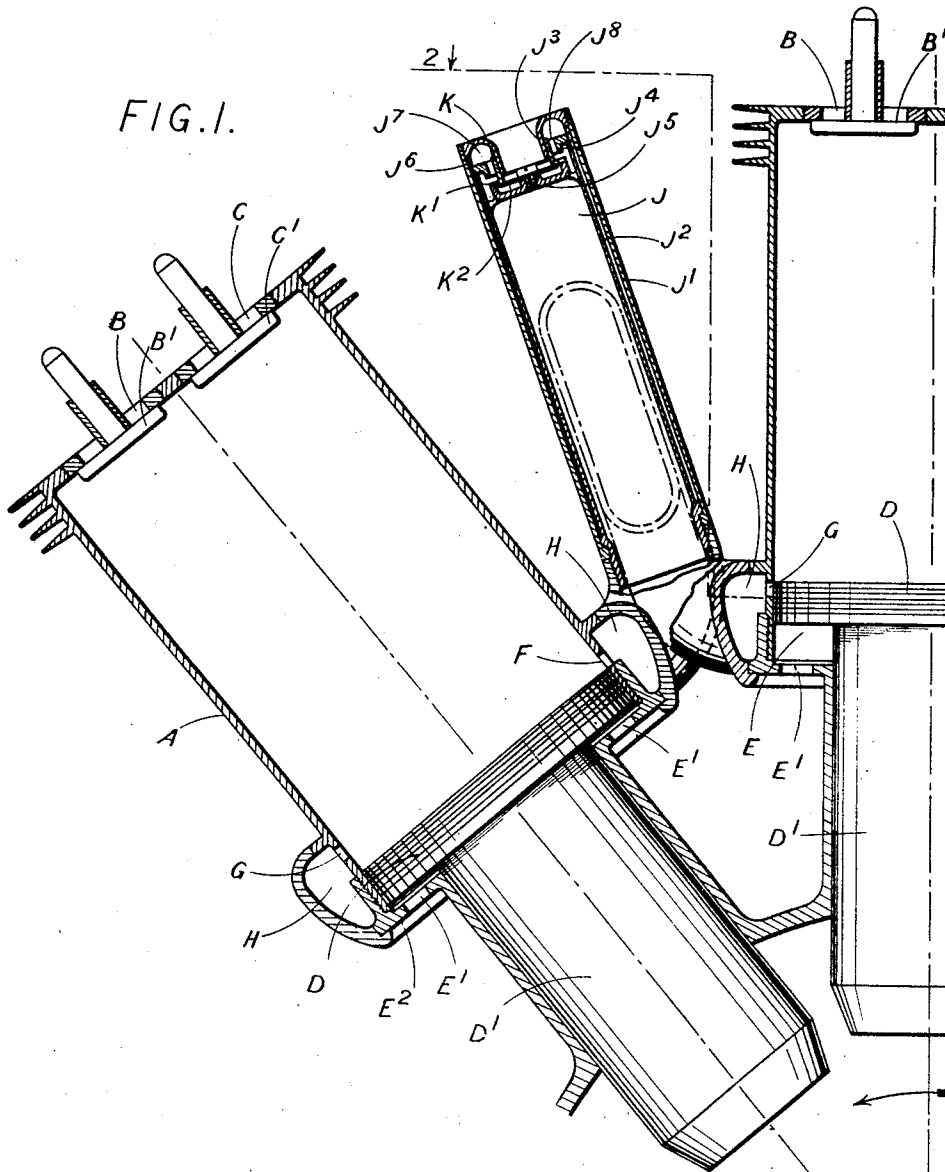


A. E. L. CHORLTON.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED JUNE 18, 1917.

1,362,080.

Patented Dec. 14, 1920.

5 SHEETS—SHEET 1.

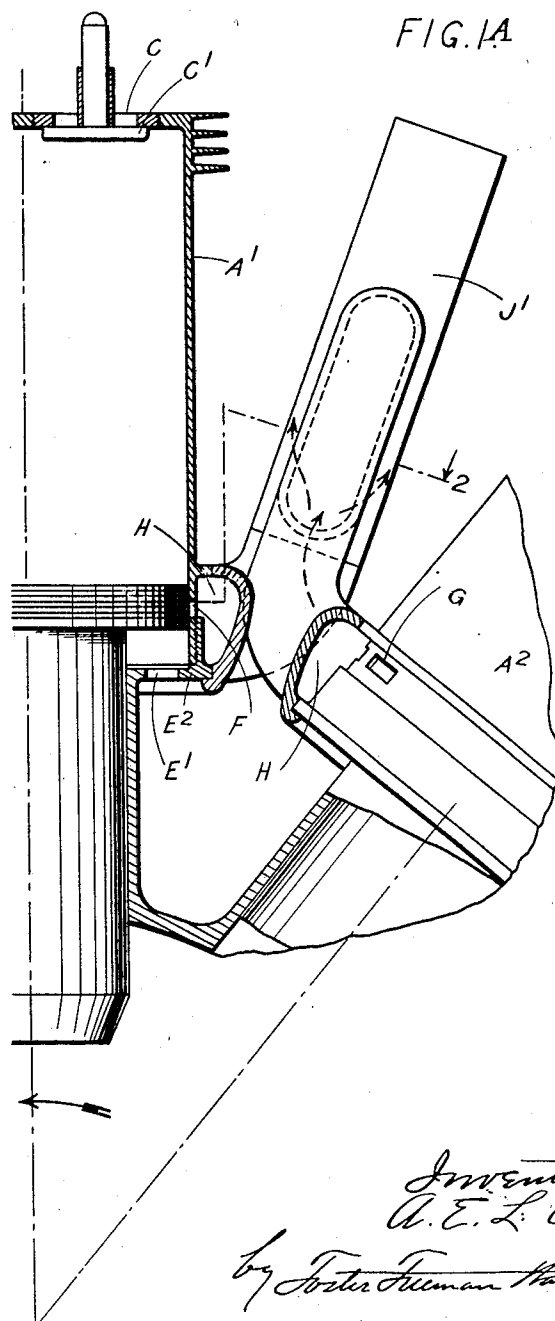


Inventor:
A. E. L. Chorlton
by Foster Fueman Watson & Co.
Attorneys

A. E. L. CHORLTON.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED JUNE 18, 1917.

1,362,080.

Patented Dec. 14, 1920.
5 SHEETS—SHEET 2.



Inventor:
A. E. L. Chorlton
by Foster Freeman Watson & Co.
Attorneys

1,362,080.

5 SHEETS—SHEET 3.

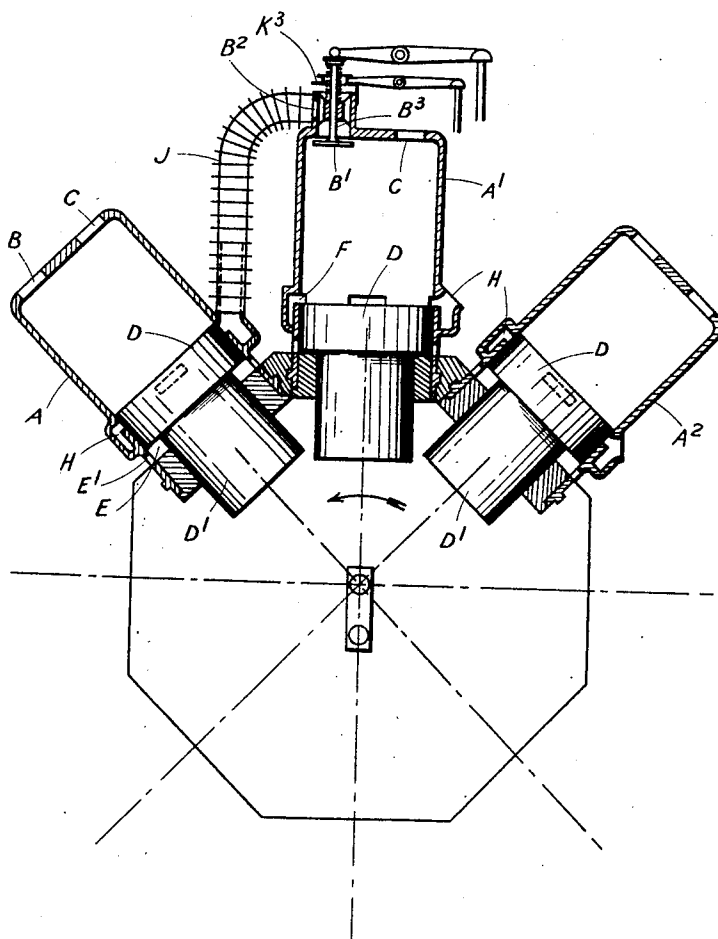
Inventor
A. E. L. Charlton
by Test. Fernand Watson Carl
Attorneys

1,362,080.

A. E. L. CHORLTON,
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED JUNE 18, 1917.

Patented Dec. 14, 1920.
5 SHEETS—SHEET 4.

FIG. 3.



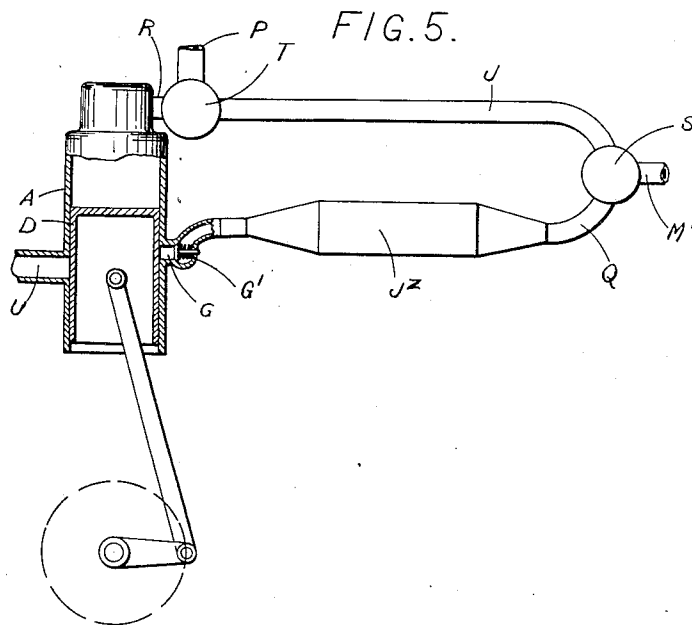
Inventor
A. E. L. Chorlton
by Foster Freeman Watson Clerk
Attorneys

A. E. L. CHORLTON.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED JUNE 18, 1917.

1,362,080.

Patented Dec. 14, 1920.

5 SHEETS—SHEET 5.



Inventor
A. E. L. Chorlton
by Foster Furman Watson & Co.
Attorneys

UNITED STATES PATENT OFFICE.

ALAN ERNEST LEOFRIC CHORLTON, OF SWALLOWBECK, ENGLAND, ASSIGNOR TO
WILLIAM BEARDMORE & COMPANY LIMITED, OF LONDON, ENGLAND.

INTERNAL-COMBUSTION ENGINE.

1,362,080.

Specification of Letters Patent. Patented Dec. 14, 1920.

Application filed June 18, 1917. Serial No. 175,515.

To all whom it may concern:

Be it known that I, ALAN ERNEST LEOFRIC CHORLTON, a subject of the King of England, residing at Swallowbeck, Lincoln, in England, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to internal combustion engines having one or more cylinders and operating on either the two, four or six stroke cycle and has for its object to bring about the introduction of a charge of gaseous fluid composed of air or a mixture containing air and fuel in such a manner as to effect certain economies as compared with methods hitherto proposed.

According to this invention the gases in a cylinder when under the pressure resulting from the combustion of a charge in that cylinder are employed to so act in a direct manner on another gaseous fluid consisting either of air or a mixture containing air and fuel accumulated outside the cylinder as to drive a charge of this air or mixture into the same or another cylinder at the correct period of the cycle. The products of combustion thus in effect constitute a gaseous piston which acts directly on a gaseous fluid the nature and properties of which from the point of view of combustion are entirely distinct from those of the products of combustion inasmuch as this gaseous fluid is a supporter of combustion and is capable of forming part of a combustible charge.

In the accompanying drawings which illustrate by way of example the application of the invention to several engines of different type and construction,

Figures 1 and "1A" show, when taken together, mainly in vertical section but partly in elevation a portion of a nine cylinder engine of the radial type operating on the four stroke cycle.

Fig. 2 is a section on the broken line 2—2 in Fig. 1.

Fig. 3 is a somewhat diagrammatic vertical sectional elevation of a portion of an eight cylinder engine of the radial type operating on the six stroke cycle showing a modification in the application of the invention.

Fig. 4 is a diagrammatic view showing one way of applying the invention to a four

cylinder vertical engine operating on the four stroke cycle, and

Fig. 5 is a diagrammatic sectional elevation showing how the invention may be applied either for charging or supercharging purposes to a single cylinder engine operating either on the two or four stroke cycle.

Like letters indicate like parts throughout the drawings.

Referring to Figs. 1 and 2, in the head of each cylinder A A' A'' are the usual exhaust and inlet ports B and C respectively controlled by valves B' and C' . Each piston is conveniently though not necessarily of the stepped or differential type having a piston portion D and a trunk portion D' of less diameter which reciprocates in a smaller cylinder mounted on the crank shaft end of the main cylinder A . There is thus formed at the crank shaft end of each cylinder an annular space E which except when the piston is at the end of its outstroke is available for gaseous fluid to circulate or pass across the cylinder and wherein the piston D can exert a pumping action. Ports E' are formed in the annular end wall E'' of the cylinder. In the side wall of each cylinder toward the crank shaft end are formed two series of ports F and G so positioned that when the piston D is at the end of its outstroke these ports will be fully uncovered. The ports G are so positioned and dimensioned that they will be fully uncovered by the piston before the latter commences to uncover the ports F . This is the preferred arrangement but in some cases it may be convenient or desirable to arrange that the dimensions of the ports G measured in the direction of the length of the cylinder are greater than those of the ports F so that as the piston nears the end of its outstroke a substantial portion but not the whole of the ports G will be uncovered before the ports F commence to be uncovered. All these ports open into an annular chamber H which is mounted on and surrounds the crank shaft end of the cylinder. In this annular chamber H there are provided radial partitions H' so disposed as to divide off the greater part of the annular chamber into which the ports F open from the lesser part into which the ports G open as shown in Fig. 2. Placed radially between each two cylinders is a receiver which comprises two tubes J J' disposed concentrically one with-

in the other so that an annular space J^2 is formed between them. The interior of the tube J at that end which is directed toward the crank shaft opens into the annular chamber H of one of the adjacent cylinders A while the annular space J^2 communicates with the annular chamber H of the other adjacent cylinder A' . The arrangement is such that gases leaving a cylinder through the ports G enter one part of the annular chamber H and pass thence through a hollow lug H^2 into the annular space J^2 of a receiver. On the other hand gases impelled from a tube J will enter the other part of an annular chamber H and pass thence through the ports F into the cylinder.

The outer end of the tubular receiver J J' J^2 may be constructed and arranged in the following manner. A central opening is formed by a short inwardly directed tube J^3 . On this tube slides a valve comprising a tube K with an outwardly directed flange K' which is normally pressed up against an annular seating J^4 by a spring K^2 carried by a member J^5 which forms a second seating for the valve flange K' and is supported by lugs from the wall of the tube J . These lugs are conveniently formed spirally. The annular space J^2 opens at J^6 into a small chamber J^7 formed between the tube J^3 and the valve seating J^4 and from this chamber leads radially inward an annular passage J^8 which is closed by the valve K' when on this seat. At this time the outer end of the tube J is in free communication with the atmosphere and gases can then pass out of this tube past the valve K K' . The strength of the spring K^2 is so determined that the valve K' will be lifted off its seat J^4 and pressed on to its seat J^5 if products of combustion under pressure pass from the cylinder into the annular space J^2 and thence into the chamber J^7 . These products of combustion can then pass through the annular passage J^8 into the tube J .

The arrangement operates as follows. In a nine cylinder engine operating on the four stroke cycle the timing is so arranged that the charges in the several cylinders are fired in the following order, 2, 4, 6, 8, 1, 3, 5, 7, 9. Hence when the piston D in the cylinder A has completed its suction stroke the piston D in the cylinder A' is nearing the end of its working stroke as shown. The engine in question is of the type in which the cylinders rotate around the crank shaft and it will be apparent therefore that when the piston D in a cylinder is in any such position that the ports F and G are uncovered on the crank shaft side of the piston, air will tend to enter the ports E' by centrifugal force and passing out from the cylinder through the ports F and G will traverse the tubes J and find its way out of the end

of this tube past the valve K K' which will then be on its seat J^4 . The passage of air in this way will be assisted by the action of the piston on each outstroke. In this way the annular chamber H and the tube J are swept clear of products of combustion and filled with fresh cool air and a cooling effect is exerted on the cylinder, piston and tubular receiver. When next the piston D for example in the cylinder A' is nearing the end of its working stroke and the ports G begin to be uncovered products of combustion under the pressure then existent in the cylinder pass through these ports into the annular space J^2 and acting on the valve K K' press it on to the seat J^5 . These products of combustion thus enter the tube J and acting as a gaseous piston drive thence the air with which this tube is filled. Since as already explained and as shown in Fig. 1 the piston D in the next adjacent cylinder A is at this stage at the end of its charging stroke this charge of cooled air from the tube J is driven under pressure through the ports F of the cylinder A and enters this cylinder as a supercharge. This charge of air may in some cases be followed by a portion of the impelling products of combustion but the passage of these products from the cylinder A' through the ports G of that cylinder and the supercharging of the cylinder A ceases as soon as the exhaust port B is opened in the head of the cylinder A' . This opening of the exhaust port B also checks any tendency for products of combustion to pass out through the ports F of the cylinder A' and in any event exhaust gases which thus find their way into the tubular receiver between the cylinders A' and A^2 will subsequently be swept out by the fresh air which passes through the receiver during the next instrokes of the pistons. It is also to be noted that the "lead" which is given to the ports G insures the passage of the products of combustion through these ports first while further the ports F in the cylinder A' will be uncovered just as the ports F in the cylinder A will be closed by the movement of the piston in that cylinder.

In order to obtain more efficient cooling in some cases it may be desirable to provide means whereby a current of air can circulate continuously by centrifugal force or otherwise through the receiver.

Turning now to the modification illustrated in Fig. 3. The engine of which part is here shown is provided with eight cylinders and operates on the six stroke cycle, but it is to be noted that the arrangement is equally applicable to an engine operating on the four stroke cycle. In this case the products of combustion leave each cylinder solely through a port B in the head of the cylinder and the ports G are dispensed with.

The ports F are distributed around the cylinders and in each case open into an annular chamber H which may be formed either concentric or eccentric with respect to the cylinder. Into this chamber leads one end of a simple tube J constituting the receiver the other end of the tube opening into a cylindrical chamber B² which is situated around the exhaust port B. The outer part of this chamber B² is open to the atmosphere and constitutes a seat for a valve K³ which is so mounted for example on the spindle B³ of the exhaust valve B' that the two valves can be operated separately. These valves B' and K³ are so arranged and actuated that either one or the other can be lifted while the other remains on its seat or they can both be lifted simultaneously. As here shown by way of example the air inlet ports E' are formed in the walls of the cylinders. These ports E' may be controlled by nonreturn valves of some suitable type but such an arrangement is more particularly applicable to nonrotating engines of the radial type or to engines of the V or other type where it is desirable to construct and arrange the piston and other parts so that a pumping action is used to charge the receiver with air for supercharging purposes.

The operation is as follows. It is to be noted that the order in which the charges are fired in the several cylinders in this case is 1, 4, 7, 2, 5, 8, 3, 6. Hence when the piston D in the cylinder A is performing its suction stroke the piston in the cylinder A' is performing its working stroke and the piston in the cylinder A² is making its blind outstroke. As shown in Fig. 3 the piston in the cylinder A is beginning its compression stroke and the piston in the cylinder A' is just at the end of its working stroke. During the preceding instroke of the piston in the cylinder A air entered the ports E' by centrifugal force aided by the suction action of the annular face of the piston D in the space E and as the valve K³ was then lifted this air could flow freely across the cylinder and right through the pipe J which was cooled thereby as also the cylinder and piston. As the piston performs its suction stroke the air contained in the space E is expelled through the pipe J which then remains filled with cool fresh air to constitute the supercharge. In the positions in which the pistons in the cylinders A and A' are shown in the drawing the exhaust valve B' has been partially closed and the valve K³ is now open. It will thus be seen that directly the ports F in the cylinder A are uncovered by the piston the opening to the atmosphere is closed by the valve K³ while the port B still remains open and the products of combustion at the pressure at which they exist in the

cylinder A' will pass into the pipe J and drive thence into the cylinder A the supercharge of air from the pipe J followed in some cases by some portion of the products of combustion. When the ports F in the cylinder A have been covered again by the piston on its instroke the valve K³ is lifted the port B remaining open at the same time so that the remainder of the products of combustion from the cylinder A' escape into the atmosphere. The passage of products of combustion in any material quantity from the cylinder A' through its ports F into the pipe J (not shown in the drawing) which connects that cylinder with the cylinder A² is prevented by reason of the valve K³ on the head of the cylinder A² being kept on its seat at this stage. Such exhaust gases as may enter that pipe J are subsequently swept out by the air which passes through the pipe. The pipes J are cooled not only by the passing of the fresh air through them but also by providing these pipes with external ribs or gills and by arranging the pipes so that they are subjected to the cooling effect of the air on their exterior as the engine rotates.

The two blind strokes of the piston in each cylinder are preferably inoperative in so far as relates to the introduction of the supercharge the air being drawn into and expelled from the cylinder during these strokes. It may be convenient however to utilize these blind strokes to assist in supercharging or in passing air through or into the connecting passages or receivers J for the purpose of cooling them and replenishing the supply of air in these receivers which is subsequently used for supercharging purposes. The blind strokes may be utilized to assist in supercharging in the manner described in the specification of the present inventor's application for U. S. A. Letters Patent Ser. No. 132688, filed 21st November 1916. The blind strokes may also be used in a similar way to pass air through the receivers the air delivered from the cylinders by the blind strokes being then conveyed by suitable means to the receivers instead of to other cylinders at the correct periods in the cycle.

In Fig. 4 is illustrated diagrammatically one method of applying the invention to a four cylinder engine in which the cylinders are arranged with their axes parallel and in the same plane. Two receptacles J^x and J^y are here employed each being of suitable construction and cooled in some convenient manner as for instance by water jackets. Each cylinder is preferably provided with a separate valve-controlled exhaust port which is opened at the usual period in the cycle. Some portion of the products of combustion however is permitted to escape through ports suitably formed and disposed

in the wall of each cylinder so that these ports will be uncovered by the piston toward the end of its outstroke. These ports also serve for the introduction of the supercharge into the cylinder and their form and arrangement may vary in accordance with requirements. The ends of the cooled receiver J^x are respectively connected by passages L and L^3 with the piston controlled ports of the cylinders A and A^3 . The ends of the receiver J^y are similarly connected by passages L' L^2 with the ports of the cylinders A' A^2 . From a fan or pump M capable of supplying air leads a passage M' in the end of which are openings N N' leading respectively into the passages L and L' . The openings N N' are controlled by valves O and O' so mounted on a common spindle that only one of these valves can be seated at a time and consequently air from the fan M can always pass through either the opening N or N' . A pipe P one end of which is open to the atmosphere has its other end in communication with the passages L^2 L^3 respectively by way of ports N^2 N^3 . These ports are controlled by valves O^2 O^3 mounted on a common spindle and arranged as the valves O O' so that when one valve is on its seat the other is lifted. Hence either the port N^2 or the port N^3 must be opened for the passage of products of combustion and air through the pipe P to the atmosphere.

The engine operates on the four-stroke cycle and the crank shaft has the cranks so arranged, as shown diagrammatically in the figure, that the crank pins Q and Q^3 of similarly disposed cranks are acted on by the pistons in the two end cylinders A and A^3 while the crank pins Q' and Q^2 are acted on by the pistons in the two inner cylinders A' A^2 . The timing is so arranged that when the piston in the cylinder A is about to commence its suction stroke, the piston in the cylinder A' is about to commence its compression stroke, the piston in the cylinder A^2 is about to commence its exhaust stroke and the piston in the cylinder A^3 is about to commence its working stroke. If the pistons are assumed to be about to perform these several strokes the valves O , O' , O^2 and O^3 are then in the positions shown in the drawings so that the openings N and N^3 are open while the openings N' and N^2 are closed. At this time the air impelled by the fan M into the pipe M' is passing through the opening N into the passage L through the receiver J^x into the passage L^3 and thence through the opening N^3 into the pipe P and so to the atmosphere. By this means the receiver J^x and the passages L and L^3 are swept clear of products of combustion and effectively cooled. As the pistons in the cylinders A and A^3 near the ends of their outstrokes and before the ports in these cylinders are uncovered the valves O

and O^3 are seated and consequently the valves O' and O^2 are lifted off their seats. When the pistons in the cylinders A and A^3 uncover the ports in those cylinders some of the products of combustion from the cylinder A^3 escape into the passage L^3 and passing thence into the receiver J^x drive the air contained therein through the passage L into the cylinder A . This cooled air is thus introduced under pressure as a supercharge into the cylinder A . The air charge may in some cases be followed by some portion of the products of combustion. At a suitable moment after the pistons in the cylinders A and A^3 have commenced their instrokes and after the ports in these cylinders have been covered by the pistons the valves O and O^3 are again lifted off their seats when air from the fan M is once more driven through the receiver J^x and sweeps out the residual products of combustion which pass through the pipe P to the atmosphere the receiver J^x being then once more filled with cool fresh air. This air is subsequently driven as a supercharge into the cylinder A^3 by the exhaust products from the cylinder A . The same process has meanwhile been taking place with regard to the cylinders A' and A^2 . At the stage when the operations, as just described, were commencing, the products of combustion from the cylinder A^2 have escaped from that cylinder into the passage L^2 and driven a charge of air out of the receiver J^y into the cylinder A' the valves O' and O^2 being at this time seated. During the instrokes of the pistons in the cylinders A' and A^2 and after the ports in the cylinders have been covered the valves O' and O^2 are lifted with the result that air from the fan M sweeps the residual products of combustion out of the receiver J^y and fills the latter with cool fresh air. Toward the ends of the next outstrokes of the pistons in the cylinders A' A^2 this charge of cooled air is driven as a supercharge into the cylinder A^2 by the exhaust products from the cylinder A' .

The fan M may be employed to deliver a mixture of air and fuel into the receivers J^x and J^y whence this mixture would then be driven as a supercharge into the several cylinders by the combustion pressure in the manner described.

An instance of how the invention may be applied to a single cylinder engine operating either on the two or four stroke cycle is shown in Fig. 5. The cylinder A is provided with one or more ports G so positioned in the length of the cylinder wall as to be uncovered by the piston D when it is nearing the end of its outstroke. A pipe leads from this port G to a chamber J^z of suitable shape and dimensions. The chamber J^z is cooled if necessary by air or water and a nonreturn valve G' of suitable type is pro-

vided in the passage between the port G and the chamber J^z. A suitably cooled receiver J can be placed in communication at one end with the chamber J^z by a pipe Q and at the other end by a pipe R with a port in the head of the cylinder A. These communicating passages are controlled by valves S and T of rotary or other type which are so constructed and operated that as desired the ends of the receiver can be cut off from the passages Q and R and opened to the passages M' and P. The pipe M' leads from a fan or pump, as in the construction illustrated in Fig. 4, adapted to deliver air or a mixture of air and fuel into the receiver. The pipe P leads to the atmosphere. Thus the receiver can be blown through and filled with air or mixture and then by operation of the valves S and T it can be placed in such communication with the interior of the cylinder by the pipe R and with the chamber J^z by the pipe Q that if this chamber has previously been filled with products of combustion under pressure these inert gases will act directly on the other gases in the receiver and drive them into the cylinder.

If the engine operates on the two-stroke cycle the cylinder is provided with an exhaust port U which will be uncovered by the piston D at the end of its outstroke and after the port G has been uncovered. The operation is then as follows. Toward the end of the outstroke of the piston D the port G is uncovered and products of combustion under pressure pass the nonreturn valve G' and enter and fill the chamber J^z. At this time the valves S and T are so set that the receiver J is being filled with air or combustible mixture supplied through the pipe M' and the gases entering the chamber J^z are trapped and remain therein under pressure being preferably cooled there. The further outward movement of the piston D uncovers the exhaust port U through which the residual products of combustion escape. If now the valve T be moved so as to shut off communication with the atmosphere through the pipe P, combustible mixture would begin to flow into the cylinder from the receiver under the pressure from the fan or pump which delivers through the pipe M'. The flow through the pipe M' is however shut off by movement of the valve S either just after the valve T has been operated to open the passage to the cylinder or the two valves may be operated simultaneously. When the valve S shuts off the pipe M' it opens communication through the pipe Q with the chamber J^z when the products of combustion therein act directly on the gases in the receiver J and drive them into the cylinder. The valves S and T are then again moved so as to establish communication between the receiver and the source of supply of com-

65 bustible mixture at one end and the atmosphere at the other and the residual inert gases in the receiver are swept out and the receiver filled again with a fresh charge of air or combustible mixture. Thus by suitable operation of the valves S and T the whole main charge or only a supercharge may be driven into the cylinder by the action of the products of combustion.

If the engine operates on the four-stroke cycle the exhaust port U is replaced by a valve controlled exhaust port in the head of the cylinder. The port G may then be positioned farther along the wall of the cylinder A. When the port G is uncovered by the piston toward the end of its working stroke products of combustion pass into the chamber J^z and are trapped and retained therein under pressure the valve S being set to shut off the passage to the receiver J. During the next instroke of the piston the residual inert gases in the cylinder are swept out by the piston through the exhaust port in the head of the cylinder. During this instroke or earlier if desired the valves S and T have been operated so that the receiver J can be filled with combustible mixture. At the commencement of the charging stroke the valves S and T are both moved so that the combustible charge in the receiver J will be driven into the cylinder by the pressure of the inert gases in the chamber J^z. Alternatively if the pressure of these gases is only to be used to introduce a supercharge into the cylinder, the valve T is first moved so as to establish communication between the receiver and the cylinder when combustible mixture will be drawn or driven into the cylinder through the pipe M' from the source of supply. At a suitable moment toward the end of the charging stroke of the piston the valve S is operated so as to shut off the admission pipe M' and allow the gases in the chamber J^z to pass into the receiver J and drive thence into the cylinder a supercharge of the gases contained therein. If the pressure of the products of combustion is employed only to introduce a supercharge the main charge may be drawn into the cylinder in the usual way through a separate inlet port in the head of the cylinder. The receiver J may then be filled with air only which is driven into the cylinder by the pressure of the inert gases in the chamber J^z. If employed for supercharging as distinct from introducing the main charge the receiver J may conveniently be of smaller capacity as also the chamber J^z.

It is to be noted that with the improved method of introducing a supercharge effective stratification is insured as the air supercharge is admitted just over the piston through the ports in the cylinder wall and

if followed by a greater or less charge of cooled products of combustion these lie between the air supercharge and the piston.

- The details of construction employed in putting the invention into practice and applying it to engines of various types may be modified in accordance with requirements. Suitable means may be provided for cutting off or modifying the supercharge so that if necessary the engine or certain cylinders thereof may operate with normal compression without supercharging while the products of combustion are exhausted in the ordinary manner.
- 15 What I claim as my invention and desire to secure by Letters Patent is:—
1. In an internal combustion engine the combination of a cylinder, a receiver, means for filling the receiver with a gaseous fluid the nature of which is such that it is a supporter of combustion and is capable of forming part of a combustible charge, means for admitting products of combustion under pressure to the receiver wherein these products of combustion act directly on the gaseous fluid with which the receiver is filled, and means for establishing communication between the receiver and the interior of the cylinder so that as a result of the action of the products of combustion on the gaseous fluid a charge of the latter will enter the cylinder as set forth.
2. In an internal combustion engine the combination of a cylinder, a receiver, means for filling the receiver with a gaseous fluid the nature of which is such that it is a supporter of combustion and is capable of forming part of a combustible charge, means for cooling the receiver, means for admitting products of combustion under pressure to the receiver wherein these products of combustion act directly on the gaseous fluid with which the receiver is filled, and means for establishing communication between the receiver and the interior of the cylinder so that as a result of the action of the products of combustion on the gaseous fluid a charge of the latter will enter the cylinder as set forth.
3. In an internal combustion engine the combination of a cylinder, provided with an inlet port and an exhaust port, a receiver in communication with the inlet port and also in communication with the cylinder exhaust port, and means for filling the receiver with a gaseous fluid the nature of which is such that it is a supporter of combustion and is capable of forming part of a combustible charge as set forth.
4. In an internal combustion engine the combination of a cylinder, provided with an inlet port and an exhaust port, a receiver in communication with the inlet port and also in communication with the cylinder exhaust port, means for cooling the receiver,

and means for filling the receiver with a gaseous fluid the nature of which is such that it is a supporter of combustion and is capable of forming part of a combustible charge as set forth.

5. In an internal combustion engine the combination of a plurality of cylinders, each having an inlet port and an exhaust port, a receiver in communication with a cylinder inlet port and also in communication with a cylinder exhaust port, and means for filling the receiver with a gaseous fluid the nature of which is such that it is a supporter of combustion and is capable of forming part of a combustible charge as set forth.
6. In an internal combustion engine the combination of a plurality of cylinders, each having an inlet port, positioned where it will be uncovered by the piston in that cylinder toward the end of its outstroke, and an exhaust port, a receiver in communication with a cylinder inlet port and also in communication with a cylinder exhaust port, and means for filling the receiver with a gaseous fluid the nature of which is such that it is a supporter of combustion and is capable of forming part of a combustible charge as set forth.
7. In an internal combustion engine the combination of a plurality of cylinders, each having an inlet port positioned where it will be uncovered by the piston in that cylinder toward the end of its outstroke, a receiver in communication with a cylinder inlet port and also in communication with a cylinder exhaust port, and means for filling the receiver with a gaseous fluid the nature of which is such that it is a supporter of combustion and is capable of forming part of a combustible charge as set forth.
8. In an internal combustion engine the combination of a plurality of cylinders, a plurality of receivers, means for filling each receiver with a gaseous fluid the nature of which is such that it is a supporter of combustion and is capable of forming part of a combustible charge, means for admitting products of combustion from each cylinder to a receiver wherein these products of combustion act directly on the gaseous fluid with which the receiver is filled, and means for establishing communication between each receiver and the interior of a cylinder so that as a result of the action of the products of combustion from one cylinder on the gaseous fluid in the receiver a charge of this fluid will enter another cylinder as set forth.
9. In an internal combustion engine the combination of a plurality of cylinders, a plurality of receivers, means for filling each receiver with a gaseous fluid the nature of which is such that it is a supporter of com-

bustion and is capable of forming part of a combustible charge, means for cooling the receivers, means for admitting products of combustion from each cylinder to a receiver wherein these products of combustion act directly on the gaseous fluid with which the receiver is filled, and means for establishing communication between each receiver and the interior of a cylinder so that as a result of the action of the products of combustion from one cylinder on the gaseous fluid in the receiver a charge of this fluid will enter another cylinder as set forth.

10. In an internal combustion engine the combination of a plurality of cylinders, each having an inlet port and an exhaust port, a plurality of receivers each in communication with the inlet port of one cylinder and the exhaust port of another cylinder, and means for filling each receiver with a gaseous fluid the nature of which is such that it is a supporter of combustion and is capable of forming part of a combustible charge as set forth.

11. In an internal combustion engine the combination of a plurality of cylinders, each having an inlet port positioned where it will be uncovered by the piston in that cylinder toward the end of its outstroke, and an exhaust port, a plurality of receivers each in communication with the inlet port of one cylinder and the exhaust port of another cylinder, means for cooling the receivers, and means for filling each receiver with a gaseous fluid the nature of which is such that it is a supporter of combustion and is capable of forming part of a combustible charge as set forth.

12. In an internal combustion engine the combination of a plurality of cylinders, each having an inlet port positioned where it will be uncovered by the piston in that cylinder toward the ends of its outstroke, and an exhaust port positioned where it will be uncovered by the piston in that cylinder toward the end of its outstroke, a plurality of receivers each in communication with the inlet port of one cylinder and the exhaust port of another cylinder, means for cooling the receivers, and means for filling each receiver with a gaseous fluid the nature of which is such that it is a supporter of combustion and is capable of forming part of a combustible charge as set forth.

13. In an internal combustion engine the combination of a cylinder, having an inlet port and an exhaust port, a receiver, means for filling the receiver with a gaseous fluid the nature of which is such that it is a supporter of combustion and is capable of forming part of a combustible charge, means for admitting products of combustion under pressure to the receiver wherein these products of combustion act directly on the gaseous fluid with which the receiver is filled,

and a passage between the receiver and the cylinder inlet port so that as a result of the action of the products of combustion on the gaseous fluid in the receiver a charge of this fluid will enter the cylinder as set forth.

14. In an internal combustion engine the combination of a cylinder, having an inlet port and an exhaust port, a receiver, means for filling the receiver with a gaseous fluid the nature of which is such that it is a supporter of combustion and is capable of forming part of a combustible charge, means for cooling the receiver, means for admitting products of combustion under pressure to the receiver wherein these products of combustion act directly on the gaseous fluid with which the receiver is filled, and a passage between the receiver and the cylinder inlet port so that as a result of the action of the products of combustion on the gaseous fluid in the receiver a charge of that fluid will enter the cylinder as set forth.

15. In an internal combustion engine the combination of a cylinder, having an inlet port, and an exhaust port positioned where it will be uncovered by the piston in that cylinder toward the end of its outstroke, a receiver, means for filling the receiver with a gaseous fluid the nature of which is such that it is a supporter of combustion and is capable of forming part of a combustible charge, means for admitting products of combustion under pressure to the receiver wherein these products of combustion act directly on the gaseous fluid with which the receiver is filled, and a passage between the receiver and the cylinder inlet port so that as a result of the action of the products of combustion on the gaseous fluid in the receiver a charge of this fluid will enter the cylinder as set forth.

16. In an internal combustion engine the combination of a plurality of cylinders, each having an inlet port and an exhaust port, a plurality of receivers, means for filling each receiver with a gaseous fluid the nature of which is such that it is a supporter of combustion and is capable of forming part of a combustible charge, means for cooling the receivers, means for admitting products of combustion from each cylinder to a receiver wherein these products of combustion act directly on the gaseous fluid with which the receiver is filled, and a passage between each receiver and the inlet port of a cylinder so that as a result of the action of the products of combustion from one cylinder on the gaseous fluid in a receiver a charge of this fluid will enter another cylinder as set forth.

17. In an internal combustion engine the combination of a plurality of cylinders, each having an inlet port, positioned where it will be uncovered by the position in that

2
cylinder toward the end of its outstroke, and
an exhaust port positioned where it will be
uncovered by the piston in that cylinder
toward the end of its outstroke, a plurality
5 of receivers, means for filling each receiver
with a gaseous fluid the nature of which is
such that it is a supporter of combustion and
is capable of forming part of a combustible
charge, means for cooling the receivers,
10 means for admitting products of combustion
from each cylinder to a receiver wherein
these products of combustion act directly
on the gaseous fluid with which the receiver

is filled, and a passage between each receiver
and the inlet port of a cylinder so that as a 15
result of the action of the products of combustion
from one cylinder on the gaseous
fluid in a receiver a charge of this fluid will
enter another cylinder as set forth.

In testimony whereof I have signed my 20
name to this specification in the presence of
two subscribing witnesses.

ALAN ERNEST LEOFRIC CHORLTON.

Witnesses:

T. E. DUNBAR KILBURN,
ARCHIBALD JOHN FRENCH.