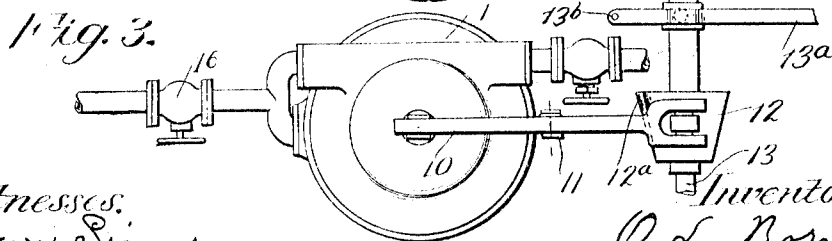
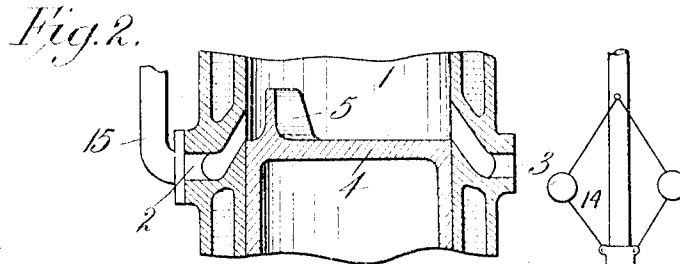
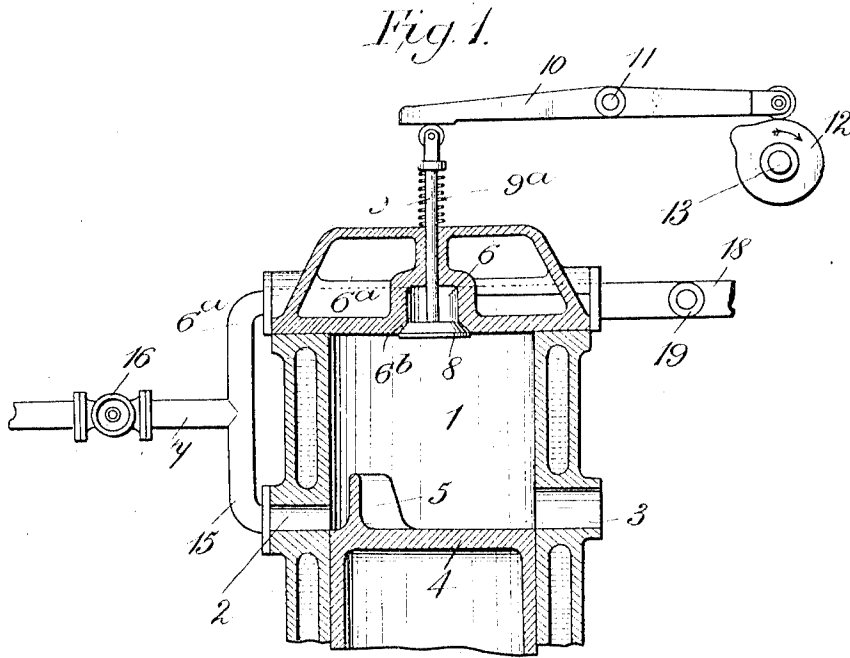


O. L. BORNER.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED SEPT. 23, 1907.

1,004,979.

Patented Oct. 3, 1911.



Witnesses:
W. Henry Simms
Frederick Hogue

Inventor
O. L. Borner
By W. Lyndwise
Attorney

UNITED STATES PATENT OFFICE.

OTTO LEO BORNER, OF LONDON, ENGLAND.

INTERNAL-COMBUSTION ENGINE.

1,604,979.

Specification of Letters Patent.

Patented Oct. 3, 1911.

Application filed September 23, 1907. Serial No. 394,087.

To all whom it may concern:

Be it known that I, OTTO LEO BORNER, a citizen of the Republic of Switzerland, residing at London, England, have invented 5 Improvements in or Relating to Internal-Combustion Engines, of which the following is a specification.

This invention relates to internal combustion engines operating on a two-stroke cycle.

10 In many forms of engine of this type, the exhaust port in the engine cylinder has been arranged more or less in line with and opposite the air and gas inlet port or ports so that with the aid of a deflector upon the 15 engine piston, either the air or gas, or both, has or have been caused to encounter the products of combustion at the time the exhaust port remains open, the object being to cause the entering charge to assist in expelling the products of combustion without becoming materially commingled therewith. 20 Under existing arrangements however it has been found that the said deflector does not insure the whole of the products of combustion being swept out of the cylinder, that is to say, the entering charge of air or gas, or both, tends to rush directly to and through the exhaust port without entirely displacing the products of combustion of the previous charge with the result that there is 30 not only a loss of useful working mixture or charge but an incomplete expulsion of the products of combustion, both of which constitute serious disadvantages. With a view of expelling the products of combustion, it has also been proposed to divide the inner or combustion chamber end of the engine cylinder with an inlet port that is connected to a compressed air chamber and controlled 40 by a spring loaded valve arranged to open automatically under the pressure of the air thereon immediately the pressure of the products of combustion in the cylinder falls sufficiently below the air pressure, as upon the opening of the exhaust port, so as to admit a scavenger charge of air to the cylinder after each explosion before the opening of the gas or charge inlet port controlled by the engine piston. For a like purpose, it has been proposed to construct the inner end of the engine cylinder with a constantly open inlet port provided with a deflector and connected by a passage to a compressed charge reservoir having uncon- 55 trolled spring loaded outlet valves, the arrangement being such that part of the com-

pressed charge will be introduced into the engine cylinder through the said inlet port and the remaining portion of the charge be simultaneously introduced through an inlet 60 port uncovered by the piston when at or near the limit of its out stroke. These known arrangements do not however enable the time at which the charge is introduced through the inlet port at the inner end of the cylinder to be varied relatively to the 65 time at which the remainder of the charge is admitted through the port controlled by the piston and therefore do not enable the working of the engine to be varied to suit 70 different working requirements.

The object of the present invention is to overcome the objections just referred to and at the same time enable the means employed for this purpose to be used in starting the 75 engine in a simple and efficient manner. For this purpose, products of combustion resulting from the combustion of a previous charge are expelled from the engine cylinder and replaced by a fresh charge at any 80 desired pressure by introducing part of the charge through a main inlet or inlets controlled by the engine piston and introducing the remainder of the charge at a later 85 stage through one or more auxiliary inlets controlled or each controlled by a valve that is positively opened at the required time by a moving part of the engine. To attain the desired end, the combustible charge, under pressure, may be partially introduced 90 through an inlet or inlets arranged in line with and opposite the exhaust port as hitherto, while the remainder of the charge is introduced through one or more auxiliary valve-controlled inlets arranged to cause a 95 fluid flow which is more or less perpendicular or at an angle to the path between the main inlet or inlets and exhaust port. A deflector is provided upon the piston as before, and the whole arrangement is such 100 that the auxiliary charge inlet or inlets is or are opened slightly in advance of the closing of the main inlet or inlets so that a sweeping movement of the waste gases toward the exhaust will be initiated by the charge entering at the main inlet or inlets 105 and be completed by the action of that portion of the charge entering through the auxiliary inlet or inlets.

Obviously, in lieu of dividing the combustible charge as suggested, it might be 110 convenient or desirable to cause the com-

bustible to enter at the main inlet or inlets and the air at the auxiliary inlet or inlets, or vice versa, while naturally the timing of the instants at which the several inlets should open with respect to the opening or closing of the exhaust port will be determined to suit different requirements. For instance, in this way the richness of the combustible charge can be regulated.

By varying the instant at which the auxiliary inlet or inlets may be closed, it is possible to cause the cylinder to receive a charge which is proportionate in its volume to the load upon the engine. Thus, if a governor be employed to control the said auxiliary valve or valves, the latter may be arranged to be closed concurrently with or soon after the closing of the exhaust port to enable the whole of the contents of the cylinder, whether the same be at atmospheric pressure or at some higher pressure, to be compressed for heavy loads, or, if the closing of the auxiliary valve or valves be delayed to an instant occurring later in the travel of the piston, a portion of the admitted charge will be returned through the auxiliary inlet or inlets, resulting in a reduced volume to be compressed, suitable for light loads.

The auxiliary valve or valves constitute a convenient means whereby the engine can either be assisted in starting or started. For instance, the said valve or valves may be timed to remain open until nearly the completion of the return stroke of the piston thereby substantially eliminating compression on such stroke and therefore enabling the engine to be started with compressed air or other fluid at a comparatively low pressure. Any suitable or known means, adapted to be operated either manually or automatically, are in this case, provided whereby, when the desired speed has been attained, the valve operating mechanism can be adjusted to cause the operation of the engine to be continued in the manner first described.

By way of illustration, one construction and arrangement of parts suitable for the carrying out of the invention is illustrated diagrammatically in Figure 1 of the accompanying drawings which is a part sectional elevation of a portion of the cylinder, piston, valve operating means and other parts of a vertical internal combustion engine. Fig. 2 shows a modified construction. Fig. 3 is a part plan view of the valve operating lever and cam shown in Fig. 1 together with a governor and a hand lever for moving the cam endwise for timing the action of the supplementary inlet valve.

As shown in Fig. 1, a jacketed cylinder 1 of ordinary construction is provided with a main inlet passage 2 and, directly opposite, with an exhaust passage 3, the lower side of the said passages being both substantially in the same plane as the top of the piston 4

when the latter is in its lowest position or end of its outward or working stroke, as in known construction of internal combustion engines. 5 is the ordinary deflector upon the top of the piston 4 for diverting the flow of the charge as it enters the cylinder through the main inlet passage 2, which may be arranged either horizontally as shown in Fig. 1, or at an angle to the center line of the cylinder as shown in Fig. 2. The latter arrangement will cause the entering charge to flow in the direction of the top of the cylinder and therefore assists the movement produced by the deflector 5. Within the top cover 1^a of the cylinder is an auxiliary inlet 6 that is connected, as through a pipe or passage 6^a and a main supply pipe 7, to the chamber or other device from which the charge to be used is obtained. The inlet 6 is provided with a seating 6^b and a co-acting valve 8 the stem 9 of which is arranged to be moved inward against the action of a spring 9^a to open the valve by a suitable moving part of the engine in any appropriate way, as for instance by a rocking lever 10 which is pivoted at 11 and adapted to be oscillated by a cam 12 which is arranged to be rotated by a rotary shaft 13 and is made of suitable shape for the purpose hereinbefore mentioned.

The arrangement of lever 10 and cam 12 shown diagrammatically in Fig. 1, can be of any of the ordinary well known kinds now commonly used in gas and oil engines for varying the time and extent of opening of a valve for controlling the admission of each combustible charge to the engine cylinder, the said cam having an inclined or spirally arranged cam projection 12^a and being arranged to be moved endwise on the shaft 13 by a hand operated lever 13^a pivoted at 13^b, and also automatically by a governor 14 mounted upon and driven by the said shaft, as well understood and as more clearly shown in Fig. 3. The spring 9^a is made sufficiently powerful to hold the valve 8 closed against any fluid pressure coming in contact therewith, so that the valve can only be positively opened by the lever 10 or equivalent at the required time. Leading from the supply pipe 7 is a branch pipe 15 that is connected to the main inlet passage 2. On the main supply pipe 7 is a regulating cock or valve 16 which may be operated either manually, as by a hand wheel or automatically by a governor driven from the engine and adjusted so as only to come into action as and when required.

With the arrangement described, it will be understood from what has been previously herein set forth, that the products of combustion left within the engine cylinder at the end of the working stroke will be acted upon more efficiently than was possible with the old arrangements. With the

particular arrangement illustrated, the said products are first acted upon by the charge entering at the main inlet 2 and thereafter by the charge entering at the inlet 6. past the valve 8.

By varying the times at which the valve 8 is opened and closed by suitable endwise adjustment of the cam 12, a smaller or larger quantity of air, gas or combustible at atmospheric pressure, or at a higher pressure, can be admitted, whereby the power of the engine can be regulated, or the starting thereof can be effected, in the manner hereinafore described. To facilitate the starting of the engine, the valve 8 is opened, it may be by raising the outer arm of the lever 10 by hand or otherwise and raising the piston 4, the fluid in the cylinder then escaping through the pipe 6^a and valve 16 which is then open. Upon the piston arriving at the end of its upstroke, the valve 16 is closed and a valve 19 on a compressed air supply pipe 18 is opened to admit compressed air through the port 6 to cause the return of the piston, these operations being repeated until the desired speed of the engine is attained when the valve 19 is finally closed, the valve 16 left open and the lever 10 released and allowed to assume its normal position.

The details of construction can be variously modified to suit the particular engine to which the invention is to be applied, the foregoing showing only one of several ways of carrying the same into effect.

What I claim is—

1. Means for expelling products of combustion from a two stroke cycle internal combustion engine, comprising a main inlet through which part of the charge is admitted to the engine cylinder, an auxiliary inlet through which the remainder of the charge is admitted at predetermined variable times and separate means for controlling said inlets.

2. Means for expelling products of combustion from a two stroke cycle internal combustion engine, comprising a cylinder having a main inlet through which part of the charge is admitted to the cylinder, an auxiliary inlet through which the remainder of the charge is introduced, separate means for controlling said inlets and governor operated means adapted to actuate the controlling means for the auxiliary inlet so as to open such inlet at predetermined variable times after the main inlet has been opened and similarly to close it at predetermined variable times after the main inlet has been closed.

3. Means for expelling products of combustion from a two stroke cycle internal combustion engine, comprising a cylinder having a main inlet through which part of the charge is introduced and an auxiliary inlet the opening and closing of which is posi-

tively effected by means capable of time variation in operation and through which the remainder of the charge is introduced.

4. Means for expelling products of combustion from a two stroke cycle internal combustion engine, comprising a cylinder having a main inlet uncovered by the engine piston at the end of the working stroke and through which part of the charge is introduced and an auxiliary inlet through which the remainder of the charge is introduced and means whereby the auxiliary inlet can be opened at predetermined variable times after the main inlet has been opened, and similarly closed at predetermined variable times after the main inlet has been closed.

5. Means for expelling products of combustion from a two stroke cycle internal combustion engine, comprising a cylinder having a main inlet uncovered by the engine piston at the end of the working stroke and through which part of the charge is introduced, and an auxiliary opening through which the remainder of the charge is introduced at a later stage with a direction of flow different to that of the flow of the main portion of the charge, and means capable of time variation in operation for positively opening and closing said auxiliary inlet.

6. Means for expelling products of combustion from a two stroke cycle internal combustion engine, comprising a cylinder having in its wall an inlet arranged to be opened as the engine piston approaches the end of its working stroke and through which part of the charge is introduced and an inlet in one of its ends through which the remainder of the charge is introduced at a later stage, and governor controlled means for positively controlling the latter inlet.

7. Means for expelling products of combustion from a two stroke cycle internal combustion engine, comprising a cylinder having in its wall a main inlet arranged opposite to an exhaust outlet, controlled by the engine piston and through which part of the charge is introduced and an inlet in one of its ends through which the remainder of the charge is introduced at a later stage in a direction to divert the natural direction of flow of the charge admitted through the main inlet, and governor controlled means for positively controlling the latter inlet.

8. In an internal combustion engine operating on a two stroke cycle, means for expelling products of combustion from the engine cylinder and replacing them by a fresh charge at any desired pressure, comprising a main inlet or inlets controlled by the engine piston and through which part of the charge is introduced and an auxiliary valve controlled inlet or inlets through

which the remainder of the charge is introduced, so that a sweeping movement of the products of combustion toward the exhaust will be initiated by the portion of the charge entering at the main inlet or inlets and be completed by the portion of the charge entering by the auxiliary inlet or inlets and governor controlled means for positively opening said auxiliary inlet valve at the required times, substantially as described.

9. In an internal combustion engine operating on a two stroke cycle, a cylinder having diametrically opposed charge inlet and exhaust openings and an auxiliary inlet in the end thereof, a source of fuel supply and a source of compressed air, means for alternatively establishing communication between the said auxiliary inlet and either of such sources and means capable of time

variation in operation for opening and closing the auxiliary inlet, while in communication with the fuel source.

10. In an internal combustion engine operating on a two stroke cycle, a cylinder having a main inlet passage opposite to the exhaust port and one or more auxiliary valve controlled inlets and valve operating means whereby the time instants of opening and closing of the said auxiliary inlets can be determined or varied substantially as hereinbefore described, whereby the engine can be regulated or started as set forth.

Signed at London England this 14th day of September 1907.

OTTO LEO BORNER.

Witnesses:

ARTHUR WOOSNAM,
T. J. BROUGHAM.