combined compression and combustion chamber, the combination of additional chambers, a communicating way and a port thereto between said additional chambers and means to compress fluid in said additional chambers, a passage way from said first named chamber to one of said additional chambers and a passage way from the remaining additional chamber to said first named chamber, a fuel depository in said last named passage way, means to obstruct said passage ways, said port and said means to obstruct in timed relation to said piston and adapted to be moved at pre-determined intervals to alternately close the communicating way between the additional chambers and open the passage ways to and from the first named chamber and the additional chambers.

12. In an internal combustion engine which is provided with a cylinder, a movable piston and a combined compression and combustion chamber, means to trap fluid under pressure from said chamber and means to thereafter apply additional pressure to said trapped fluid, said trapping and additional pressure means comprising additional chambers and passageways, means to obstruct said passageways, means to control said obstructions and means to transfer said fluid from one of said additional chambers to the other thereof, all arranged to, substantially simultaneously, receive fluid from and discharge fluid into said first named chamber.

13. In an internal combustion engine which is provided with a cylinder, a movable piston and a combined compression and combustion chamber, means to trap fluid under pressure from said chamber, means to thereafter apply additional pressure to said trapped fluid, said trapping and additional pressure means comprising additional chambers and passageways, means to obstruct said passageways, means to control said obstructions and means to transfer said fluid from one of said additional chambers to the other thereof, all arranged to, substantially simultaneously, receive fluid from and discharge fluid into said first named chamber, and means to deposit fuel in the path of said fluid discharge.

14. In an internal combustion engine, the combination of a combined combustion and compression chamber, additional and communicable chambers, a passageway from said first named chamber to one of said additional chambers, and a passageway provided with a fuel depository thereto, from the remaining additional chamber to said first named chamber, means to obstruct said passageways, a passageway and means to obstruct the same between said additional chambers, said means to obstruct said first named passageways and said means to obstruct the passageway between said additional chambers arranged to be alternately moved to establish communication between the additional chambers and the combustion chamber and between said additional chambers.

15. In an internal combustion engine, a combined combustion and compression chamber, means, comprising an inlet valve, to

supply air under pressure to said chamber, at pre-determined intervals, means to apply additional pressure to said air in said chamber, a holding chamber, an additional compression chamber, means to establish communication between said holding chamber and said additional compression chamber synchronously with said pre-determined intervals, and means to synchronously discharge the contents of said first named chamber to said holding chamber and the contents of said additional compression chamber to said first named chamber, at intervals midway of said pre-determined intervals.

16. In an internal combustion engine, a combined combustion and compression cylinder, a piston, the travel whereof comprises ignition and exhaust positions in said cylinder, a holding chamber and an additional compression chamber, means to establish, said piston being at one end of said cylinder and in exhaust position, communication between said holding and additional compression chamber, and means to synchronously establish, said piston being at the opposite end of said cylinder and in ignition position, communication between said combustion and compression cylinder and said last named chambers.

17. In an internal combustion engine, comprising a combined cylinder and combustion chamber provided with a piston, means to obtain and ignite fuel in said chamber, said means comprising means to admit air to said cylinder and means including said piston to quickly compress said air into said chamber, means to inject previously trapped products of combustion and fuel into said compressed air in said combustion chamber, said injected products of combustion being at a greater pressure than the air contents of said combustion chamber, and means to trap substantially simultaneously with said injection products of combustion resulting from said injection and the ignition obtained thereby.

WALDO G. GERNANDT.

In the presence of—
CHARLES TURNER BROWN.
J. SCUDDER.