W. G. GERNANDT.

INTERNAL COMBUSTION ENGINE.

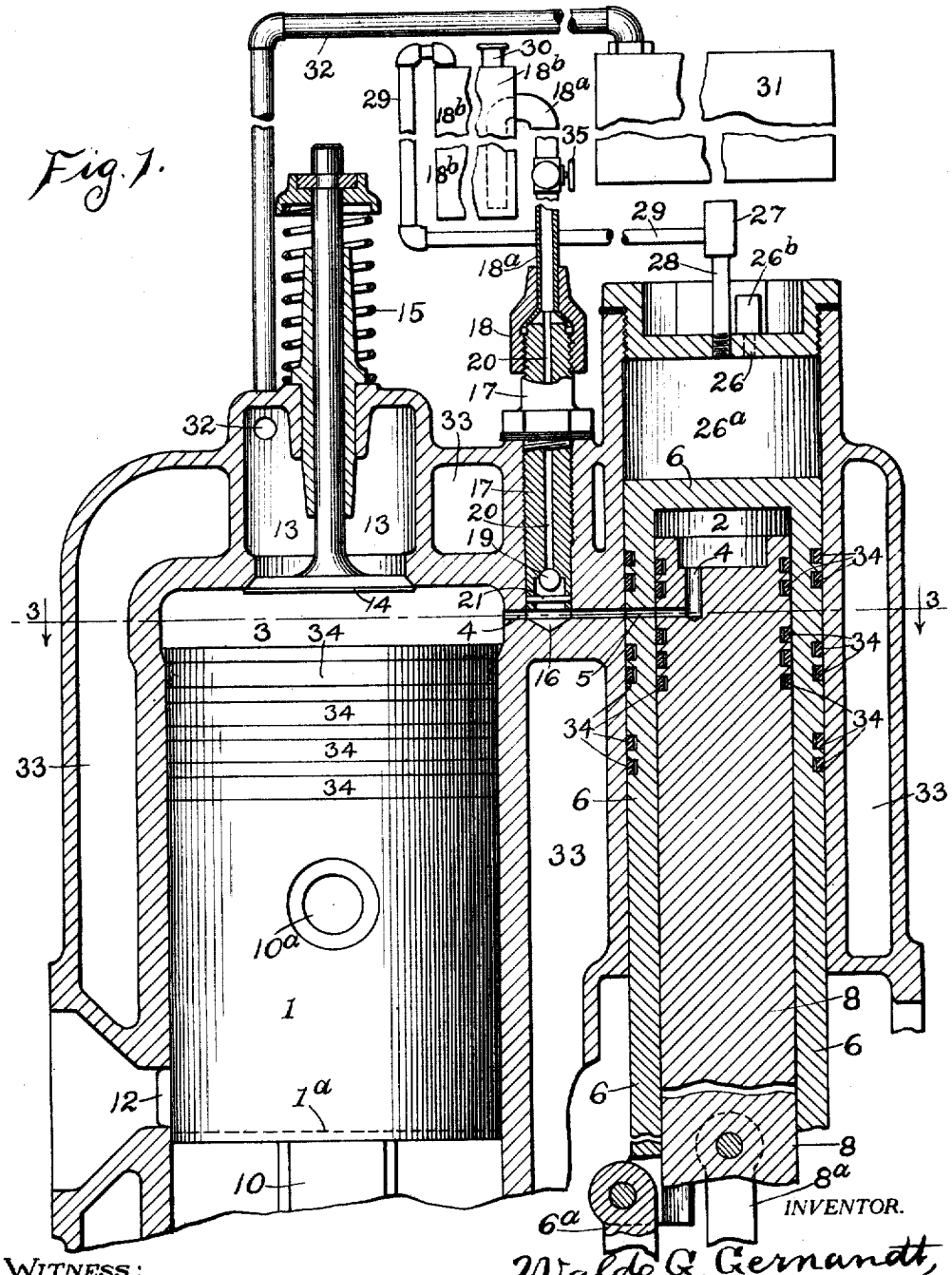
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1,305,533.

Patented June 3, 1919.

3 SHEETS—SHEET 1.

Fig. 1.



WITNESS:

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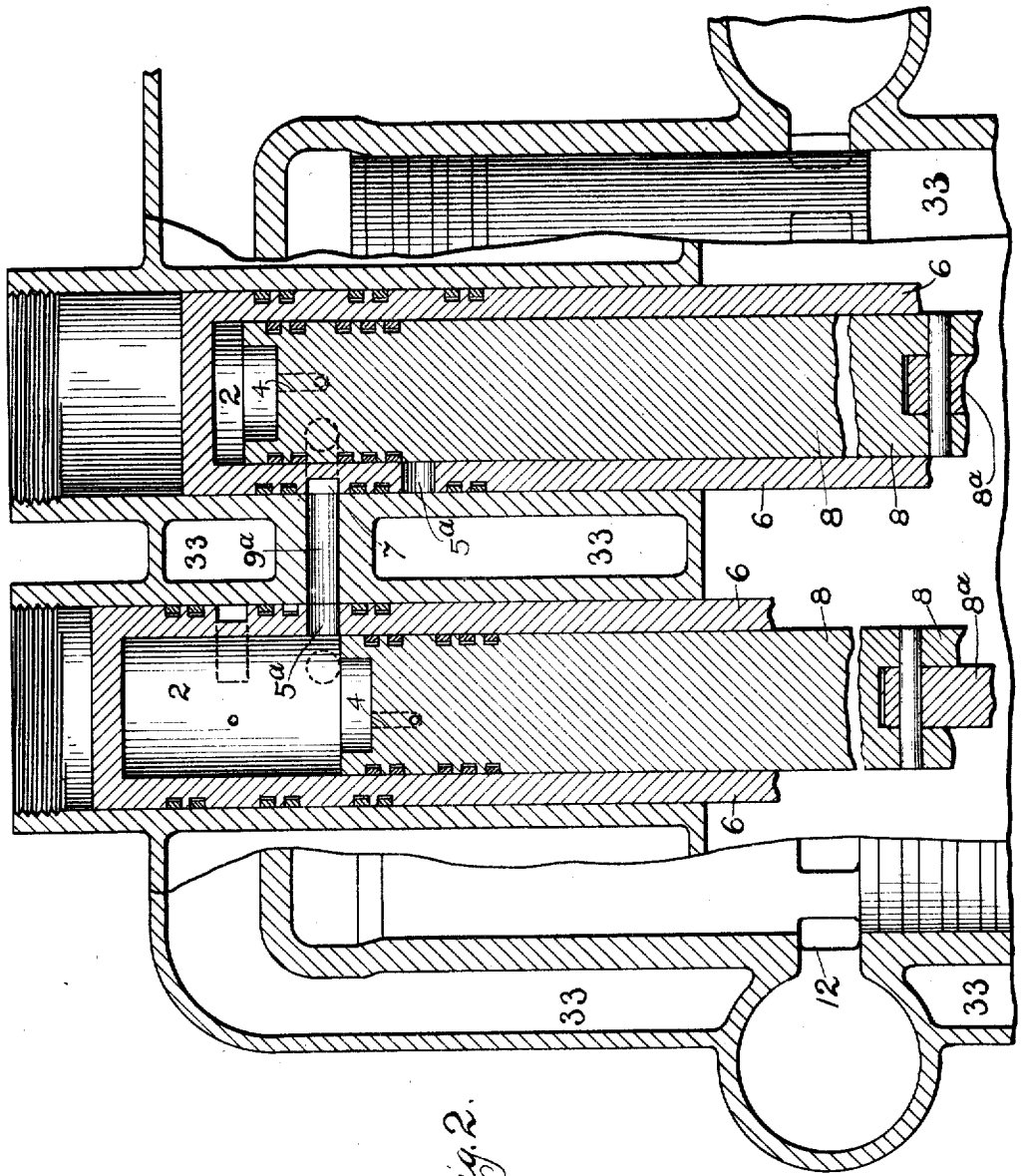


Fig. 2.

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3 SHEETS—SHEET 3.

Fig. 4.

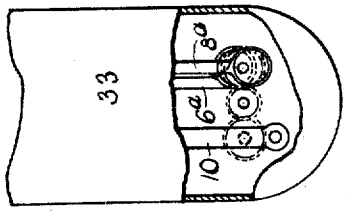
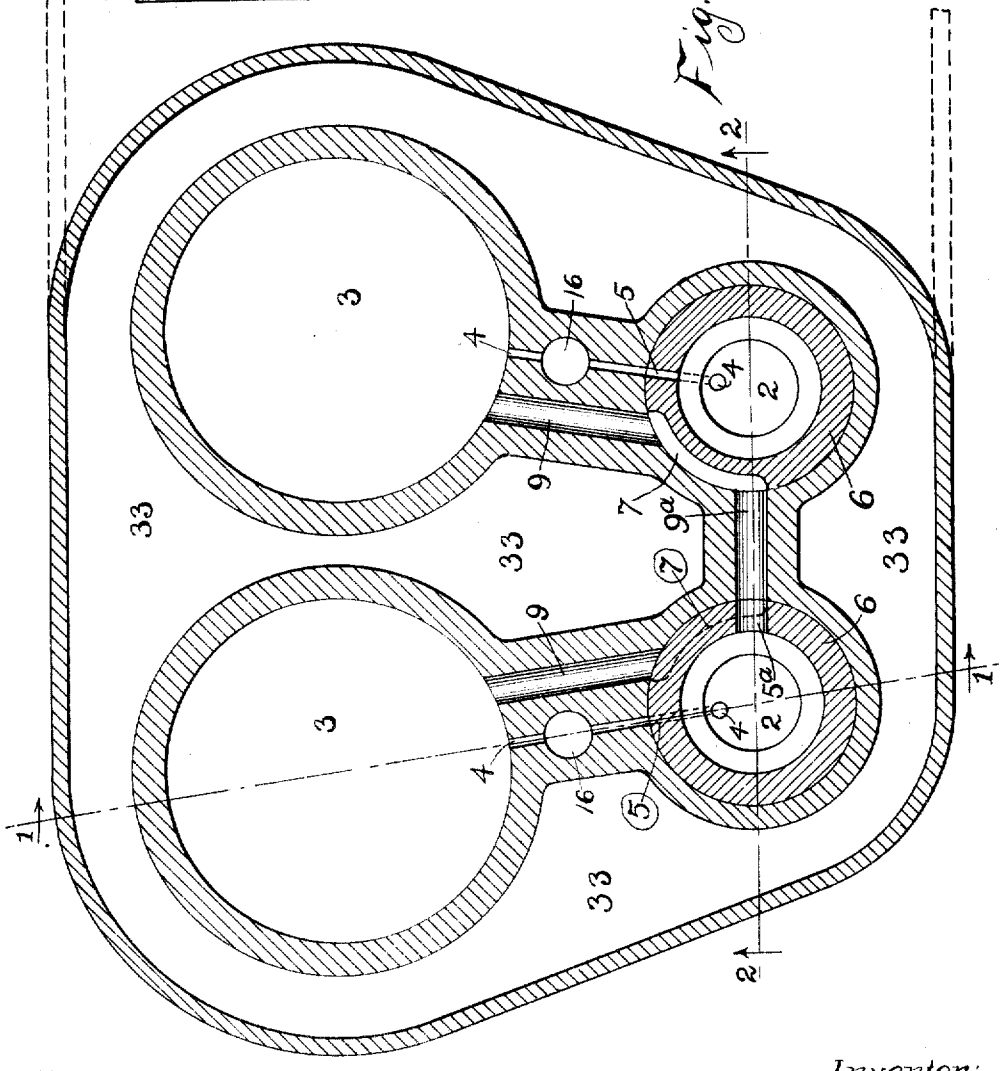


Fig. 3.



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UNITED STATES PATENT OFFICE.

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

INTERNAL-COMBUSTION ENGINE.

1,305,533. Specification of Letters Patent. Patented June 3, 1919.

Application filed December 26, 1917. Serial No. 208,968.

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 and useful Improvements in Internal-C bustion Engines, of which the following specification.

This invention relates to an internal co bustion engine of the high compression typ

And the objects of the invention are t obtain a construction applicable to a multi-cylinder high pressure internal combustion engine of simple construction, effective operation and adapted to use liquid hydrocarbon for fuel, which is operable 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 i the quantity of fuel supply, and a devi wherein the quick combustion, produci movement of the engine, will at all tir occur when the piston (or pistons) are s stantially in a predetermined position w out regard to the rapidity of travel of piston.

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

In the drawings forming part of specification a two cylinder high pres internal combustion engine is illustrated bodying the present invention, and

Figure 1 is a vertical sectional view on 1—1 of Fig. 3, viewed in the direction i cated by the arrows, of one of the cylir of said engine and related parts, with movable members thereof in proper rel position for ignition in the combustion c ber of said cylinder and also illustrati elevation air supply and fuel supply bers.

Fig. 2 is a vertical section of the mo members which are illustrated in Fig. line 2—2 of Fig. 3, viewed in the dire indicated by the arrows. Fig. 3 is a zontal section on line 3—3 of Fig. 1, vi in the direction indicated by the arrows

Fig. 4 is a diagram, on a reduced s showing a crank shaft, a cam shaft, a necting gear, and connecting rods.

A reference character applied to c nate a given part indicates said part thr out the several figures of the drawing, wherever the same appears.

1 represents a piston; 2 a compression chamber; 3, a combined compression and combustion chamber and 4 a passageway from chamber 2 to chamber 3. 5, 5^a respectively represent ports in the cylindrical portion of the combined compression piston and sleeve 6. 7, represents a groove on the peripheral face of the combined compression piston and sleeve 6. 8, represents a pump ston. 9, 9^a represent passageways. Groove forms a port to passageways 9 and 9^a. 6^a d 8^a represent connection rods.

In assembling an engine embodying this ntion one or more units, as I term them, connected to crank and cam shafts which in timed relation, and the parts and mbers which are required to disclose the nstruction of said unit to one skilled in the rt, are illustrated in the drawings. Each unit comprises two pistons, movably mounted in water jacketed cylinders, to obtain combined compression and combustion chambers 3, two combined compression pistons and sleeves 6, and two pump pistons, 8.

The compression chambers, 2 are contained within the respective combined compression piston and sleeve 6, and one end of the pump piston, 8. forms a movable wall to said chambers. The discharge end of a passageway 9^a is controlled by port 5^a and when said port is open is in communication with a compression chamber 2; the inlet end of each of said passageways 9^a, and the discharge end of a corresponding passageway 9 are controlled by a port 7, and when said port is open said passageways 9 and 9^a are in communication. The inlet end of said passageway 9 is at all times in communication with a combined compression and combustion chamber 3.

When port 5 is open compression chamber 2 is in communication, by way of passageway 4, with the combined compression and combustion chamber 3.

By the last above named passageways and ports when port 5 is open and a compression chamber 2 is in communication through passageway 4 with a combustion chamber 3 said chamber 3 is at said time also in communication with the other one of the compression chambers 2, by way of passageway 9, port 7, passageway 9^a and port 5^a.

When a chamber 2 is in communication by way of passageway 4 and port 5 with a chamber 3, both said chambers are reduced to their smallest, or nearly so, capacity and the remaining compression chamber 2 of the unit, (which is also in communication with said chamber 3 as above set forth) is expanded to its largest possible, or nearly so, capacity. At said time one of the pistons (1) of a unit is in substantially the position which is illustrated in Fig. 1 and the other piston 1 of said unit is in position with the upper end thereof substantially on the line represented by broken lines 1^a Fig. 1. That is, one of said pistons is at one end of its travel and the other thereof is at the other or opposite end of its travel.

10 represents a connecting rod which is pivoted at its upper end to the piston 1, as by pin 10^a, and at its lower end, in the usual manner, to a crank shaft. The combined compression piston and sleeve 6 and the pump piston 8 are, respectively, joined to cams on the cam shaft of the engine, by connecting rods so timed that when one thereof is at its position in its extreme travel in one direction the other is at its position of extreme travel in the opposite direction and said cams are timed with the cranks of the crank shaft so that when a piston 1 is in position with its combustion chamber 3 of smallest possible dimension the compression chamber 2 in communication therewith by way of passageway 4 and port 5 is also of smallest possible dimension and the compression chamber 2 which is also in communication with said combustion chamber 3 by way of passageways 9, 9^a and ports 7, 5^a, is of largest possible dimension.

12 represents the exhaust port of the engine; 13, an inlet passageway for air; 14, an automatic valve to inlet passage 13, yieldingly held closed by spring 15; 16, a fuel pocket or depository in passageway 4; 17, a tube the discharge end whereof communicates with depository 16; and 18 a connection by means of which tube or pipe 18^a, (which communicates at one end with fuel supply tank 18^b), is attached to said tube 17. 19, represents a ball check valve adapted to permit fuel therethrough on its way to and through tube 18^a and passageway 20 in tube 17 from fuel tank 18^b; and 21 a pin arranged to limit the opening movement of the ball check valve 19, so that said ball is sufficiently near the discharge end of passageway 20 to be forced to its seat and close said passageway when the pressure in passageway 4 is greater than the pressure in said passageway 20.

The broken lines 26 indicate an air passageway arranged to discharge into the compression space or chamber 26^a and 26^b represents the shell or case of a check valve arranged to permit the flow of air to chamber 26^a and to prevent the flow of air therefrom through the passageway indicated by the broken lines 26. 27, represents the shell or case of a check valve. 28, a tube or pipe in communication at its inlet end with chamber 26^a, and 29 a tube or pipe in communication at its discharge end with fuel tank 18^b. The check valve 27 is interposed between the discharge end of tube 28 and the inlet end of tube 29 to prevent backward flow from fuel tank 18^b into chamber 26^a. The upper end of the combined compression piston and sleeve 6 forms a movable wall of chamber 26^a and said chamber forms a compression chamber which is supplied with air through the passageway indicated by broken lines 26 and which is adapted to force said air from said chamber through pipes or tubes 28, 29 and check valve 27 to the fuel supply tank 18^b, thereby putting the fuel in said tank under pressure. 30 indicate the shell of a relief valve which is mounted on said tank 18^b to prevent over pressure in said tank. 31 represents by a broken rectangle, a source of air supply, and 32 a pipe or conduit from air supply 31 to air inlet passage 13. 33, represents the space or chamber which when filled with water forms the water jacket of the unit. 34, 34, represent compression rings.

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 hydro-carbon 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 2 is reduced to its smallest dimension, and the compression chamber 26^a is enlarged to its greatest dimension, with port 26 open. The port 5 registers with passageway 4, port 5^a with passageway 9^a (see Fig. 3), and passageways 9, 9^a with annular groove 7. By the registering of the above named ports and passageways compression chambers 2, 2 are in communication with the combustion chamber 3 which is illustrated in Fig. 1.

Assuming the device to be in operation the contents of compression chamber 2 (illustrated in Fig. 1), which is in communication with the combustion chamber 3 by way of passageway 4 and port 5, being at a greater pressure than are the compressed air contents of said combustion chamber 3, will flow with rapidity through the passageway 4 into said combustion chamber, carrying along

therewith the fuel contents of pocket 16. Rapid combustion of the contents of said 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 which is in communication with said chamber 3 by way of passageways 9, 9a and ports 7 and 5a being, immediately prior to said ignition, at the same pressure as the contents of said combustion chamber 3, upon the sudden rise in pressure due to said combustion last above set forth, a like rise in pressure will be obtained or produced in said chamber 2, and be there trapped upon the movement of the combined compression piston and sleeve valves 6, 6 and the movement of the pump pistons 8, 8, bringing ports 5a and 7 out of line.

When the piston 1 which is illustrated in Fig. 1 has moved downward, in the operation of the engine, so that the upper end thereof is on (or substantially so) the broken line 1a in said figure, exhaust port 12 is open and the pressure in the cylinder of the engine which contains said piston is released. At the same time the other piston, 1, of the unit will have moved in its cylinder into the position of its extreme upward travel and the trapped products of combustion in the chamber 2 corresponding with said other piston and cylinder, will have been subjected to additional compression by the movement of the members 6 and 8 which form the walls of said corresponding chamber 2, and the operation which has been recited as occuring when piston 1 which is illustrated in Fig. 1 is in the position there shown will occur relative to the other piston 1 and the members 6 and 8.

When in the operation of the engine a combustion chamber, 3, is released from pressure, air will flow from a source of supply (31) through pipe or conduit 32 and passageway 13 into said combustion chamber, said flow forcing valve 14 downward off its seat. The air supply being under greater than atmospheric pressure said flow of air into said combustion chamber will scavenge the cylinder before piston 1 had moved upward a sufficient distance to close exhaust port 12.

During the above described operations chamber 26a will alternately be enlarged and reduced in dimension by the movement of the combined compression piston and sleeve valve 6 and air will be forced from said chamber 26a into fuel tank 18b through members 28, 27 and 29 as hereinbefore described.

When a combustion chamber 3 is released from pressure the check valve 19 in passageway 20 corresponding which said chamber drops from its seat and fuel, the quantity thereof being determined by the position of valve 35, flows to fuel depository 16, (passageway 4 being closed at such time by port 5).

The connection rods 6a and 8a are respectively driven by cams which rotate in timed relation with the crank shaft of the engine, said connection being the ordinary connection for driving the valve cam shaft of internal combustion engines.

I claim:—

1. In an internal combustion engine, provided with a plurality of cylinders, means to discharge products of combustion therefrom, combustion and compression chambers therein, and movable pistons arranged to form movable walls to said compression chambers, said pistons in timed relation to alternately enlarge and diminish the dimensions of said compression chambers, the combination of means to supply air to said enlarged compression chambers and said pistons arranged to deposit said air, under pressure, in said combustion chambers, additional compression chambers having movable walls connected in timed relation with said pistons to enlarge and diminish the dimensions of said additional chambers synchronously with the enlarging and diminishing of said first named compression chambers, each of said additional chambers provided with an obstructed inlet passageway from one and an obstructed discharge passageway to the other of said combustion chambers, and ports in said obstructions arranged to register with said passageways on the approach of said pistons to the ends of the compression travels thereof, said additional compression chambers thereby being successively in synchronous communication with said combustion chambers, and means to deposit fuel in said discharge passageways.

2. In an internal combustion engine, a plurality of cylinders, means to supply air thereto, means to discharge products of combustion therefrom, combustion and compression chambers therein, and movable pistons arranged to form movable walls to said compression chambers, said pistons in timed relation to alternately enlarge and diminish the dimensions of said compression chambers and thereby successively receive air therein and deposit said air under pressure in said combustion chambers, in combination with additional compression chambers having movable walls connected in timed relation with said pistons to diminish and enlarge the dimensions of said additional chambers synchronously with the diminishing and enlarging of said first named compression chambers, each of said additional chambers provided with an obstructed inlet passageway from one and an

obstructed discharge passageway to the other of said combustion chambers and means arranged to remove said obstructions from said passageways on the approach of said pistons to the ends of the compression travels thereof, said additional compression chambers thereby successively being in synchronous communication with said combustion chambers, and means to deposit fuel in said discharge passageways.

3. In an internal combustion engine, a plurality of cylinders, means to discharge products of combustion therefrom, combustion and compression chambers therein, means to supply air thereto, and movable pistons arranged to form movable walls to said compression chambers, said pistons in timed relation to enlarge and diminish the dimensions of said compression chambers successively, and deposit air therein in said combustion chambers, under pressure, in combination with additional compression chambers having movable walls connected in timed relation with said pistons to enlarge and diminish the dimensions of said additional chambers synchronously with the enlarging and diminishing of said first named compression chambers, each of said additional chambers respectively provided with an obstructed inlet passageway from one and an obstructed discharge passageway to the other of said combustion chambers, and means comprising ports, to remove said obstructions from said passageways on the approach of said pistons to the ends of the compression travels thereof, said additional compression chambers, one thereof being enlarged and one diminished, being thereby simultaneously put in communication with a diminished combustion chamber, and means to deposit fuel in said discharge passageways.

4. In an internal combustion engine, a casing and a plurality of combustion chambers therein, in combination with a corresponding number of compression chambers respectively comprising pistons arranged to form movable walls having compression and enlarging travels and said pistons in timed relation to alternately diminish and enlarge the dimensions of said compression chambers, each of said compression chambers provided with an obstructed inlet passageway from one and an obstructed discharge passageway to the other of said combustion chambers, and means, comprising ports, to remove said obstructions from said inlet passageways on the approach of said pistons to the ends of the enlarging and to remove said obstructions from said outlet passageways on the approach of said pistons to the ends of the compression travels thereof, said additional compression chambers, one thereof being enlarged and one diminished, being thereby simultaneously put in communication with a diminished combustion chamber, and means to deposit fuel in said discharge passageways.

5. In an internal combustion engine, a casing and a plurality of combustion chambers therein, in combination with a corresponding number of compression chambers respectively comprising pistons arranged to form movable walls having compression and enlarging travels and said pistons in timed relation to alternately diminish and enlarge the dimensions of said compression chambers, each of said compression chambers, provided with an obstructed inlet passageway from one and an obstructed discharge passageway to the other of said combustion chambers, and means, comprising ports, to remove said obstructions from said inlet passageways on the approach of said pistons to the ends of the enlarging and to remove said obstructions from said outlet passageways on the approach of said pistons to the ends of the compression travels thereof, said additional compression chambers, one thereof being enlarged and one diminished, being thereby simultaneously put in communication with a diminished combustion chamber, and means whereby said discharge into a combustion chamber injects fuel thereto.

6. In an internal combustion engine, the combination of a plurality of combustion chambers and a plurality of compression chambers having movable walls comprising pistons connected in timed relation to synchronously enlarge the dimensions of one and diminish the dimensions of the other of said compression chambers, each of said compression chambers provided with an obstructed inlet passageway from a combustion chamber and an obstructed discharge passageway to a different combustion chamber, and means, comprising ports, to remove said obstructions from said inlet passageways on the approach of said pistons to the ends of the enlarging and to remove said obstructions from said discharge passageways on the approach of said pistons to the ends of the compression travels thereof, said compression chambers being thereby simultaneously provided, one with an inlet passageway and the other with a discharge passageway in communication with one of said combustion chambers.

7. In an internal combustion engine, the combination of a plurality of combustion chambers, and a plurality of compression chambers having movable walls comprising hollow pistons and pistons in said hollow pistons, means to connect said pistons in timed relation to synchronously enlarge the dimensions of one and diminish the dimensions of the other of said compression chambers, each of said compression chambers, provided with an inlet passageway and a discharge passageway, the wall of said hol-

low pistons arranged to obstruct said passageways and means, comprising ports in said walls, to remove said obstructions from said inlet passageways on the approach of said pistons to the ends of the enlarging and to remove said obstructions from said outlet passageways on the approach of said pistons to the ends of the compression travels thereof, said compression chambers, one thereof being enlarged and one diminished, being thereby simultaneously provided with unobstructed passageways in communication with said combustion chambers, and a fuel depository in said outlet passageways.

8. In an internal combustion engine, the combination of a plurality of combustion chambers, and a plurality of compression chambers having movable walls comprising hollow pistons and additional pistons in said hollow pistons, means to connect said pistons in timed relation to synchronously enlarge the dimension of one and diminish the dimension of the other of said compression chambers, each of said compression chambers provided with an inlet passageway, comprising a groove on the periphery of each of said hollow pistons, and a discharge passageway, the wall of said hollow pistons arranged to obstruct said passageways and means, comprising ports in said walls, to remove said obstructions from said inlet passageways on the approach of said pistons to the ends of the enlarging and to remove said obstructions from said outlet passageways on the approach of said pistons to the ends of the compression travels thereof, said compression chambers being thereby simultaneously provided with unobstructed passageways in communication with said combustion chambers, and a fuel depository in said outlet passageways.

9. In an internal combustion engine comprising a plurality of cylinders each provided with a combustion chamber, a piston, an inlet air port and an exhaust port, means to successively obtain and ignite fuel in said combustion chambers, said means comprising fuel depositories, means to trap some of the contents of one of the combustion chambers while said contents are at greater than atmospheric pressure, means to increase the pressure of said trapped contents, means to trap some of the contents of an additional combustion chamber while said contents are at greater than atmospheric pressure, means to increase the pressure of said last named trapped contents, and means to inject said trapped and additionally compressed contents obtained from said first named combustion chamber and fuel from the fuel depository of said additional chamber into said compressed contents of said additional combustion chamber, and means to inject said trapped and additionally compressed contents obtained from said additional combustion chamber and fuel from the fuel depository of said first named chamber into the compressed contents of said first named combustion chamber; said trapped and additionally compressed contents being at a greater pressure than the compressed contents of the combustion chamber into which they are injected.

10. In an internal combustion engine comprising a plurality of cylinders, each provided with a combustion chamber and with a movable piston, means to successively obtain and ignite fuel in said combustion chambers, said means comprising a fuel depository to each of said combustion chambers, ports to successively admit air to said cylinders and means, including said pistons, to quickly compress air in said combustion chambers, means to trap products of combustion successively produced in said combustion chambers and means to inject said trapped products from one of said combustion chambers, and fuel, into said compressed air in another of said combustion chambers, said products of combustion being at a greater pressure than said compressed air, and said injecting means comprising means to direct said products of combustion through the fuel depository of the combustion chamber into which said products are injected.

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In the presence of—
CHARLES TURNER BROWN,
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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."