A. E. OSBORN.

INTERNAL COMBUSTION ENGINE.

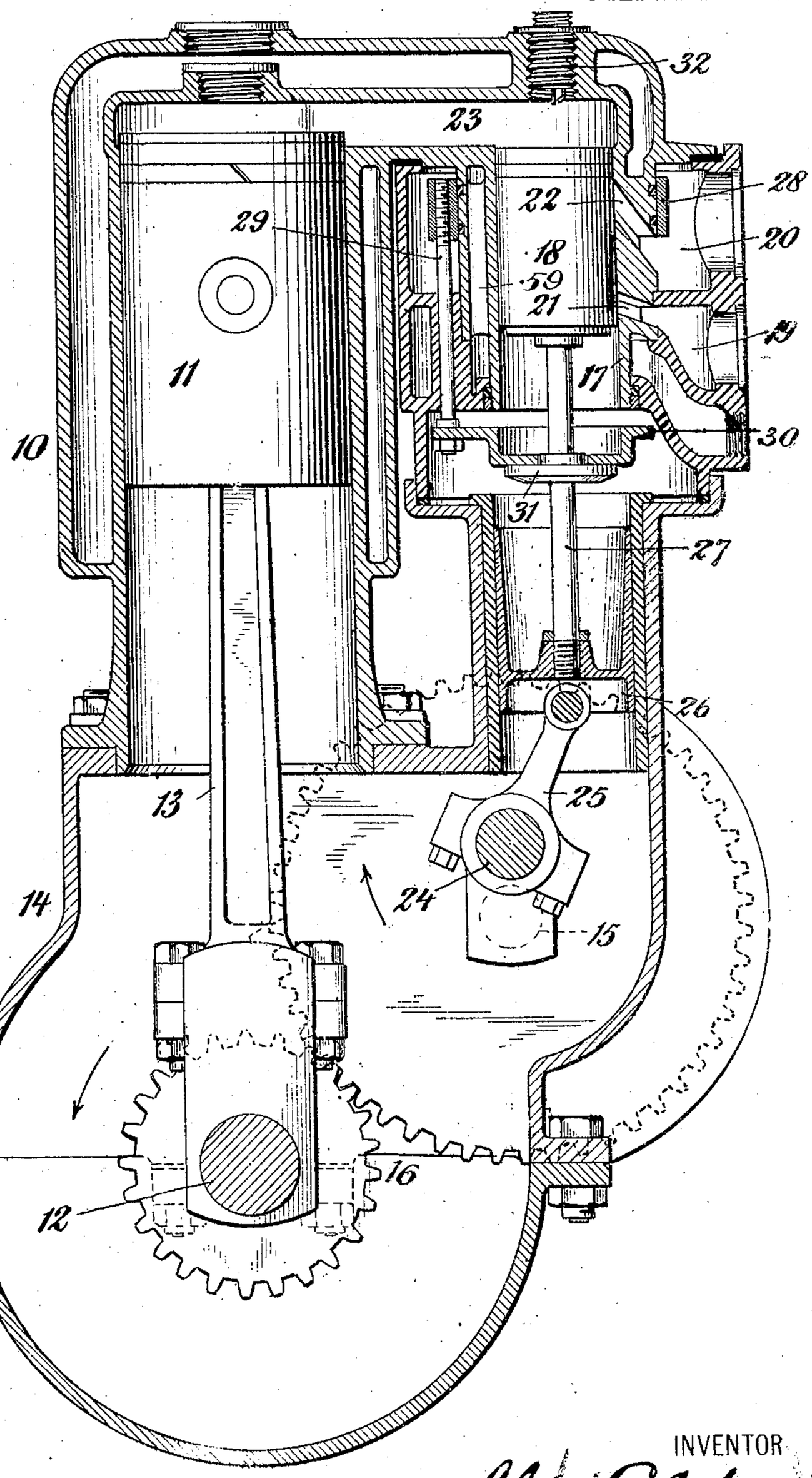
APPLICATION FILED MAR. 21, 1910.

985,198.

Patented Feb. 28, 1911.

3 SHEETS—SHEET 1.

Fig. 1.



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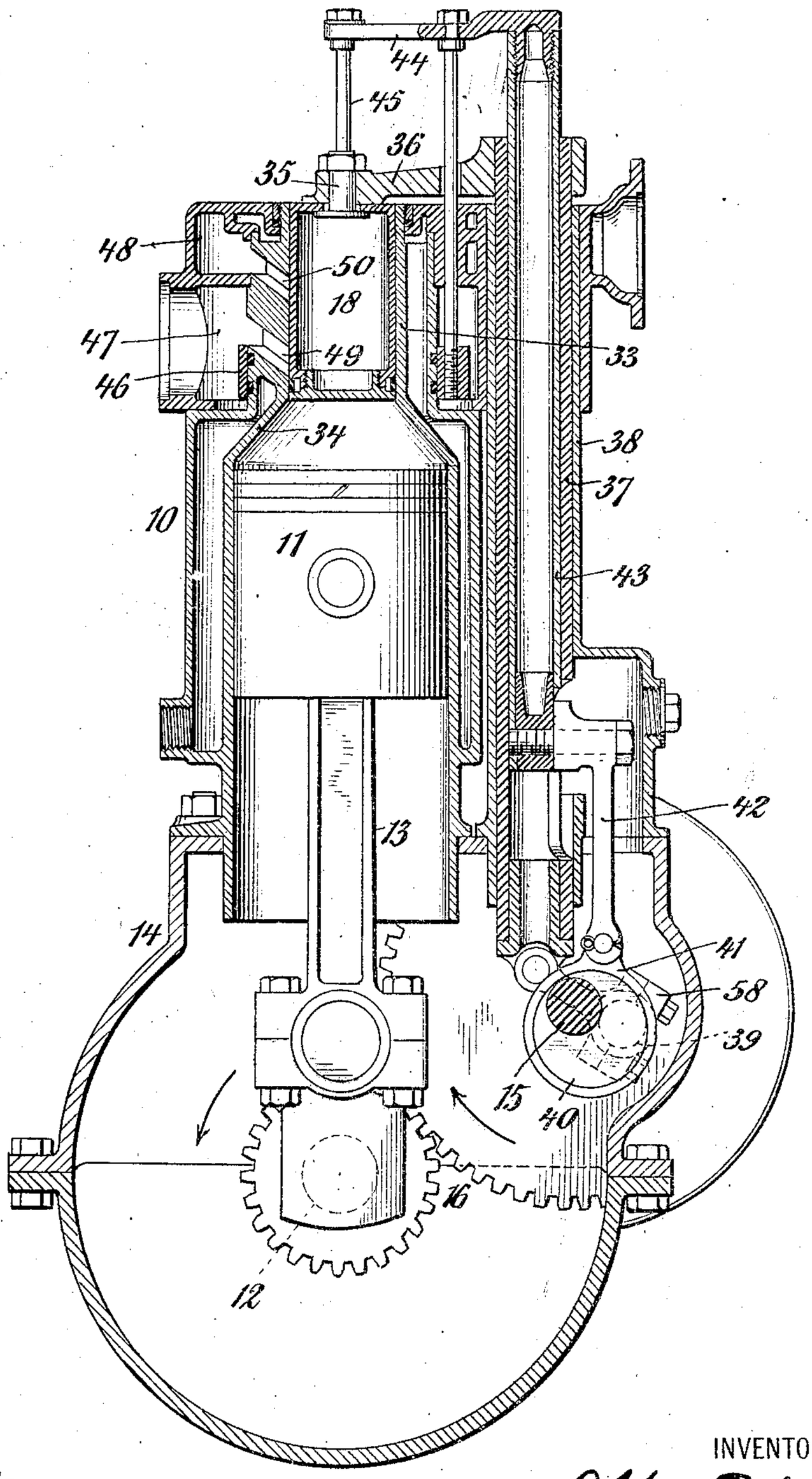
3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

44

Fig. 3,

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INTERNAL-COMBUSTION ENGINE.

985,198. Specification of Letters Patent. Patented Feb. 28, 1911.

Application filed March 21, 1910. Serial No. 550,709.

To all whom it may concern:

Be it known that I, ALDEN E. OSBORN, a citizen of the United States of America, and a resident of New York, county and State of New York, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

My invention relates to improvements in internal combustion engines, and particularly to improvements in valve mechanism therefor.

In two co-pending applications serially numbered 505,860 and 548,748, and filed respectively on the 3rd day of July, 1909, and the 11th day of March, 1910, I have shown, described, and claimed certain forms of valve mechanism in which a distributing passage is controlled upon one side by a main valve to connect the same with the working cylinder, and upon the other side by a distributing valve to connect the same alternately with inlet and exhaust chambers.

In my present invention I employ a valve chamber having separate passages connecting respectively with the inlet and exhaust chambers, a main valve for controlling one end of both of these passages, and a secondary valve for controlling the opposite end of one of them. The secondary valve may be employed in connection with either the inlet or the exhaust passage, as will presently be shown, the other passage being constantly open to the chamber with which it connects except as it is controlled at its other end by means of the main valve.

The object of my invention is to provide a simple and efficient form of positively operated valve mechanism for internal combustion engines in lieu of the commonly employed spring-closed and cam-opened puppet valves.

In order that my invention may be thoroughly understood, I will now proceed to describe certain embodiments thereof, having reference to the accompanying drawings illustrating the same, and will then point out the novel features in claims.

In the drawings: Figure 1 is a view in central vertical section through an internal combustion engine provided with a valve mechanism constructed in accordance with my invention. Fig. 2 is a similar view of an engine provided with a valve mechanism of somewhat different form but constituting another embodiment of my invention. Fig. 3 is a similar view of an engine having a valve mechanism of still further modified construction but likewise constituting an embodiment of my invention.

I will refer first of all to the construction shown in Fig. 1 and which in general form is similar to the type of valve mechanism disclosed in the co-pending application Serial Number 505,860, filed July 3, 1909, above referred to. The engine comprises the usual working cylinder 10, working piston 11 therein, crank shaft 12, connecting rod 13 connecting the said piston with the said crank shaft, crank casing 14 inclosing the said connecting rod and crank shaft, and valve operating shaft 15 connected by gearing 16 with the said crank shaft 12 and arranged to rotate once for every two revolutions of the shaft 12. Located in proximity to the cylinder 10 is a valve casing including a tubular member 17 within which is mounted a reciprocating piston valve 18. Surrounding the tubular member is an inlet chamber 19 and an exhaust chamber 20, the former being in communication with the interior of the valve chamber through a passage 21 in the walls thereof, and the latter in similar communication through another passage 22 therein. The piston valve 18 is arranged to over-ride the inner end of the two passages 21 and 22 and hence controls the same and their connection, with the engine cylinder 10, the valve chamber communicating with the said working cylinder through a cross-over passage 23. The said main valve 18 is operated by means of an eccentric crank pin 24 upon the valve operating shaft 15, the same being connected therewith through a suitable connecting element 25 in engagement with the eccentric crank pin 24 and pivotally connected with a tubular cross head 26 secured to a rod 27 which is in turn connected at its opposite end with the valve 18. The throw of the eccentric pin 24 is sufficient to cause the valve 18 to uncover and cover both of the passages 21 and 22 in the operation of the engine, the exhaust passage 22 being first uncovered in the downward movement of the valve 18, and thereafter the inlet passage 21. The center of the valve operating shaft 15 is preferably offset with respect to a line in the path of

movement of the axis of the pivotal connection between the connecting element 25 and the cross head 26, whereby the angular movement of the valve operating shaft when moving the valve in one direction will be greater than when moving it in the other. When the parts are rotating in the direction indicated by the arrow in Fig. 1, the angular movement of the shaft 15 will be greater when moving the valve 18 downward than when moving it upward, whereby the valve will move downward slower than it will move upward.

Surrounding the tubular valve casing member 17 at the upper end thereof and within the exhaust chamber 20, is an annular valve 28 (hereinafter referred to as the secondary or exhaust valve). This valve is arranged to control the end of the passage 22 where it communicates with the exhaust chamber 20. The said valve is connected through one or more rods 29 with an operating head 30, the said operating head being arranged to surround the main valve rod 27. When the main valve 18 descends it will, near the limit of its downward movement, reach and engage the head 30, and thereafter upon the completion of its downward movement it will move the said head downward with it, carrying with it the exhaust valve 28, whereby the said valve will be caused to close the exhaust passage 22. After the main valve has completed its downward movement it will move upward freely until it approaches the limit of its upward movement. At this point the head 30 will be engaged by a collar 31 with which the valve rod 27 is provided, whereby in the completion of the upward movement of the said main valve the exhaust valve will be carried upward with it to again open the exhaust passage 22, the valve being finally returned to the position in which it is shown in Fig. 1.

From the foregoing the operation of the engine will be readily understood. With the parts in the position in which they are shown, a compressed charge is contained within the upper end of the working cylinder 10 and the cross-over passage 23, and ignition thereof being effected through the spark plug, the piston will commence to move downward in a working stroke. The crank shaft 12 will rotate in the direction of the arrow, while the valve operating shaft will rotate therewith at half the speed thereof in the opposite direction. As the piston 11 moves downward the main valve 18 will move downward until near the lower end of the working stroke, and after the gases in the cylinder 10 have expended the greater portion of their energy the valve 18, will commence to uncover the passage 22 whereby to permit the spent gases to exhaust. During the next upward movement of the main piston the valve 18 will continue its downward movement until, near the extremity thereof and about the extremity of the upward movement of the piston 11, the exhaust valve 28 will be moved downward to close the exhaust passage 22 and the inlet passage 21 will be uncovered. As the main piston moves downward in its next stroke, a fresh charge will be drawn in through the inlet passage 21 until as the main piston nears the lower extremity of such stroke and a full charge has been introduced into the cylinder, the valve 18 will close the passage 21 in its return stroke, while in the return stroke of the main piston 11 to compress the charge the valve 18 will be somewhat rapidly moved upward to complete its return stroke, during the latter portion of which the said valve 18 will close the inner end of the exhaust passage 28 while at the same time moving the exhaust valve 28 upward to open the outer end thereof so that the parts will be in position to permit free escape of the spent gases through the exhaust passage 22 when the valve 18 next moves downward to uncover the inner end thereof. The main piston 11 and the main valve 18 reach the upper end of their strokes at about the same time, and at this point a cycle of operation of the engine will have been completed, and the ignition of the gases compressed by the last upward movement of the main piston taking place, a new cycle of operation will commence.

In Fig. 2 I have shown a form of engine similar to that shown in the second said copending application above referred to, namely, application Serial Number 548,748 filed March 11, 1910. In this form of engine the main valve chamber is arranged as an extension of the upper end of the working cylinder 10 instead of being arranged alongside thereof as in Fig. 1, and the main and secondary valves are each operated by independent eccentrics or crank pins instead of the secondary valve being operated directly by the main valve at the extremity of its movements in either direction. In Fig. 2 a tubular valve casing member 33, corresponding to the member 17 of Fig. 1, is connected with the main cylinder 10 by a reducing neck 34, the main valve 18 therein being thus in line with the piston 11. The main valve is connected by suitable connecting means 35 with a head 36 secured at the upper end of a tubular slide 37 mounted to reciprocate in a tubular guideway 38 secured to, or formed as a part of, the engine casing. The slide 37 is connected by means of a connecting element 55 with an eccentric pin 39 upon the shaft 15, corresponding to the eccentric pin 24 of the construction shown in Fig. 1. The shaft 15 is provided with a second eccentric 40 which is connected by means of a suitable connecting element 41

with an extension 42 rigidly secured to a second tubular slide 43 mounted within the first said tubular slide 37, the said tubular slide 43 having a head 44 at the upper end thereof which is connected by suitable rods or similar connecting elements 45 with the secondary or exhaust valve 46, the said valve corresponding to the valve 28 of the construction shown in Fig. 1. As a matter of convenience in this construction the exhaust chamber 47 is located beneath the inlet chamber 48, the exhaust passage 49 through the tubular valve casing member 33 being correspondingly arranged below the inlet passage 50. The foregoing is for the reason that the lower end of the valve casing in this instance connects with the working cylinder 10 instead of the upper end as in the construction in Fig. 1. The axial center of the shaft 15 is so disposed with respect to the parts reciprocated by the eccentrics thereon, and the eccentrics are so disposed upon the shaft with respect to each other and are arranged to have such a throw, as to properly move the main and secondary valves to bring about the proper control of the passages. In general, the pivotal connections between the eccentric connecting elements and the slides are located out of line with each other and upon opposite sides of a plane containing the axis of the shaft 15, the paths of movement of the said pivotal connections being parallel with the said planes. By this means each of the said valves is moved faster in one direction than in the other, the faster movement of one valve being in an opposite direction to that of the other. The eccentric 40 is, furthermore, arranged upon the shaft 15 angularly somewhat in advance of the eccentric 39, and the throw of the eccentric 39 is considerably greater than that of the eccentric 40. In general, the foregoing results in the following operation of the valves with respect to the movement of the working piston. With the parts in the position shown, the working piston is about to commence a working stroke. As the main piston moves downward in its working stroke the valve 18 will move slowly upward until as the piston reaches a point near the completion of its downward movement the inner end of the said passage 49 will be uncovered by the valve 18 and the spent gases will commence to exhaust. This exhausting will continue as the piston moves upward upon its return stroke, until, as it reaches the upper end of its stroke, the secondary valve 46 will close the outer end of the exhaust passage 49 to close the cylinder to exhaust. In the meantime the valve 18 will have moved upward so that as the piston 11 again commences its downward stroke the inlet passage 15 will be opened by the valve 18 to permit a fresh charge to be drawn into the cylinder therethrough. This will continue while the piston 11 moves downward, the valve 18 in the meantime moving to its upper extremity and then commencing to move downward until as the piston 11 reaches the extremity of its downward movement the valve 18 will have moved downward to a position to just close the passage 50. Thereafter, as the piston 11 rises to compress the fresh charge, the valve 18 will move downward to close the inner end of the passage 49, and just as the inner end of the said passage is closed the valve 46 will begin to open so that when the piston 11 reaches the upper extremity of its compression stroke the valve 46 will have moved downward to fully open the outer end of the passage 49, ready for the next time the main valve 18 moves upward to uncover the inner end thereof. The cycle of the operation is now completed and the parts are now back in their former positions in which they are shown in Fig. 2, ready for another working stroke.

In both the constructions above described, it will be seen that I provide two passages both of which are controlled at their inner end, and one of which is controlled at its outer end. Thus, one of the said passages is controlled by two valves and it is necessary that both of the said valves be moved to a position to uncover the passage in order that gases may pass therethrough, while in the case of the other passage the uncovering thereof by one valve is all that is necessary to completely control it. In the broad aspect of my invention it is immaterial whether the passage controlled by the two valves be the exhaust passage or the inlet passage, and while I have shown the exhaust passage as so controlled in the two examples of my invention so far described, I have illustrated another form in Fig. 3, in which the inlet passage is thus included.

In general, the construction of Fig. 3 is similar to that of Fig. 2, in that the casing member is formed in line with, and as an extension of, the main cylinder 10, but the inlet chamber 51 is located beneath the exhaust chamber 52, and similarly, the inlet passage 53 is located beneath the exhaust passage 54. Moreover, the secondary valve 55 is arranged in the inlet chamber 51, being disposed in a position to control the outer end of the inlet passage 53. The main valve 18 is connected through a head 36 and tubular slide 37 with a tubular cross-head 56 which is in turn connected by a suitable connecting element 57 with the eccentric 37 upon the valve operating shaft 15, while the secondary valve 55 is connected through the rods 45, head 44, tubular slide 43, extension 42, and connecting element 41 with the eccentric 40. In this case in order to obtain the proper relationship of movement of the parts

the eccentric element 57 with which the cross head 56 is connected, is below the shaft 15 instead of above it as in the structure of Fig. 2, and the eccentric 35 is arranged upon the shaft angularly in advance of the eccentric 40 instead of angularly in the rear thereof as in the structure of Fig. 2. I also prefer to give a somewhat proportionately longer throw to the main valve 18, but the various positions of the parts with respect to each other and the proportionate movements given to the valves may, of course, be varied to suit different conditions. In this construction the main valve will move upward to first uncover the inlet port and then the exhaust, but while the inlet port is uncovered and prior to the re-covering of the exhaust port, the secondary valve 55 will keep the outer end of the inlet passage 53 closed. Thereafter, at the time of the movement of the piston 11 to draw in a fresh charge, which will be after the valve 18 has moved downward to cover the passage 54 but before it has reached the passage 53, the valve 55 will be lifted to uncover the outer end of the said passage whereby to permit a fresh charge to pass therethrough. Then during the compression stroke the main valve will continue to move downward and the secondary valve will return to the position in which it is shown in Fig. 3 to close the outer end of the said passage so that when the valve 18 rises to again uncover the exhaust passage 54, the inlet passage will be maintained in a closed condition by the said inlet valve 55.

What I claim is:

1. In an internal combustion engine, the combination with a valve casing having separate inlet and exhaust passages therethrough arranged the one in advance of the other, of a valve arranged to control one end of both the said passages and in its movement to over-ride them successively, and a secondary valve for controlling the other end of one of the said passages.

2. In an internal combustion engine, the combination with a valve casing having separate inlet and exhaust passages therethrough arranged the one in advance of the other, of a valve arranged to control one end of both the said passage and in its movement to over-ride them successively, and a secondary valve for controlling the other end of the said exhaust passage.

3. In an internal combustion engine, the combination with a tubular valve casing having separate inlet and exhaust passages through the walls thereof, of a main valve arranged within the said valve casing to control the inner end of both of the said passages, and a tubular secondary valve arranged around the said tubular valve casing for controlling the outer end of one of the said passages.

4. In an internal combustion engine, the combination with a valve casing having separate inlet and exhaust passages therethrough, of a slide valve arranged to control one end of both the said passages, means for reciprocating the said slide valve, and a secondary valve for controlling the other end of one of the said passages.

5. In an internal combustion engine, the combination with a valve casing having separate inlet and exhaust passages therethrough, of a slide valve arranged to control one end of both of the said passages, a secondary slide valve for controlling the other end of one of the said passages, and means for reciprocating the said valves.

6. In an internal combustion engine, the combination with a tubular valve casing having separate inlet and exhaust passages through the walls thereof, of a piston valve arranged within the valve casing to control the inner end of both of the said valve passages, means for reciprocating the said piston valve, and a tubular secondary valve arranged around the said tubular valve casing for controlling the outer end of one of the said passages.

7. In an internal combustion engine, the combination with a tubular valve casing having separate inlet and exhaust passages through the walls thereof, of a piston valve arranged within the said valve casing to control the inner end of both of the said passages, a tubular secondary valve arranged around the said tubular valve casing for controlling the outer end of one of the said passages, and means for reciprocating the said valves.

8. In an internal combustion engine, the combination with a valve casing having separate inlet and exhaust passages therethrough arranged the one in advance of the other, of a valve arranged to control one end of both the said valve passages and in its movement to over-ride them successively, a secondary valve for controlling the other end of one of the said passages, and valve operating means including a shaft, an eccentric thereon, and means directly connecting the said eccentric with one of the said valves.

9. In an internal combustion engine, the combination with a valve casing having separate inlet and exhaust passages therethrough arranged the one in advance of the other, of a valve arranged to control one end of both the said passages and in its movement to over-ride them successively, a secondary valve for controlling the other end of one of the said passages, and valve operating means including a shaft, eccentrics thereon, and means directly connecting the said eccentrics with the said valves.

10. In an internal combustion engine, the combination with a valve casing having separate inlet and exhaust passages there-

through, of a valve arranged to control one end of both the said passages, a secondary valve for controlling the other end of one of the said passages, and valve operating means including a shaft, eccentrics thereon, and means directly connecting the said eccentrics with the said valves, one of the said eccentrics being arranged upon the shaft angularly in advance of the other.

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