G. HOLLOWAY.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED OCT. 4, 1909.

1,001,404. **Patented Aug. 22, 1911.**

2 SHEETS—SHEET 1.

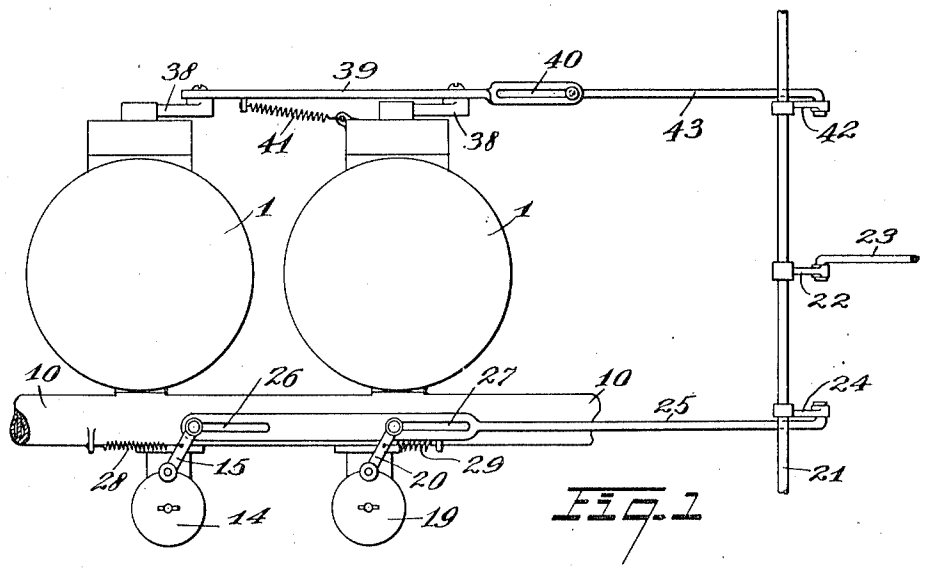

Fig. 1

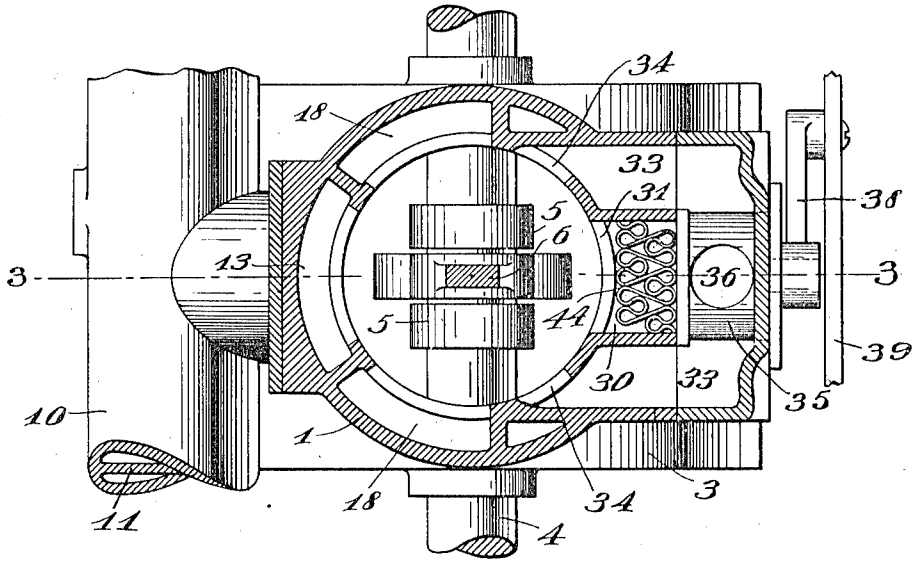

Fig. 2

Witnesses:

Brennan B. West.

Nathan F. Fretter

Inventor.

George Holloway.

By Baldwin, Foss & Hull,

Attys

G. HOLLOWAY.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED OCT. 4, 1909.

1,001,404.

Patented Aug. 22, 1911.

2 SHEETS—SHEET 2.

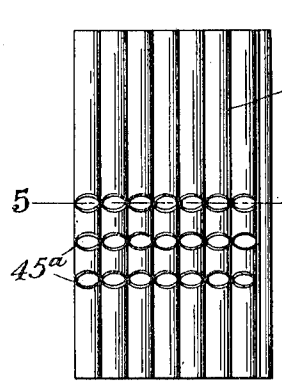

FIG. 4

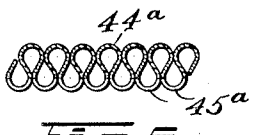

FIG. 5

FIG. 3

Witnesses:-

Brennan B. West

Nathan F. Fretter.

Inventor

George Holloway.

By Bates, Fouke & Hull,

Attys

UNITED STATES PATENT OFFICE.

GEORGE HOLLOWAY, OF SANDUSKY, OHIO.

INTERNAL-COMBUSTION ENGINE.

1,001,404. Specification of Letters Patent. Patented Aug. 22, 1911.

Application filed October 4, 1909. Serial No. 520,945.

To all whom it may concern:

Be it known that I, GEORGE HOLLOWAY, a citizen of the United States, residing at Sandusky, in the county of Erie and State of Ohio, have invented a certain new and useful Improvement in Internal-Combustion Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

This invention relates to internal combustion engines, and more particularly to the type of explosive engines known as two-cycle engines, and it has for its object the production of an engine having increased efficiency and power while running at high rates of speed.

In two-cycle engines the explosive charge is usually compressed in the crank case, the explosive fluid being admitted to the crank case through a carbureter and being taken from the case and conveyed to the engine cylinder through a by-pass, the inlet port from the by-pass being under the control of the engine piston. As the speed increases above normal, the individual charges of fluid and the force of the explosions diminish.

In my invention, I provide a main passageway leading to the cylinder or crank case through which the explosive fluid is supplied for running the engine at or below normal speed, said supply being taken through a carbureter of any suitable type. For supplementing the supply of fluid when the engine is running above normal speed, I provide one or more additional ports in the cylinder, said ports being under control of the engine piston and of the operator so that they may be opened by the latter to a greater or less extent dependent upon the speed of the engine. With the auxiliary port or ports, I may connect an auxiliary carbureter so as to supply either mixture or air to the crank case, it being understood that when fuel is supplied to the auxiliary carbureter it will furnish mixed gases, or, when no fuel is supplied to it, it will furnish air only. Instead of using the auxiliary carbureter, when air only is to be supplied, any other form of valve mechanism for controlling the air supply may be used in place of the auxiliary carbureter. In conjunction with the means thus set forth for increasing the supply of explosive fluid to the crank case, I also provide a supplementary by-pass under control of a valve, whereby the amount of mixture taken from the crank case by the engine is also increased. While I contemplate using this auxiliary by-pass with the auxiliary passages to the crank case, this same may be used whether or not the engine is provided with the auxiliary passages.

In the drawings forming a part of this application—Figure 1 is a plan view of a two-cycle engine having my invention applied thereto, this figure showing two cylinders, although a greater or fewer number of cylinders may be employed; Fig. 2 is a section taken transversely through one of the engine cylinders on the line 2—2 of Fig. 3; Fig. 3 is a sectional view taken longitudinally through the engine cylinder on the line 3—3 of Fig. 2; and Figs. 4 and 5 are a side elevation and a sectional view, respectively, through a modified form of plate designed to be interposed in the by-pass for preventing back firing, Fig. 5 being taken on the line 5—5 of Fig. 4.

Taking up a detailed description of the invention by the use of reference characters, 1 represents an engine cylinder which, as stated, may be of any desired number; 2 represents the engine piston, 3 the closed crank case, 4 the crank shaft, 5 the crank on said shaft, 6 the connecting rod between the piston and the crank, 7 the exhaust port, 8 the water jacket and 9 the igniting device, which device may be of any suitable type.

The features above referred to are common in two-cycle engines, and further description thereof is not deemed necessary.

Secured to the cylinders 1, and preferably extending continuously from one cylinder to the other so as to connect all of the cylinders together, is what may be termed a manifold 10, the same being shown, in the present instance, as a pipe or tubular casting divided longitudinally through its center by a partition 11. It will, of course, be understood that the ends of the manifold are closed against the admission of air. The upper half of the manifold is connected through a passageway 12 with an intake port 13 which communicates with the lower part of the cylinder 1 when the piston is in its upper position, as shown in Fig. 3. At a suitable point on said manifold I attach the main carbureter 14, which carbureter may be of any suitable type. This carbureter communicates with the passageway 12

so that the explosive fluid furnished through that carbureter passes through the port 13 into the lower part of the cylinder and into the crank case 3. The amount of fluid passing through the carbureter is regulated by a valve having a crank arm 15. The space below the partition 11 in the manifold communicates with a passageway 16, from which branch outwardly about the cylinder and within the walls thereof a pair of passages 17, one of the same being indicated in dotted lines in Fig. 3, said passages 17 communicating with the cylinder through ports 18. At a suitable point along the manifold, an auxiliary carbureter is provided, the same being shown as similar to the carbureter 14, although such similarity of structure is not necessary and, as stated, when air only is to be supplied through the passageway 16, any other suitable form of fluid valve may be used instead of the auxiliary carbureter. The amount of fluid passing through the auxiliary carbureter is controlled by a valve having a crank 20, similar to the crank 15. While the engine is running below and at normal speed, a sufficient amount of explosive fluid is supplied through the carbureter 14, in which case the auxiliary carbureter need not be employed. When, however, the speed increases above normal, an additional supply of fluid is needed to supplement the mixture furnished by the main carbureter; and, under these circumstances, the auxiliary carbureter is thrown into operation, the same supplying an additional amount of mixture or air through the passageway 16 and ports 18. The width of the ports 18 is greater than that of the ports 13, as clearly shown in Fig. 3, the reason for such formation being that, as the speed of the engine increases, the time during which the ports are opened is correspondingly abridged, and the increased area of the supplemental opening multiplied by the time of opening at the higher speed may be made more nearly equal to the product of the area of the main inlet and the time of opening at low speeds. While the form of manifold thus described forms a very satisfactory construction, the details thereof may be varied. For example, the passages 12 and 16 of the engine may communicate with entirely separate pipes, or no pipe at all for the auxiliary carbureter may be provided, in which case the auxiliary carbureter, or outer valve, would be attached directly to the engine cylinder.

While the carbureters 14 and 19 may be controlled by entirely independent means, I have shown mechanism for first causing the main carbureter to open, the degree of opening being under control of the operator, and for throwing in the auxiliary carbureter after the main carbureter has been opened substantially to its full extent. The means for thus operating these carbureters includes a crank shaft 21, which is mounted on any stationary support about the engine, said shaft having a crank 22 with which a rod 23 is connected, said rod being under control of the operator. Also secured to the shaft 21 is a crank 24, to which I pivot a bar 25 having a pair of slots 26 and 27 therein, said slots being of substantially the same length. On the cranks 15 and 20 are pins which project into the said slots 26 and 27, the said pins normally resting in the ends of the slots that are farthest from the shaft 21. The crank 15 for operating the valve in the main carbureter has attached thereto a coiled spring 28, the tendency of which is to open the valve, while the crank 20 for operating the auxiliary carbureter has a coiled spring 29 connected therewith which tends to hold the valve of the carbureter closed. When the shaft 21 is rocked, the bar 25 is moved to the left, as shown in Fig. 1, whereupon the spring 28 opens the valve in the main carbureter, the crank 15 rocking until the pin on the crank 20 of the auxiliary carbureter has reached the right hand end slot of 27. At this moment the main carbureter is open to substantially its full extent, and the auxiliary carbureter is ready to be thrown into action. A further rotation of the crank shaft 21 in the same direction, therefore, results in forcing open the valve in the auxiliary carbureter against the tension of its spring 29. By this arrangement, therefore, both carbureters may be controlled by the same mechanism, and the auxiliary carbureter is not thrown into operation until the main carbureter has been opened to substantially its fullest extent.

My invention also contemplates a by-pass from the crank case to the engine cylinder, the conducting capacity of which may also be varied to suit the requirements of the engine for explosive mixture. The normal by-pass is shown at 30, said by-pass communicating with the engine cylinder through a port 31. This part of the by-pass is similar to the ordinary form used in two-cycle engines, the same being intended to convey the mixture to the cylinder that is necessary while the engine is running at or below normal speed. When the speed of the engine is increased above normal, the conducting capacity of the by-pass should be correspondingly increased; and for accomplishing this result, I attach to the cylinder opposite the main by-pass a casing 32 having a chamber therein which communicates with the main by-pass 30 and from which chamber there extend branches 33 which lead to auxiliary inlet ports 34 in the engine cylinder. Within the casing 32 I place a valve 35, the same being of hollow cylindrical construction, one end of the same being extended substantially to the main by-pass and being opened whereby the mixture in the main by-

pass may enter the valve. Extending through the peripheral wall of the valve 35 is a port 36, which port is adapted to register with the chamber above the valve, from which chamber the passages 33 extend, whereby, when the valve is turned into the position shown in Fig. 3, the mixture from the crank case may pass through the valve and through the auxiliary ports 34 into the engine cylinder to supplement the mixture passing at the same time through the main by-pass and through the port 31.

The valve 36 is provided with a stem 37, to which is secured a crank 38, said crank being connected to a bar 39 having a slot 40 near its end, said slot being of substantially the same length as the slots 26 and 27 in the bar 25. Connected with the bar 39 is a coiled spring 41, the tendency of which is to hold the bar in its right hand position, as shown in Fig. 1, with the valve 36 closed. The bar 39 is operated from the rock shaft 21 through a crank 42 on the shaft and through a pitman 43, which is connected to the bar by a pin extending into the slot 41, said pin normally resting in the outer end of the slot. Upon the oscillation of the rock shaft 21, no movement of the crank 38 takes place until the pin on the pitman 43 reaches the inner end of the slot, which takes place at substantially the same moment that the pin in the crank 20 of the auxiliary carbureter reaches the right hand end of its slot 27. Up to this time, therefore, only the main carbureter and the main by-pass have been in operation. Any further oscillatory movement of the shaft 21 in the same direction, however, results in throwing the auxiliary carbureter into action, and in opening the valve 35 to thus increase the carrying capacity of the by-pass.

While I have shown a common means for actuating both carbureters and the valve in the auxiliary by-pass, I do not regard it as necessary that these devices be operated by the same means, as separate and independent means for operating the same may be employed. And while the above description has been applied to a single valve for a single cylinder, it will be understood that the valves for all the cylinders are connected to the same bar 39 so as to be rotated simultaneously and to the same degree, Fig. 1 showing the two crank arms 38 so connected.

In two-cycle engines there is a liability of the engine back-firing through the by-pass into the crank case. I have, therefore, interposed in the main by-pass 30 a device for preventing such back-firing; and, in Figs. 2 and 3, I have shown this device as consisting of a metal plate 44 that is so folded upon itself into a series of folds as to provide a multiplicity of comparatively small tubular passages through which the mixture must pass in reaching the cylinder. More specifically stated, the plate is first so folded as to form a tube near the median line of the device, thence it is carried outwardly and back to form a similar tube at one side of the device, thence across and in substantial contact with the first fold to the opposite side of the device where the plate again folds inwardly to form a tube at the said opposite side, thence around and back again to the said opposite side of the device, forming another tube near the median line, thence back in substantial contact with the last-mentioned tube and forming another tube at the said opposite side of the device and across to the side first mentioned, after which the folding is continued in the same manner as that just stated. The mixture passing through the main by-pass is carried straight through the tubes of the plate 44, said tubes terminating at their upper ends adjacent the port 31. The mixture that passed through the auxiliary by-pass is also carried through the said tubes for a portion of their length, the folds on that side next the valve 35 being cut away at 45 so as to permit the mixture to pass into the valve and thence on into the cylinder through the ports 34. By the means thus described, all back-firing into the crank case is effectually prevented. In Figs. 4 and 5 I have shown a somewhat modified form of plate for preventing this back-firing, said plate being designated as 44ª. Instead of having the double system of folding shown in Fig. 2, the plate is simply folded back and forth upon itself to form two series of parallel tubes. On one side of these tubes the metal is cut away at 45ª so as to permit the mixture to enter the valve 35 in the manner hereinbefore described with respect to the plate 44.

As above stated the second or auxiliary carbureter may be employed only as an air inlet, and its function as a fuel dispenser omitted, throwing this burden solely upon the first or main carbureter, or the auxiliary carbureter could be entirely dispensed with and any suitable type of air valve employed. Whichever expedient be adopted it is obvious that fluid of some kind, either air alone or air mixed with hydrocarbon will pass through this device and will supplement the charge introduced through the main carbureter. It will, therefore, be understood that where I have used the term "fluid" in the claims as referring to the substance passing through the auxiliary inlet, I intend either air alone or air mixed with hydrocarbon.

While I have shown what I regard as a satisfactory embodiment of my invention, the details shown may be varied without departing from the spirit of my invention, and I desire it to be understood that the

following claims are not intended to be limited to such details any further than is rendered necessary by the specific terms therein employed.

Having thus described my invention, what I claim is:

1. In an explosive engine, the combination with the cylinder of a two cycle engine having a plurality of ports and separated passageways leading to said ports, a main carbureter in the passageway leading to one of said ports, said carbureter supplying the explosive mixture while the engine is running at normal speed, an auxiliary carbureter in the passageway leading to another admission port, said latter carbureter being adapted to supply additional fluid to the engine when it is running at increased speeds to supplement the mixture taken through the main carbureter, and means for regulating the quantity of mixture passing through said carbureters.

2. In a two-cycle explosive engine, the combination with the engine cylinder, of a piston therein, a closed chamber within which the explosive mixture is compressed and from which it is admitted to the cylinder, a main carbureter in a passage leading to said chamber, said carbureter supplying the mixture for the engine while it is running at normal speed, a by-pass connecting the chamber with the engine cylinder, an auxiliary carbureter connected with another passage leading to the chamber, said auxiliary carbureter being adapted to furnish an additional supply of fluid to said chamber when the engine is running at higher speed, and means for throwing said auxiliary carbureter into operation only after said main carbureter is open to its full capacity.

3. In a two-cycle explosive engine, the combination with a cylinder, of a piston therein, a chamber within which the explosive mixture may be compressed and from which it may be admitted to the cylinder, a by-pass connecting the said chamber with the cylinder, two separated passageways communicating with the said chamber, a main carbureter connected with one of said passageways for supplying the explosive mixture while the engine is running at normal speed, an auxiliary carbureter connected with the other passageway and through which additional fluid may be admitted to supplement the mixture passing through the first-mentioned carbureter when the engine is running at higher speeds, and means for regulating the quantity of mixture passing through the carbureters, said means operating to open the main carbureter to substantially its full extent before the auxiliary carbureter is affected.

4. In a two-cycle explosive engine, the combination with an engine cylinder, of a piston therein, a closed crank case upon which the said cylinder is mounted and in which explosive mixture is compressed, a by-pass connecting the said crank case with the engine cylinder, a pair of separated passages leading to the engine cylinder above the crank case, a main carbureter connected with one of said passages through which the mixture is supplied to the engine while the same is running at normal speed, an auxiliary carbureter connected with the other passage through which additional fluid may be supplied for supplementing the mixture through the first-mentioned carbureter while the engine is running above normal speeds, and means for controlling said carbureters whereby the quantities of mixture admitted through each may be regulated.

5. In a two-cycle explosive engine, the combination with an engine cylinder, of a piston therein, a closed crank case upon which the said cylinder is mounted and in which said explosive mixture is compressed, a by-pass connecting the said crank case with the engine cylinder, a pair of separated passages leading to the engine cylinder above the crank case, a main carbureter connected with one of said passages through which the mixture is supplied to the engine while the same is running at normal speed, an auxiliary carbureter connected with the other passage through which additional fluid may be supplied for supplementing the mixture through the first mentioned carbureter while the engine is running at higher speeds, and means for controlling said carbureters whereby the quantities of mixture admitted through each may be regulated, said means operating on the main carbureter to open the same to substantially its full extent before the auxiliary carbureter is affected.

6. In a two-cycle engine, the combination with a cylinder, of a piston mounted to reciprocate therein, a closed crank casing within which the explosive mixture for the engine is compressed and from which it is admitted to the cylinder, a member connected with the cylinder, said member having a pair of separated passages therein, said passages communicating with the cylinder through separated ports, a main carbureter connected with one of said passages, said carbureter supplying the mixture while the engine is running at normal speed, an auxiliary carbureter connected with the other passage in said member, said auxiliary carbureter being adapted to supply additional fluid to supplement the mixture supplied by the first carbureter when the engine is running above normal speed, means for controlling the said carbureters, a by-pass connecting the crank casing with the cylinder and a plate in said by-pass, said plate being formed of sheet-metal which is bent upon itself into a series of folds so as to form a series of tubular pas-

sages through which the mixture passes before reaching the cylinder, for the purpose specified.

7. In a two-cycle engine, the combination with a cylinder, of a piston mounted to reciprocate therein, a closed crank casing within which the explosive mixture is compressed and from which it is admitted to the cylinder, a member connected with the cylinder, said member having a pair of separated passages therein, said passages communicating with the cylinder through separated ports, a main carbureter connected with one of said passages, said carbureter supplying the mixture while the engine is running at normal speed, an auxiliary carbureter connected with the other passage in said member, said auxiliary carbureter being adapted to supply additional mixture to supplement the fluid supplied by the first carbureter when the engine is running above normal speed, a by-pass connecting the crank casing with the cylinder, a plate in said by-pass, said plate being formed of sheet-metal which is bent upon itself into a series of folds so as to form a series of tubular passages through which the mixture passes before reaching the cylinder, for the purpose specified, and means for operating said carbureters, said means operating to open the main carbureter to substantially its full extent before the auxiliary carbureter is affected.

8. In an explosive engine, the combination with a cylinder, of a piston mounted to reciprocate in said cylinder, a crank case within which the explosive mixture may be compressed, a main and an auxiliary carbureter through which the mixture may be drawn into the crank case, a main by-pass connecting the crank case with the engine cylinder, a supplemental by-pass connecting the main by-pass with the engine cylinder, a valve in the supplemental by-pass for closing the same or for opening said by-pass to admit additional mixture through the supplemental by-pass into the cylinder, and a common means for operating the carbureters and the said valve, said means operating to first open the main carbureter, and, after said main carbureter has been opened to substantially its full extent, to then operate both the auxiliary carbureter and the valve.

9. In an explosive engine, the combination with a cylinder, of a piston mounted to reciprocate in said cylinder, a crank case within which the explosive mixture may be compressed, a main and an auxiliary carbureter through which the mixture may be drawn into the crank case, a main by-pass connecting the crank case with the engine cylinder, a supplemental by-pass connecting the main by-pass with the engine cylinder, a valve in the supplemental by-pass for closing the same or for opening said by-pass to admit additional mixture through the supplemental by-pass into the cylinder, a rock-shaft, means connected with said rock-shaft for operating the carbureters and the said valve, said means operating to first open the main carbureter, and, after said main carbureter has been opened to substantially its full length, to then operate both the auxiliary carbureter and the valve, and means interposed in the main by-pass for preventing the engine from back-firing.

10. In an explosive engine, the combination with an engine cylinder, of a piston operating in the said cylinder, the engine being provided with a plurality of passageways under control of the piston through which the explosive fluid for running the engine may be supplied, a carbureter connected with one of said passageways, said passageway supplying the engine with explosive mixture when it is running at normal speed, and means for controlling the other passageways of the engine whereby additional fluid may be admitted when the engine is running above normal speed.

11. In an explosive engine, the combination with an engine cylinder having a plurality of ports and separated passageways leading to said ports, of a piston in the cylinder controlling said ports, a carbureter connected with the passageway leading to one of said ports, said carbureter supplying the explosive mixture while the engine is running at normal speed and means for controlling the other passageway leading to said ports whereby additional fluid may be supplied to the engine when it is running above normal speeds to supplement the mixture taken through the carbureter.

12. In a two-cycle explosive engine, the combination with the engine cylinder, having a plurality of ports therein, of a piston in the cylinder controlling said ports, a closed chamber within which the explosive fluid admitted through said ports is compressed and from which it is admitted to the cylinder, a carbureter in a passage leading to one of said ports, said carbureter supplying the explosive mixture for the engine while it is running at normal speed, a by-pass connecting the chamber with the engine cylinder and means for admitting an additional quantity of fluid through the other of said ports to supplement the mixture supplied through the carbureter when the engine is running above normal speed.

13. In a two-cycle explosive engine, the combination with an engine cylinder having a plurality of ports therein, of a piston in the cylinder controlling said ports, a closed crank case upon which the said cylinder is mounted and in which the explosive fluid is compressed, a by-pass connecting the crank

case with the engine cylinder, a pair of separated passages leading to the engine cylinder above the crank case, said passages communicating with said ports, a carbureter connected with one of said passages through which the explosive mixture is supplied to the engine while it is running at or below normal speed, and means for controlling the other passage whereby additional fluid may be admitted to the cylinder and crank case when the engine is running above normal speed.

14. In an explosive engine, the combination, with an engine cylinder having a plurality of ports and separated passage-ways leading to said ports, of a piston in the cylinder controlling said ports, a carbureter connected with the passageway leading to one of said ports, said carbureter supplying the explosive mixture while the engine is running at normal speed, and the other of said ports serving as a means for admitting an additional quantity of fluid to supplement the mixture supplied through the carbureter when the engine is running above normal speed, the width of said other ports being greater than that of said first port.

15. In a two-cycle explosive engine, the combination, with the engine cylinder having a plurality of ports therein, of a piston in the cylinder controlling said ports, a closed chamber within which the fluid admitted through said ports is compressed and from which it is admitted to the cylinder, a carbureter in communication with certain of said ports and supplying explosive mixture to the engine at all times, and a valve controlling the other of said ports and adapted to be actuated so as to admit an additional quantity of fluid therethrough to increase the power and speed of the engine.

16. In a two-cycle explosive engine, the combination, with the engine cylinder having a plurality of ports therein, of a piston in the cylinder controlling said ports, a closed chamber within which the mixture is compressed and from which it is admitted to the cylinder, a carbureter adapted to supply explosive mixture to said chamber at a time when the pressure within said chamber is less than that of the atmosphere and to be cut off from said chamber at other times, and said cylinder ports serving as a means for admitting an additional quantity of fluid to said chamber to increase the power and speed of the engine.

17. In a two-cycle explosive engine, the combination with the cylinder, of a piston, and a closed crank case below the piston, a carbureter adapted to supply explosive mixture to said crank case at a time when the pressure within said crank case is less than that of the atmosphere and to be cut off from said crank-case at other times, and means for admitting an additional quantity of fluid to said crank-case substantially simultaneously with such mixture admission, to increase the power and speed of the engine.

In testimony whereof, I hereunto affix my signature in the presence of two witnesses.

GEORGE HOLLOWAY.

Witnesses:
D. F. ROGERS,
R. C. MILLER.