

Jan. 29, 1924.

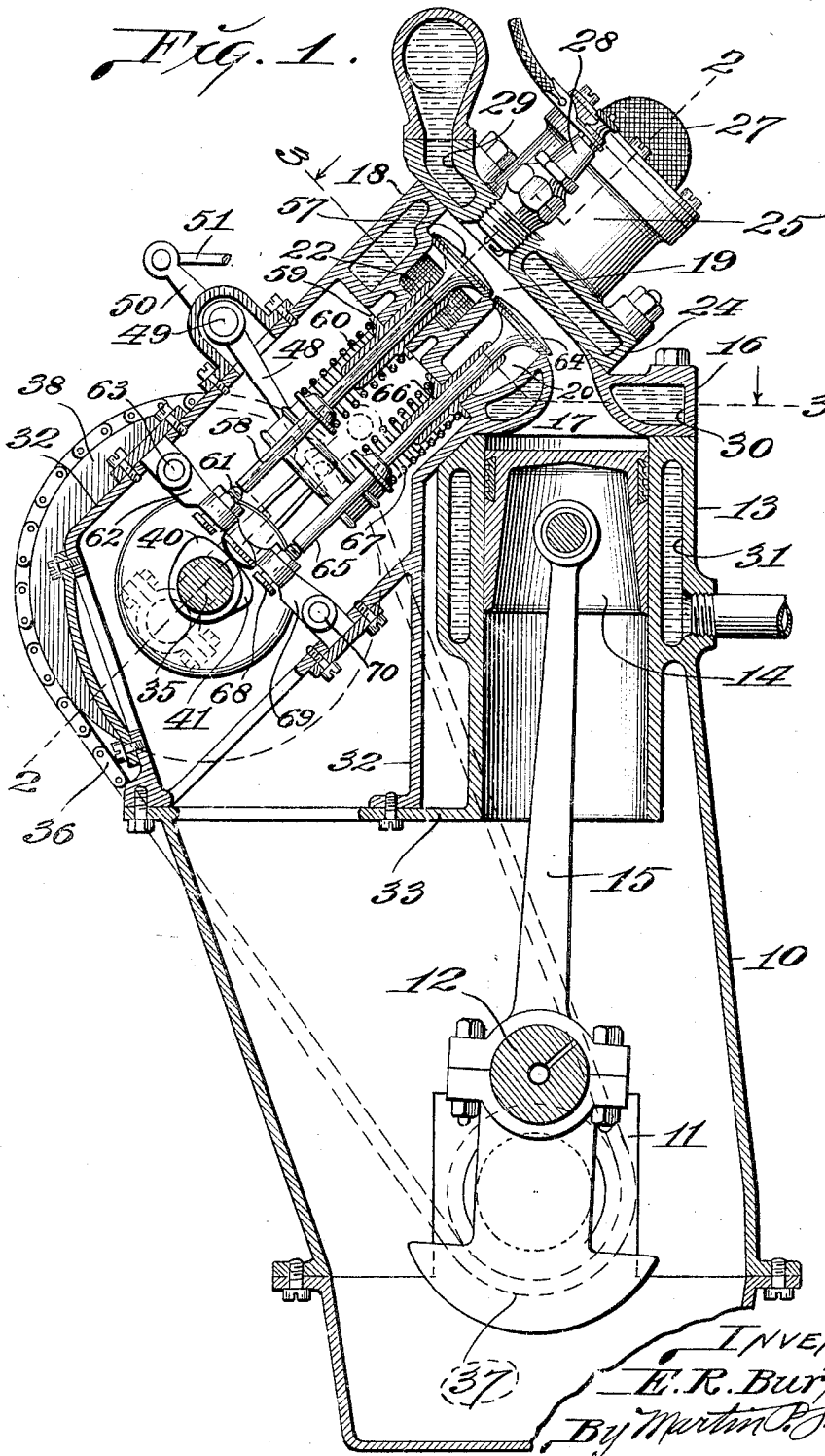
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E. R. BURTNETT

INTERNAL COMBUSTION ENGINE

Filed June 27, 1922

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

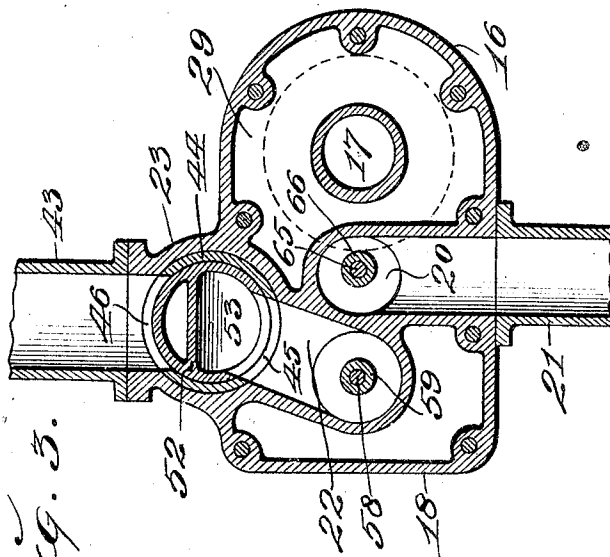


Fig. 3.

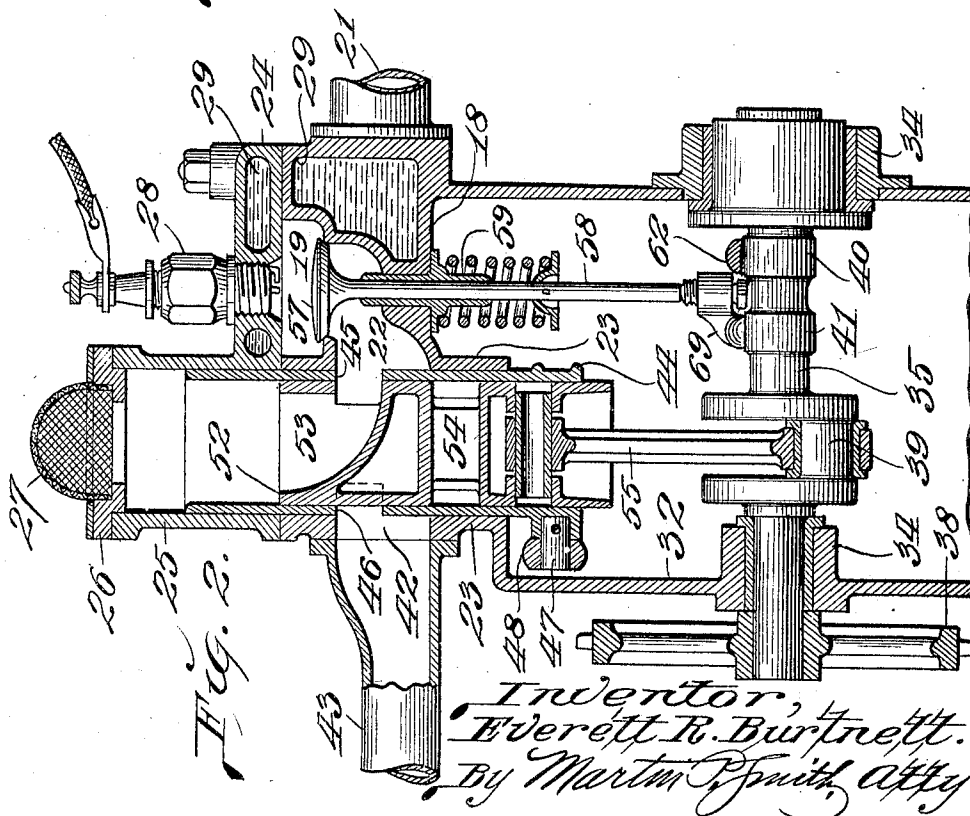


Fig. 2.

Inventor,
Everett R. Burnett.
By Martin P. Smith, Atty.

UNITED STATES PATENT OFFICE.

EVERETT R. BURTNETT, OF LOS ANGELES, CALIFORNIA, ASSIGNOR OF ONE-HALF TO
HOMER A. BRUNNELL, OF LOS ANGELES, CALIFORNIA,

INTERNAL-COMBUSTION ENGINE.

Application filed June 27, 1922. Serial No. 571,240.

To all whom it may concern:

Be it known that I, EVERETT R. BURTNETT, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

The conventional internal combustion engine operating either on the two or four cycle principle and charged with gaseous fuel, vaporized by a carburetor or other metering means, is throttled by the long practiced principle of strangulation, and which action is usually accomplished by the use of a butterfly valve, located in the main header portion of the inlet manifold, directly behind the venturi structure of the carburetor. One or more inlet valves are provided for each cylinder, also one or more exhaust valves, or valve port means.

Conventional practice is, to time the inlet valves so that they will be held open for the full duration of the inlet or induction stroke of the piston, and if two inlet valves are used, to time them in synchronism with each other. This establishes a constant time duration of opening of the inlet valve port, for any engine speed or power output. The principle is, in effect, the starving of the engine cylinder, of volume during the induction stroke, for, with an engine having a given bore and the piston within the bore travelling a given stroke, the outward stroke of the piston results in the addition of a given cubic displacement to the total internal cubic space within the cylinder.

In all conventional engines, this piston stroke displacement is constant. If totally displaced by the induction of a complete new charge at atmospheric pressure, the initial pressure will be constant, and the charge compressed by the inward stroke of the piston into the cylinder clearance of the desired ratio of space proportionate to the space displaced by the piston travel, to obtain the desired compression ratio, the compression pressure will also be constant. Under such conditions, assuming that the charge is of a given mixture strength, the pressure of combustion will be constant and this will result in a constant power output.

The power demand upon internal combustion engines, and especially those used in the automobile, tractor and airplane, is not con-

stant. Instead, it is subject to physical variation following the will of the operator. Hence the demand for a variation of the power output.

The butterfly valve is used for variable control, closing and opening the fuel passage common to all cylinders, controlling the initial pressure by the variation of the ratio of volume admitted to the cylinder, proportionate to the total displacement of the piston stroke, and as the initial pressure is reduced, the compression pressure is correspondingly reduced. It is a demonstrated and accepted fact that thermal efficiency improves with the increase of compression.

With present fuel, such as volatile liquid hydro-carbon, compression pressures are restricted to certain limits, owing to the resulting "knocking" or detonation occurring when certain compression pressures are reduced. Therefore, with an engine having a given compression pressure at which the power and fuel economy is found to be the greatest, any reduction in that compression pressure consequential of a reduction in the volume admitted and the lowering of the initial pressure resulting from the closing of the butterfly valve to throttle the engine, means inefficient engine operation.

Therefore it is the prime object of my invention to provide in an engine a constant initial and compression pressure, and secure a variation of the power output by variation of the proportion of gaseous mixture admitted to the cylinder, in ratio to the total cubic displacement demand.

With conventional engines operating with the strangulation throttle system, designers have endeavored to construct the fuel admission means so as to cause as great a turbulence within the cylinder as possible. It is my idea to reverse this action, for in conventional engines the residue or portion of the products of previous combustion remaining in the cylinder clearance is more or less equal in volume at a given pressure to the volume of the new charge admitted to the cylinder when the engine was throttled by strangulation, and this action results in a very high dilution of the small quantity of fresh charge, by the spent non-combustible volume.

Since this dilution could not be prevented, owing to the conventional design, it was found desirable to make the dilution as

thorough as possible, and to attain a uniform combustion, for if the gaseous mixture remained in more than one stratified pocket, each intact and separate from the other
5 pockets of fuel mixture by a non-combustible volume, the combustion would not be uniform, but would cause an internal pressure variation as the various pockets of combustible volume were reached by the flame
10 wave through the whole compressed charge within the cylinder. This variation of internal pressure causes the phenomenon of detonation that is so detrimental to the engine where high compression is attempted,
15 for, the higher the compression, the higher the combustion pressure, likewise the greater the variation of internal pressure resulting from the separate burning of portions of the charge.

20 Therefore it is one of the purposes of my invention to stratify the charge, completely fill the cylinder at all times and obtain a constant initial pressure, satisfy the displacement demand of the piston during the
25 suction stroke with an inert volume, and control the variation of the gas mixture admitted and the consequent power output by a variation of the time proportionate to the time interval of that portion of the induction
30 stroke that the gas mixture is permitted to enter the cylinder, and which gas mixture always enters the combustion chamber last and begins to enter when the piston has yet
35 to create the displacement beyond any given point of the stroke.

The combustion chamber of my improved engine is designed so that the inlet valve occupies the remotest end of the combustion chamber or cylinder clearance. Therefore,
40 since the inert portion and the fuel mixture portion of the charge enter the cylinder through the same valve, with the inert portion entering first and the fuel portion last, then as the piston moves inward on the compression
45 stroke, the inlet valve having closed said fuel portion will be compressed in an intact volume in the remote corner through which it entered, and it is here that the ignition means is located.

50 Thus it will be seen that, since turbulence is prevented, and dilution of the fresh charge eliminated, the fuel charge admitted can be of much leaner mixture than is ordinarily required. The narrow channel effect of the combustion chamber clearance
55 prevents eddying of the ingoing charge and, as the volume movement is free for the full duration of the induction stroke, stratification of the charge will be complete.

60 As will be hereinafter described, I have provided means for discontinuing the supply of inert volume (which enters the cylinder through the one inlet valve common to
65 supply of fuel mixture at any desired time

during the induction stroke of the piston, there being but one volume element entering the cylinder at a time, and each element entering by the same valve port, the cutoff
70 between the two being variable, as desired in throttling.

The very small quantity of undiluted fuel mixture thus admitted, confined and compressed directly around the terminals of the
75 electrodes of the spark plug and backed up by a great quantity of inert volume, will burn with complete combustion and greatly increase the range of expansion.

A single inert volume of combustible charge causes only one temperature and
80 pressure rise, prevents detonation and the heat of combustion is absorbed by the volume compressing the balance of the cylinder content, instead of being lost by excessive
85 radiation, as would be the case in conventional engines where the combustible particles occupy the whole of the compression clearance, and are confined within and adjacent to the total externally cooled wall area
90 of the cylinder clearance.

Since the power obtainable from an engine of a given size and the fuel economy in operation depend upon the compression
95 of fuel charge, and since the limit of compression pressure is restricted by detonation, it becomes necessary to provide means to raise the compression without incurring detonation. Stratification of the charge permits relatively high compression without
100 incurring detonation and the more complete the charge stratification, the more effective the result.

The principal objects of my invention are to provide simple and efficient means for effecting a stratification of the charge taken
105 into the combustion chamber of the engine and to provide means for throttling, by controllable means, the variable time duration of the fuel admission period in ratio to the total time period of the induction or suction
110 stroke of the piston.

Therefore I propose to produce an internal combustion engine operating with constant initial pressure and constant compression, but with variable fuel supply, the throttling being accomplished by the variation of
115 the time after the beginning of the suction stroke of the working piston, so that the gaseous mixture is permitted to enter the cylinder through the inlet valve and the admission of inert air, or products of the previous combustion taking place through the
120 same inlet valve, for the full period of variable time from the beginning of the suction or inlet stroke of the working piston until such time as the gaseous mixture is allowed
125 to enter. Thus, constant volume is admitted to the cylinder without the high vacuum that results in the undesirable oil pumping.

A further object of my invention is to provide an internal combustion engine that receives, at all speeds and at all loads, a constant volume, a constant compression and a stratified charge, and further to provide an engine having exhaust and inlet valve to each cylinder with the exhaust valve located so that the full charge entering the cylinder during the admission stroke, passes directly over and around said exhaust valve, thereby serving to materially cool the same.

In my proposed structure, the inlet valve functions for the admission of an inert volume for any desired first portion of the admission stroke and also for the admission of gaseous fuel mixture for the desired and remaining part of the admission stroke, the proportion of fuel mixture admitted being in direct ratio to the total volume content admitted by the throttling means and this proportion or ratio is controlled by the action of a sliding cutoff member, one for each cylinder, but actuated in synchronism, in multiple cylinder engines.

In my improved engine, the variation of the power developed is controlled by means regulating the ratio of gaseous mixture (of any richness desired) admitted to a portion of each charge to the inert balance of content that makes up the total displacement.

The combustion chamber clearance occupied by the compressed charge is formed so as to aline the valves in the plane of the volume travel or admission charge column movement, one before the other and located in a narrow pocket that forms a part of the combustion chamber, with the inlet valve in the furthest end from the main part of the combustion chamber directly over the working piston, and the spark plug being located in the extreme end of this narrow pocket and the exhaust valve being seated between the inlet and the working cylinder.

The object of this form of combustion chamber is to provide means for stratifying the charge and causing it to remain so, until ignited, also to allow for the cooling of the exhaust valve by the inlet charge which always flows directly over it.

A further object of my invention is to provide an L-head valve structure with a removable head for valve attention, the valve seats being on a plane at an angle relative to the axis of the cylinder, thus minimizing obstruction to the free or flow column movement of the ingoing charge or outgoing products of combustion.

A further object is to provide an engine having an inlet and exhaust valve arranged one behind the other and centered on a radius line directly from the main cylinder axis, instead of side by side, with valve centers on two separate radius lines.

This improved arrangement results in a

narrow channel structure through which the admission charge must fully occupy in its circulation movement on entering the cylinder between the inlet valve port and the displacement created by the outward stroke of the working piston.

The formation of the combustion chamber as described causes the residue products of the preceding combustion that occupy the whole of the cylinder clearance at the end of the exhaust stroke and at the beginning of the inlet stroke, to pass inwards toward the displacement created by the outward movement or suction stroke of the working piston, such movement taking place in advance of the new charge entering the cylinder through the inlet valve port and channel.

The combustion chamber thus formed is intended to reduce turbulence to a minimum and to entirely eliminate the mixing of the new charge with the quantity of residue products of combustion remaining in the cylinder clearance at the beginning of the new charge induction period.

In my improved engine, the half speed valve mechanism driven from the engine shaft operates harmoniously and in accord with the four stroke cycle and is a common actuator to both poppet and slide valves, for it includes a combined cam and crank shaft.

My invention contemplates an engine having an inlet valve and an exhaust valve for each cylinder, said valves opening directly into the combustion chamber of said cylinder and a slidably mounted charge selector, arranged for adapting either inert air or any other desirable volume passage means, with the inlet valve of the combustion chamber during all or any variable part of the induction stroke and gaseous fuel mixture volume passage means with the said inlet valve, during the remaining total time of the induction stroke, after the cut off of the inert air passage means.

Thus I provide a constant inlet passage registration with the direct inlet valve of the combustion chamber, for the full period or duration of the inlet stroke and means for controlling the variation of the ratio of gaseous mixture (of any externally vaporized mixture strength) included in the volume of each induction stroke.

A further object of the invention is to provide, in an internal combustion engine, a combustion chamber formed so as to provide a variable division of the charge volume content and produce a stratification of the induced and compressed charge, thus permitting the instant and complete combustion of a small quantity of gaseous mixture and the heat of such combustion spending itself in wave velocity through the remaining portion of the confined compressed

charge (in character, a quantity of inert air or cooled returned products of previous combustion), thus creating a high volume non-detonating expansion action.

5 Under such conditions, the mass of the inert charge absorbs the heat of combustion of that portion of the charge that is of a combustible quality and the heat absorption resulting in quantity expansion, thus balancing the small extreme with the greater moderate quantity and creating a more steady, refined internal combustion and obtaining maximum expansion from minimum heat units.

15 A further object of my invention is to provide an internal combustion engine that operates with a stratified charge and the inlet portion of the charge absorbing the heat of combustion, thereby moderating the temperature of the whole content and reducing engine temperatures, piston temperatures and valve trouble.

My invention consists in certain novel features of construction and arrangement of parts that will be hereinafter more fully described and claimed, and illustrated in the accompanying drawings, in which:

Figure 1 is a vertical section taken through the center of one of the cylinders of my improved engines;

Figure 2 is an enlarged section taken approximately on the line 2—2 of Figure 1;

Figure 3 is an enlarged cross section taken on the line 3—3 of Figure 1.

35 Referring by numerals to the accompanying drawings, which illustrate a practical embodiment of my invention, 10 designates the crank case which may be of any suitable form, and constructed in two or more parts, and the end walls of said case are provided with bearings 11 for a crank shaft 12.

45 Formed integral with the upper portion of the crank case are one or more cylinders, such as 13, and arranged for operation within each cylinder is a piston such as 14. Each piston is connected to a crank of the shaft 12 by a pitman such as 15. Removably secured to the top of cylinder block 13 is a head block 16, in which is formed an upwardly tapering chamber or throat 17, the lower end thereof communicating with the upper end of the piston chamber within the cylinder.

50 Block 16 is formed with a lateral extension 18, that is preferably inclined approximately forty-five degrees relative to horizontal and vertical planes, and formed in the upper portion of said extension is a relatively small chamber or pocket 19 that performs the multi-functions of an inlet duct or passageway for air and gaseous fuel, an outlet duct or passageway for burnt gases or products of combustion, a stratification chamber for the compressed gaseous fuel, inert air, and products of combustion and

also as a pocket for the combustion of the compressed gaseous fuel charge.

Formed in the lower portion of extension 18 and immediately to the rear of throat 17 is an exhaust duct 20, the inner end thereof communicating with the pocket 19 and the outer end communicating with an exhaust pipe 21 that leads from the side of the head.

70 Formed in extension 18 to the rear of duct 20 is a duct or passageway 22 for the inlet of air, gaseous fuel, cooled products of combustion or the like, the upper end of said duct communicating with the rear portion of pocket 19 and its lower end communicating with the intermediate portion of the chamber within a cylinder 23.

This cylinder is preferably formed integral with the side of extension 18 and it occupies an inclined plane that is approximately at right angles to the inclined plane, 85 occupied by said extension, and by virtue of such position the axis of said cylinder is disposed approximately forty-five degrees relative to the axis of cylinder 13.

90 Secured on top of block 16 and extension 18 and closing the pocket 19 therein is a head plate 24, and formed integral with the side thereof is a short cylinder 25 that fits directly upon and forms a continuation of the cylinder 23. Seated in the upper end of cylinder 25 is a ring 26 that carries a strainer 27 of reticulated or foraminous material.

Seated in plate 24, preferably at a point above the upper end of inlet duct 22, is a spark plug 28. Plate 24 is formed with a chamber 29 through which a fluid cooling medium, such as water, is adapted to circulate and said chamber communicates directly with similar chambers 30 and 31 that are formed in head block 16 and cylinder 105 13, respectively.

Chamber 30 is of ample proportions and surrounds throat 17, pocket 19 and ducts 20 and 22, while chamber 31 is formed in the upper portion of the wall of cylinder 13. 110

Formed integral with the lower portions of extension 18 and cylinder 23 is an inclined housing 32, the lower portion of which rests upon and is secured to a horizontal plate 33 that forms a part of crank case 10. 115

120 Journalled in bearings 34 in the end walls of this housing is a combined cam and crank shaft 35 that is driven at half the speed of shaft 12, preferably by means of a chain 36 that passes around a relatively small sprocket wheel 37 on crank shaft 12 and a larger sprocket wheel 38 on shaft 35. Shaft 35 is provided with a crank 39, in alignment with the cylinders 23 and 25 and arranged on said shaft to the side of said crank are cams 40 and 41. 125

Formed through the wall of cylinder 23 directly opposite to the lower end of duct 22 is an inlet opening 42, to which is connected a gaseous fuel supply pipe 43. 130

Arranged for reciprocatory movement within cylinders 23 and 25 is an open ended sleeve valve 44, having formed therein oppositely disposed ports 45 and 46 and which latter are normally in communication with ports 22 and 42, respectively. These ports 45 and 46 are approximately half the width of the ports 22 and 42.

Projecting from the lower portion of sleeve 44 is a wrist pin 47 that receives the bifurcated end of a crank arm 48 and the latter being carried by a rock shaft 49 that is journaled in the side wall of housing 32. The outer end of this shaft 49 carries a crank arm 50, to which may be connected a manually operable rod 51.

The parts just described provide effective means for reciprocating the sleeve 49 within the cylinders 23 and 25 and consequently shifting the positions of the ports 45 and 46 relative to ports 22 and 42. Arranged for reciprocatory movement within the sleeve 49 is a cylindrical selector valve 52, having in its upper portion a port 53 that is normally in communication with the chambers in the upper portions of sleeve 44 and cylinder 25 and the lower end of said port 53 being adapted to register with ports 45 and 22.

Formed through the central portion of valve 52 is a transverse port 54 that is adapted to register with and establish communication between ports 45 and 46. Connected to a wrist pin in the lower end of valve 52 is the upper end of a pitman 55, the lower end thereof being connected to a crank 56 on shaft 35.

Normally resting upon a valve seat that is formed at the upper end of duct 22 is an inlet valve 57 having a stem 58 that is arranged for sliding movement through a bearing 59 in extension 18 and associated with said valve stem is an expansive spring 60 that normally retains said valve upon its seat. The lower end of stem 58 rests upon a bearing member 61 that is adjustably seated in a short lever 62, and the latter being pivoted at 63 to the housing 32 and its free end bearing on cam 40.

Normally resting upon a seat that is formed around the upper end of exhaust duct 20 is an exhaust valve 64 having a stem 65 that slides through a bearing 66 in extension 18, and said stem being provided with a spring 67 that normally holds said valve upon its seat.

The lower end of the stem 65 bears upon a member 68 that is adjustably seated in a lever 69, pivoted at 70 to housing 32 and the free end of said lever bearing on cam 41.

The operation of my improved engine is as follows:

At the termination of each exhaust stroke of piston 14 there remains in throat 17 and

pocket 19 a relatively small volume of burned gases or products of combustion.

At the beginning of the suction stroke of the piston or shortly after, cam 40 actuates lever 62 to open inlet valve 57, at which time valve selector 52 is moving upwardly with port 53 in registration with port 45. It will be understood that sleeve 44, having ports 45 and 46, is adjusted vertically within cylinders 23 and 25 to vary and regulate the position of said ports with respect to ports 22 and 42, such adjustment being accomplished by manual actuation of rod 51.

As long as port 53 is in registration with port 45, inert air of cooled products of combustion (from a suitable container connected to cylinder 25) will be drawn through strainer 27 and will pass through cylinder 25, port 53, port 45, duct 22, past open inlet valve 57, through pocket 19 directly over exhaust port 64 and through throat 17 into the piston chamber within cylinder 13, which latter gradually increases in capacity as the piston continues its downward or suction stroke. The body of air or cooled products of combustion thus entering the piston chamber forces the products of combustion previously left in the throat 17 and pocket 19 downwardly within the piston chamber and such products of combustion take the form of a stratum that lies directly on top of the head of piston 14.

During the latter portion of the suction stroke of the piston selector valve 52 moves upward so that the lower end of port 53 moves out of registration with port 45 and immediately the upper edge of port 54 moves into registration with ports 45 and 46. Thus the inlet of air is cut off and during the final portion of the suction stroke of the piston, gaseous fuel will be drawn from supply pipe 43 through ports 46, 54, 45 and 22 past open inlet valve 57 (which is gradually closing) into pocket 19, over exhaust valve 64 and through throat 17 into the piston chamber on top of the body or stratum of inert air or cooled products of combustion and which latter, it will be understood, overlies the stratum of products of combustion that lies directly on top of the piston head.

As the piston approaches its low center, inlet valve 57 closes, thereby cutting off the further ingress of air and on the succeeding upward travel of the piston, products of combustion, inert air and gaseous fuel drawn into the piston chamber will be compressed within pocket 19 and throat 17, with a compressed stratum of gaseous fuel in the upper portion of pocket 19, between inlet valve 57 and the terminals of spark plug 28, a stratum of compressed air or cooled products of combustion in the

lower portion of chamber directly over exhaust valve 64 and a compressed stratum of products of combustion directly above the head of the piston and within throat 17.

5 At the point of highest compression or immediately thereafter a spark is produced between the terminals of the electrodes of the spark plug, thereby igniting the charge of gaseous fuel that is compressed within the upper portion of pocket 19 and the force of the
10 resulting explosion is transmitted to and through the strata of air and products of combustion and is delivered directly onto the head of the piston to drive the same
15 downwardly on its power stroke.

As the piston approaches its low center cam 41 actuates lever 69 to open exhaust valve 64 and on the succeeding upward movement of the piston the burned products of
20 combustion will be discharged through throat 17 past open valve 64 and through duct 20 to exhaust pipe 21. As the piston reaches its high center, the exhaust valve closes, thereby leaving within throat 17 and
25 chamber 19 a relatively small volume of burned gases, and which latter will, on the succeeding suction stroke, be drawn into the piston chamber in advance of the inert air or cooled products of combustion in the manner
30 heretofore described. Thus it will be seen that I have produced an engine that is of relatively simple structure, capable of being readily assembled or taken apart and which will produce a relatively high degree
35 of power with minimum fuel consumption.

As hereinbefore stated, the decided advantages gained in the engine of my improved construction are the results of charge stratification and the throttling, by control-
40 able means of variable time duration of the fuel admission period in ratio to the total time period of the induction stroke of the engine's piston.

Obviously, minor changes in the size, form and construction of the various parts of my
45 improved engine may be made and substituted for those herein shown and described without departing from the spirit of the invention, the scope of which is set forth in the appended claims.
50

Having thus described my invention, I claim:

1. An internal combustion engine having a pocket that is directly connected to the
55 piston chamber, said pocket being provided with a valved inlet port, and means for successively admitting air and gaseous fuel into said pocket through said valved inlet port.

2. An internal combustion engine having
60 a pocket that is directly connected to the piston chamber, said pocket being provided with a valved inlet port, means for successively admitting air and gaseous fuel into said pocket through said valved inlet port,

there being a valved exhaust port arranged
65 between said inlet port and the piston chamber.

3. An internal combustion engine provided with a pocket that is in direct communication with the piston chamber, said
70 pocket being provided with valved inlet and exhaust ports, the valve of the exhaust port being arranged to close prior to the discharge of all of the products of combustion from said pocket, and means for admitting
75 in succession air and gaseous fuel through said inlet valve into said pocket.

4. An internal combustion engine having a pocket that is in direct communication with the piston chamber, said pocket being
80 provided with an inlet port and an exhaust port, and means associated with said inlet port for admitting into said pocket a volume of inert air and a charge of gaseous fuel.

5. An internal combustion engine having
85 a combustion pocket that is directly connected at one end to the piston chamber of the engine, and means for admitting through a single inlet port a volume of inert air into the opposite end of said pocket, and for admitting a charge of gaseous fuel immediately
90 succeeding the admission of the volume of inert air.

6. An internal combustion engine having a pocket that communicates at one end with
95 the piston chamber, said pocket being provided with valved inlet and exhaust ports, with the exhaust port arranged between the inlet port and the piston chamber, a chamber in communication with the inlet port,
100 a sleeve arranged for operation within said last mentioned chamber, and a valve arranged for operation within said sleeve, said sleeve and valve being provided with ports that are adapted to control the inlet of air
105 and gaseous fuel into the inlet port of said pocket.

7. An internal combustion engine having a pocket that communicates at one end with
the piston chamber, said pocket being provided with valved inlet and exhaust ports,
110 with the exhaust port arranged between the inlet port and the piston chamber, a chamber in communication with the inlet port, a sleeve arranged for operation within said
115 last mentioned chamber, a valve arranged for operation within said sleeve, said sleeve and valve being provided with ports that are adapted to control the inlet of air and gaseous fuel into the inlet port of said pocket,
120 and means for operating the valve within said sleeve.

8. An internal combustion engine having a pocket that communicates at one end with
the piston chamber, said pocket being provided with valved inlet and exhaust ports,
125 with the exhaust port arranged between the inlet port and the piston chamber, a cham-

ber in communication with the inlet port, a sleeve arranged for operation within said last mentioned chamber, a valve arranged for operation within said sleeve, said sleeve and valve being provided with ports that are adapted to control the inlet of air and gaseous fuel into the inlet port of said pocket, means for operating the valve within said sleeve, and means for adjusting said sleeve so as to vary the position of its ports relative to the ports in the enclosed valve and in said inlet valve.

9. An internal combustion engine having a combustion pocket that is directly connected to the piston chamber, a poppet valve controlled inlet port communicating with said pocket, a second chamber communicating with said inlet port, an adjustable sleeve arranged within said second chamber, a piston valve arranged for operation within said sleeve and said sleeve and piston valve being provided with ports that are adapted to coincide with each other and with said inlet port.

10. An internal combustion engine having a combustion pocket that is directly connected at one end with the piston chamber, means associated with said engine for admitting inert air into said combustion pocket on top of the products of combustion remaining therein and resulting from the combustion of the previous ignition of gaseous fuel within said combustion chamber, and which inert air admitting means is also effective in admitting a predetermined volume of gaseous fuel on top of said volume of inert air and which products of combustion, inert air and gaseous fuel are compressed in strata form on the succeeding compression stroke of the piston within the piston chamber.

11. In an internal combustion engine hav-

ing a piston chamber and an inlet port communicating therewith, means for supplying either air or a gaseous fuel volume to said inlet port for the duration of the induction period of the cycle, said means being adjustable so as to vary the time duration of either the air or gaseous fuel volume in relation to each other and the variable duration of the air and gaseous fuel supply equaling the time duration of the induction period of the engine.

12. In an internal combustion engine having a combustion chamber and an inlet valve controlling a port leading into said chamber, means for supplying two volumes of different gaseous substance and means between said inlet valve and the sources of supply for discontinuing the supply of one gaseous substance and beginning the supply of the other gaseous substance at any point in time ratio to the open time duration of said inlet valve, said inlet valve timing the combined gaseous substance induction duration to the combustion chamber and said means between the inlet valve and sources of supply, timing the variation of each gaseous substance supply in time duration to the opening of said inlet valve.

13. In an internal combustion engine having a combustion chamber and an inlet valve controlling a port leading to said chamber, means for admitting, in succession to said port, while the valve thereof is open, a volume of air and a volume of gaseous fuel and a portion of said volume admitting means being adjustable so as to control the duration of the respective admission periods.

In testimony whereof I have signed my name to this specification.

EVERETT R. BURTNETT.