

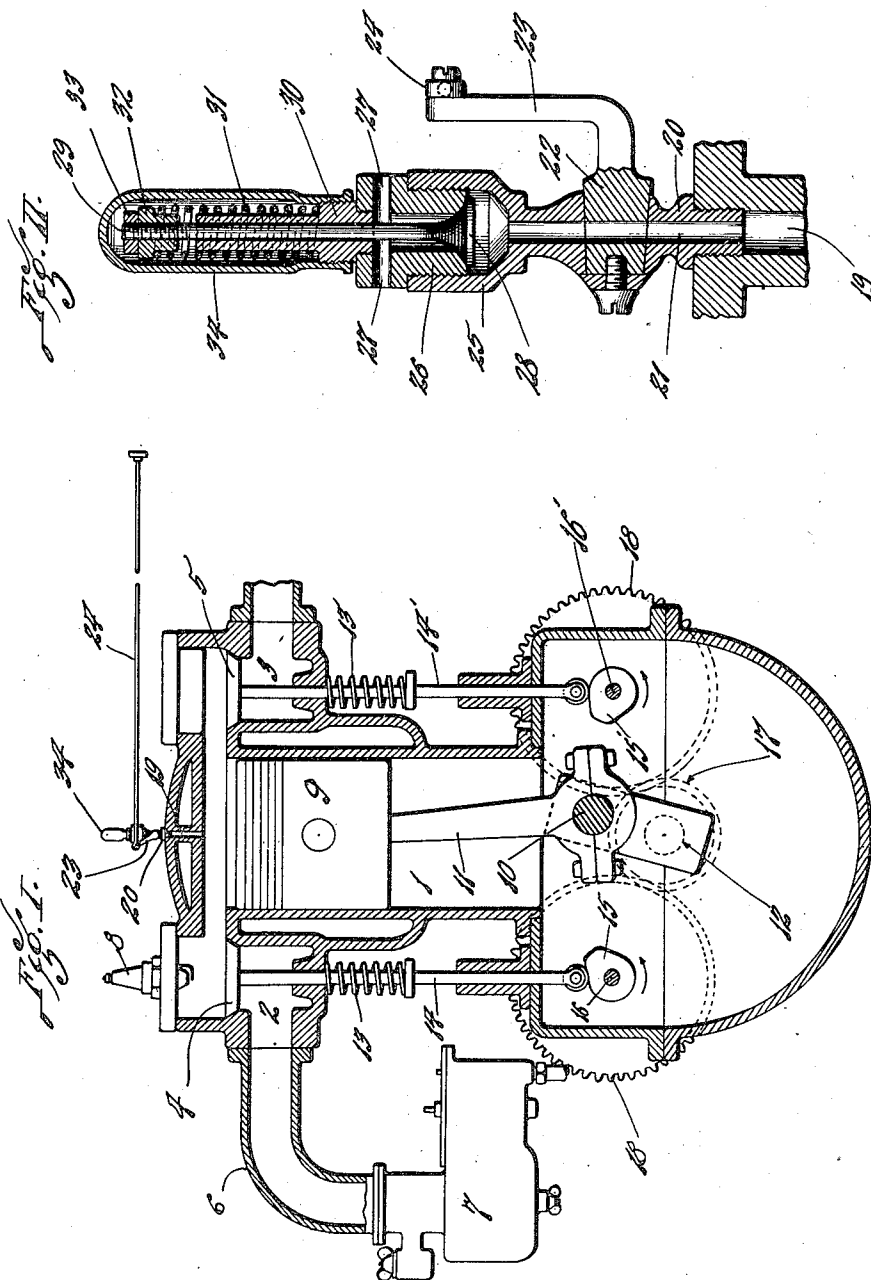
Aug. 19, 1924.

B. L. CAMPBELL

1,505,697

CHARGE FORMING DEVICE FOR INTERNAL COMBUSTION ENGINES

Filed Oct. 7, 1921



Inventor:
B. L. Campbell
by Cook & McCarley atty.

Patented Aug. 19, 1924.

1,505,697

UNITED STATES PATENT OFFICE.

BENJAMIN L. CAMPBELL, OF ST. LOUIS, MISSOURI, ASSIGNOR OF ONE-HALF TO
FRANK G. O'HAYER, OF WEBSTER GROVES, MISSOURI.

CHARGE-FORMING DEVICE FOR INTERNAL-COMBUSTION ENGINES.

Application filed October 7, 1921. Serial No. 506,155.

To all whom it may concern:

Be it known that I, BENJAMIN L. CAMPBELL, a citizen of the United States of America, and a resident of the city of St. Louis and State of Missouri, have invented certain new and useful Improvements in Charge-Forming Devices for Internal-Combustion Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

This invention relates to improvements in charge forming devices for internal combustion engines, and more particularly to a device whereby air is admitted to the combustion chamber of an engine so as to commingle with and support combustion of the charge therein. The invention is especially adapted for use in an internal combustion engine equipped with a carburetor from which carbureted air is drawn into the combustion chamber.

The engine herein described is equipped with an ordinary carburetor, an inlet valve controlling the admission of carbureted air to the cylinder, and an ordinary exhaust valve for the discharge of products of combustion. In addition to this, the engine cylinder is provided with an auxiliary air inlet for the admission of air alone, and an automatic check valve controlling the delivery of air through the auxiliary inlet. It is to be understood that the air entering the auxiliary air inlet does not flow through the main inlet.

At the beginning of the suction stroke of the piston, the main inlet valve and the exhaust valve are closed, so a partial vacuum is created in the cylinder with the result of drawing a charge of air through the auxiliary inlet and into the cylinder, and as the piston continues in motion, the main inlet valve is opened to admit the carbureted air. The admission of auxiliary air is controlled by a check valve preferably provided with a spring whereby it is normally held in its closed position. In response to a partial vacuum in the cylinder, the check valve and its spring will yield to admit the auxiliary air, and the spring can be adjusted to most effectively control the admission of this air.

If the main inlet valve is closed during the first part of the suction stroke, a high vacuum will be created in the cylinder during this period, and the vacuum will after-

wards be lowered or reduced by the opening of the main inlet valve. The spring just referred to can be so adjusted that the auxiliary air valve will open in response to the high vacuum and close when the vacuum is reduced by the opening of the inlet valve. It will, therefore, be understood that the auxiliary air can be admitted to the cylinder while the main inlet valve is closed, and that the admission of this auxiliary air can be discontinued in response to the opening of the main inlet valve. If this is done, the carburetor valves can be properly adjusted for the highest efficiency, and the action of the auxiliary air valve will have no effect on the charge-mixing elements of the carburetor, for the auxiliary valve will perform its function while the main inlet valve is closed.

The new device provides auxiliary air which facilitates combustion of the fuel in the cylinder, and actual experience has shown that its use results in all of the numerous advantages of more perfect combustion in the engine cylinder. Severe service tests have shown that when an engine is equipped with this device it develops more power from a given quantity of fuel, and that it practically eliminates carbon from the cylinder as well as undesirable exhaust odors. I cannot fully explain the reasons for the greatly improved combustion which results in all of these advantages, but I believe it is due partly to the fact that the admission of the auxiliary air does not materially impair the production of the explosive mixture at the carburetor, and partly to the fact that combustion of the carbureted air is sustained by the auxiliary air.

Furthermore, the auxiliary air is admitted before the carbureted air enters the cylinder, and this pure air displaces residual burnt gases from the top of the cylinder, causing them to flow ahead of the carbureted air, and the residual gases may be more or less purified or revived by the pure air.

The auxiliary air valve relieves the vacuum at the beginning of the suction stroke, and this apparently avoids the loss of power that would be required to create a more perfect vacuum, and it enables the engine to be more easily cranked in starting. However, in cold weather a very rich mixture is required to start the engine, and I

have therefore shown a manually operated valve whereby the auxiliary air inlet can be closed to prevent the admission of auxiliary air. This manually operated valve can be
 5 closed whenever a rich mixture is required, and it can be adjusted to regulate the delivery of auxiliary air.

With the foregoing and other objects in view, the invention comprises the novel construction, combination and arrangement of
 10 parts hereinafter more specifically described and illustrated in the accompanying drawings wherein is shown the preferred embodiment of the invention. However, it is to be
 15 understood that the invention comprehends changes, variations and modifications which come within the scope of the claims hereunto appended.

Fig. I is a diagrammatical vertical section illustrating an internal combustion engine embodying the features of this invention.
 20

Fig. II is an enlarged vertical section showing the means for controlling the admission of auxiliary air to the interior of the cylinder.
 25

To illustrate the invention I have shown a four cycle engine comprising a cylinder 1 provided with a main inlet port 2, an exhaust port 3, a main inlet valve 4 and an exhaust valve 5. An intake pipe 6 leads from a carburetor 7 to the inlet port 2. 8 designates a spark plug for the ignition of the charge in the cylinder.

35 A piston 9, mounted in the cylinder, is connected to a crank 10 by means of the usual connecting rod 11. The crank 10 is secured to a power shaft 12.

The valve operating means comprises a
 40 spring 13 surrounding the stem 14 of the inlet valve, and a similar spring 13' surrounding the stem 14' of the exhaust valve. These springs tend to retain the valves 4 and 5 in their closed positions. A cam 15
 45 on a cam shaft 16 engages a roller at the lower end of valve stem 14, and a similar cam 15' on the shaft 16' engages a roller at the lower end of stem 14'. The means for operating the cam shafts comprises a
 50 gear 17 fixed to the crank shaft 12 and meshing with gears 18 on the respective cam shafts 16 and 16'.

A restricted inlet port 19 is formed in the head of the cylinder to provide for the admission of pure air to the interior of the cylinder. 20 designates a valve-holding member screwed into the port 19 and having a passageway 21 forming a continuation of
 55 said port. A valve, or cock, 22 mounted in the member 20, is provided with an operating handle 23 to which a long operating rod 24 is connected. This operating rod may extend to a point distant from the engine,
 60 for example, to the instrument board of an automobile where it can be conveniently

operated by hand to open and close the valve 22.

A cup 25, at the upper end of passageway 21 is threaded to receive a bushing 26 provided with air inlets 27 communicating with the atmosphere. A check valve 28,
 70 engaging a valve seat at the lower end of bushing 26, is provided with a stem 29 which extends through a tube 30 on the bushing. A compression spring 31 surrounds the stem 29 and engages a shoulder
 75 on the lower portion of tube 30, the upper end of said spring being engaged with a spring seat 32 screwed onto the threaded upper end of stem 29. This spring seat 32
 80 can be adjusted to vary the pressure of the springs 31, and after being adjusted it can be locked by means of a jam nut 33. An elongated cap 34 may be screwed onto the
 85 lower portion of the tubular member 30 so as to enclose the spring 31 and its adjusting device.

Since the operation of a four cycle engine is well understood in the art, I will merely describe the action during the suction strokes of the piston. Fig. I shows the parts in the positions they occupy after the piston has started its suction stroke. The piston has moved downwardly from its upper dead center, and both of the valves 4 and 5 are closed. During this initial part
 95 of the suction stroke, a partial vacuum is created in the cylinder, with the result of opening the check valve 28 to admit pure air through the inlet port 19. As the piston continues its downward motion, the cam 15 will open the main inlet valve 4, thereby reducing the vacuum in the cylinder and admitting a charge of carbureted air from the carburetor 7 and intake pipe 6. The
 100 spring 31 (Fig. II) can be so adjusted that it will close the auxiliary inlet valve 28 when the large inlet valve 4 is open, and if this adjustment is made, the operation during each suction stroke will be substantially as follows:
 105

During the first part of the suction stroke, while the main valves are closed, pure air will be drawn through the auxiliary inlet port 19, so as to displace and commingle with the burnt residual gases in the upper portion of the cylinder. Thereafter, as the piston continues its downward motion, the main inlet valve 4 will be open to admit the charge of carbureted air through the main inlet port 2 and while this charge is passing into the cylinder, the auxiliary valve 28 will be closed.
 115

The flow of auxiliary air can be regulated, or shut off, by the manually controlled valve 22 between the automatic check valve 28 and the auxiliary inlet port 19.
 125

I claim:

1. A four cycle internal combustion engine provided with a cylinder, a piston in
 130

said cylinder, said cylinder having a main inlet port for the admission of the combustible charge, a main inlet valve adapted to open and close said main inlet port, an exhaust port, a valve adapted to open and close said exhaust port, an auxiliary air inlet port being formed through a portion of the cylinder to provide for the admission of air to the interior of the cylinder, an auxiliary air valve adapted to close said air inlet, valve operating means whereby said main inlet valve is held in a closed position during the beginning of the suction stroke of the piston so as to create a partial vacuum in the cylinder, said auxiliary air valve being adapted to be actuated to permit the passage of air through said auxiliary port during the beginning only of the suction stroke of the piston and while said intake and exhaust valves are closed, and means whereby said auxiliary air valve is closed in response to the opening movement of the main inlet valve, the last mentioned means being yieldable to permit opening of the auxiliary air valve in response to said partial vacuum.

2. A four cycle internal combustion engine provided with a cylinder, a piston in said cylinder, said cylinder having a main inlet port for the admission of the combustible charge, a main inlet valve adapted to open and close said main inlet port, an exhaust port, a valve adapted to open and close said exhaust port, an auxiliary air inlet port being formed through a portion of the cylinder to provide for the admission of air to the interior of the cylinder, an auxiliary air valve adapted to close said air inlet, a spring tending to retain said auxiliary air valve in its closed position, said spring and air valve being yieldable in response to a partial vacuum in the cylinder to admit air to the interior of the cylinder during the beginning only of the suction stroke of the piston and while said inlet and exhaust valves are closed, and means whereby said spring is adjusted to close said auxiliary air valve in response to the opening movement of said main inlet valve.

3. A four cycle internal combustion engine provided with a cylinder, a piston in said cylinder, said cylinder having a main inlet port for the admission of the combustible

charge, a main inlet valve adapted to open and close said main inlet port, an exhaust port, a valve adapted to open and close said exhaust port, an auxiliary air inlet port being formed through a portion of the cylinder to provide for the admission of air to the interior of the cylinder, an auxiliary air valve adapted to close said air inlet, valve operating means whereby said main inlet valve is held in its closed position during the beginning of the suction stroke of the piston so as to create a partial vacuum in the cylinder, a spring tending to retain said auxiliary air valve in its closed position, said spring and air valve being yieldable in response to said partial vacuum to admit air to the interior of the cylinder during the beginning only of the suction stroke of the piston and while said inlet and exhaust valves are closed, means whereby said spring is adjusted to close said air valve in response to the opening movement of said main inlet valve and a manually operated valve movable to close said auxiliary inlet to prevent the admission of air therethrough.

4. A four cycle internal combustion engine having a cylinder provided with an exhaust port and a main inlet port for the admission of carbureted air, a portion of said cylinder being provided with a restricted air inlet passageway for the admission of air alone, a main inlet valve adapted to close said main inlet port, a carburetor communicating with said main inlet valve, an exhaust valve adapted to close said exhaust port, a piston in said cylinder, valve operating means actuated by said piston to open and close said valves, said valve operating means being so timed that the main inlet valve is closed during the first part of the suction stroke of the piston, a check valve in said restricted air inlet passageway, said check valve being movable to its open position in response to a partial vacuum in the cylinder during the beginning only of the suction stroke of the piston and while said inlet and exhaust valves are closed, and a spring whereby said check valve is closed in response to the opening movement of said main inlet valve.

In testimony that I claim the foregoing I hereunto affix my signature.

BENJAMIN L. CAMPBELL.