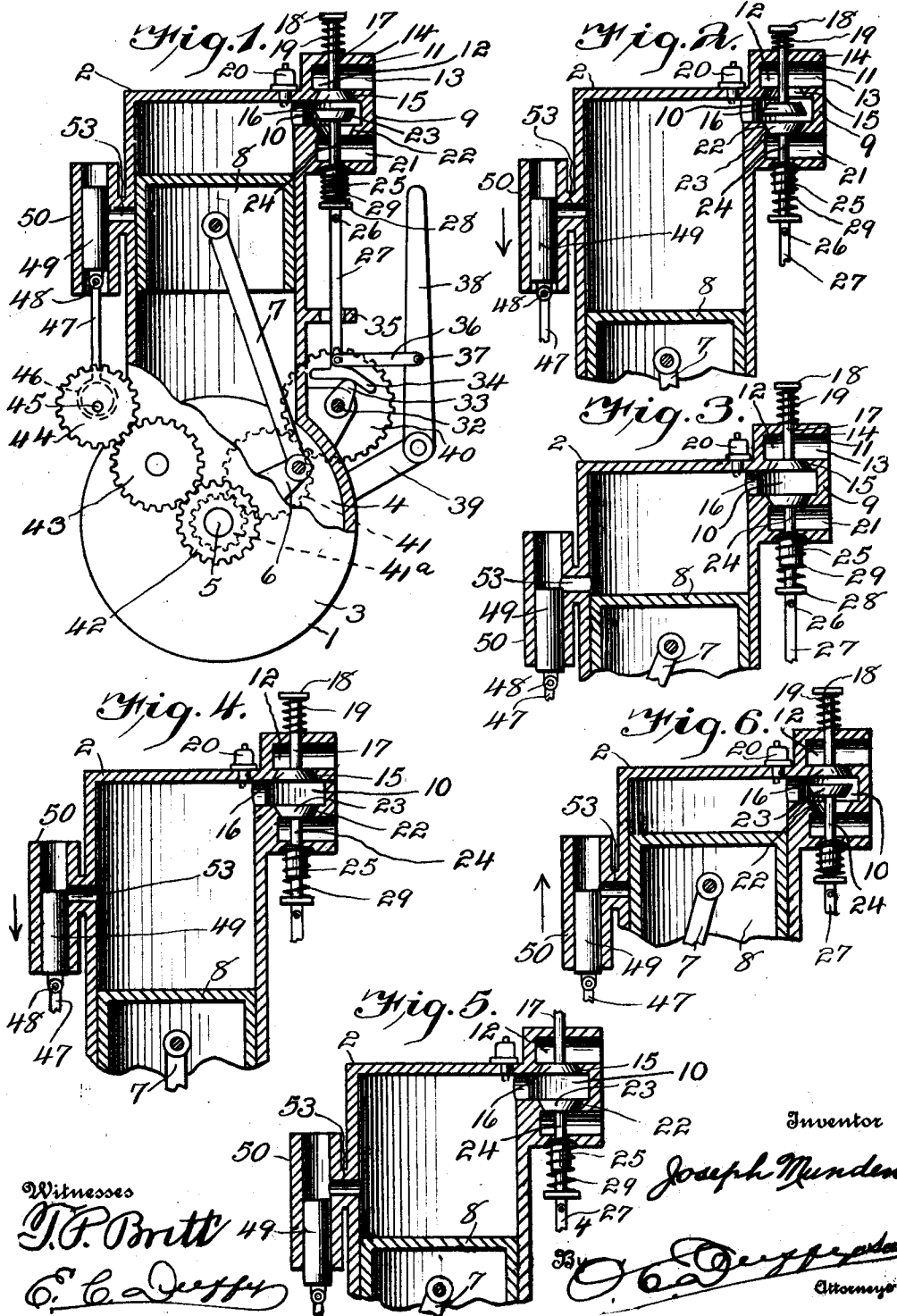


J. MUNDEN.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED FEB. 13, 1911.

1,062,494.

Patented May 20, 1913.



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JOSEPH MUNDEN, OF BRADENVILLE, PENNSYLVANIA.

INTERNAL-COMBUSTION ENGINE.

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Specification of Letters Patent.

Patented May 20, 1913.

Application filed February 13, 1911. Serial No. 608,224.

To all whom it may concern:

Be it known that I, JOSEPH MUNDEN, a citizen of the United States of America, residing at Bradenville, in the county of Westmoreland and State of Pennsylvania, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to internal combustion engines and the objects of my invention are to obviate the necessity of using a muffler, a water cooling jacket, and transfer pipes and ports as in an ordinary type of engine.

Other objects of the invention are to furnish an engine of the above type with means which will be hereinafter set forth whereby a current of cold air will enter the cylinder of the engine after each exhaust stroke, thereby directly cooling the heated inner walls of the cylinder.

Further objects of the invention are to furnish an engine of the above type with novel means for regulating the explosive mixture admitted to the engine whereby a greater or less power stroke can be obtained, and to provide an engine of the above type that has great flexibility.

My invention aims to eliminate the following well-known and troublesome defects experienced in connection with various types of internal combustion engines:—
First: the exploding gases expanding only to the same distance from where they were compressed, thereby necessitating a muffler for the noisy exhaust, with its back pressure losses and retention of burned gases in the compression space. Second: the incomplete expulsion of burned gases which remain and foul the next explosion charge, causing carbon deposits in the cylinder. Third: the lack of direct cooling to the most heated parts, particularly the inner walls of the cylinder, and fourth: the throttling of the engine for a lighter power stroke reduces the compression pressure which reduces the efficiency and consequently provides a less flexible engine.

In eliminating the above defects I have devised an internal combustion engine that is simple in construction, durable, and inexpensive to manufacture.

The invention will be hereinafter specifically described and then particularly

claimed, and reference will now be had to the drawing, wherein there is illustrated one embodiment of the invention, but it is to be understood that the structural elements thereof can be varied and changed, as to the size, shape, and manner of assemblage, without departing from the scope of the appended claims.

In the drawing:—Figure 1 is an elevation partly in section illustrating an internal combustion engine constructed in accordance with this invention, the said figure illustrating the position of the piston and valves during the early part of the intake or suction stroke. Fig. 2 is a fragmentary sectional view illustrating the position of the piston and valves during the last part or completion of the intake or suction stroke. Fig. 3 is a similar view illustrating the position of the piston and valves during the middle portion of the compression stroke. Fig. 4 is a similar view illustrating the position of the piston and valves at the completion of the explosion or working stroke. Fig. 5 is a similar view illustrating the position of the piston and valves during the early portion of the exhaust stroke, and Fig. 6 is a similar view illustrating the position of the piston and valves during the latter portion of the exhaust stroke.

Like numerals of reference indicate the same parts throughout the several figures.

The reference numeral 1 denotes a crank case or casing supporting a vertical cylinder 2 having the lower end thereof in communication with said casing and the upper end thereof closed. Journaled in the end walls 3 and 4 of the casing 1, is a shaft 5 having a crank 6 within the casing 1. Pivottally connected to the crank is a piston rod 7 having a piston 8 slidably mounted within the cylinder 2. The upper end of the cylinder 2 is provided with a housing 9 having a chamber 10 formed therein, said chamber being in communication with the upper end of the cylinder 2. The top of the housing 9 is provided with a valve body 11 having the bore 12 thereof in communication with the chamber 10 and with an inlet opening 13. The material bordering upon the lower edges of the bore 12 is beveled to provide a valve seat 15 for a valve 16. This valve is mounted upon the lower end of a valve stem 17 extending upwardly through the top of the valve body 11 and having the

upper end thereof provided with a head 18. Encircling the upper end of the valve stem 17 between the top of the valve body 11 and the head 18 is a coiled spring 19 adapted to normally retain the valve 16 upon the seat 15. The valve 16 is adapted to control the admission of the explosive mixture to the chamber 10 and the cylinder 2 and located in the top of the cylinder at the inner end of the chamber 10 is a sparking plug 20 of the ordinary and well known type.

The housing 9 is provided with an angular air inlet port 21 and the material bordering upon the upper end of said port is beveled to provide a valve seat 22 for a valve 23. The valve 23 is carried by the upper end of a valve stem 24 slidably mounted in the housing 9, said stem passing through a depending boss 25 of the housing 9 and having the lower end thereof pivotally connected, as at 26 to a push rod 27. The lower end of the valve stem 24 has a head 28 and encircling the boss 25 and the rod 24, between the head 28 and the lower side of the housing 9 is a coiled spring 29 adapted to normally retain the valve 23 in a closed position.

Conveniently journaled on the casing 1 is a shaft 32 provided with a cam 33 and resting upon this cam is the lower angular end 34 of the rod 27, said rod extending through a guide 35, carried by the cylinder 2 above the brackets 30. Pivotally connected to the lower end of the rod 27 is a link 36 pivotally connected, as at 37 to an operating lever 38 fulcrumed upon a bracket 39, carried by the casing 1.

Mounted upon the shaft 32 is a gear wheel 40 meshing with a gear wheel 41 revolubly supported by the end wall 4 of the casing 1, said gear wheel meshing with another gear wheel 41^a upon the shaft 5.

Mounted upon the shaft 5 adjacent to the end wall 3 of the casing 1 is a gear wheel 42 meshing with the gear wheel 43 revolubly supported by the end wall 3. The gear wheel 43 meshes with the gear wheel 44 mounted upon the end of a shaft 45. The shaft 45 is provided with an eccentric 46 having a pitman 47 pivotally connected, as at 48 to a slide valve 49 arranged in a cylindrical valve body 50, carried by the cylinder 2 intermediate the ends thereof. The valve body 50 communicates with the cylinder 2 by means of a horizontal port 53 in the manner shown in the drawings.

The construction shown in the drawings is that of a four-cycle engine, and in operation there are several particular points to be considered, the principal being a relative timing in the operation of valves 23 and 49, the former being open during the latter part of the exhaust stroke and the first portion of the intake stroke while the latter, which is timed to open only when

the piston 8 reaches the end of its downward stroke, is open during the earlier portions of the exhaust and the compression strokes, the valve 23 opening slightly in advance of the closing of the port 53 by the piston on its exhaust stroke.

In describing the operation of the engine, the successive strokes will be described, beginning with the intake stroke, it being understood that the piston is in the position shown in Fig. 1. At this time, the valve 23 is open. The valve 16 is closed and the valve 49 is closed. The movement of the piston 8 toward its lower extreme of movement causes air to be drawn in through the port 21 until the piston has moved a portion of its intake stroke, at which time the valve 23 closes, cutting off the supply of air, so that the further movement of the piston 8 causes the valve 16 to open for the admission of the fuel, the result being that the air which has been drawn in through the first half of this stroke is positioned between the piston and the fuel which has been taken in through the port 13. As the cam 33 can be set to provide for the timing operation, it will be readily understood that an earlier or a later closing of the port 21 will determine the amount of explosive mixture which is introduced.

The intake stroke having been completed by the movement of the piston to its lower extreme, as shown in Fig. 2 the compression stroke begins, and during the period provided by the change in direction of movement of the piston 8, as shown in Fig. 3 the valve 49 opens the port 53, with the result that as the piston goes up on its compression stroke, both valves 16 and 23 will be closed, but the port 53, being open, will permit of the passage through this port of the air which is located between the piston and the explosive charge, which is the residue of the exhaust remaining after the previous exhaust stroke together with the air which was taken into the cylinder through valve 23 when in position shown in Fig. 1, this acting as a scavenger in clearing out the products of combustion produced during the preceding operation. When the piston reaches the port 53, said port becomes closed and the further movement of the piston toward and to its upper extreme provides the compression. As will be understood, that portion of the air which has not passed out through the port 53 will act in this compression operation, so that there is actually an equal compression with each operation regardless of the amount of the explosive mixture which has been introduced, the latter being at all times prior to the explosion, located at the explosion end of the cylinder. The charge is now exploded, resulting in causing the piston to have its second downward stroke (the valve 49 having closed the

port 53 in the mean time), the piston traveling its stroke length with all of the valves closed, the valve 49 commencing to open the port 53 as the piston reaches the end of its power stroke as shown in Fig. 4. The exhaust stroke then takes place, and at the beginning of this stroke, as shown in Fig. 5 the valve 49 being open causes the initial exhaust to be through the port 53. As the piston approaches this port, the valve 23 opens, so that the completion of the exhaust is had through the port 21, this arrangement providing for exhaust of the main portion of the gases through port 53 without, however, producing any recoil on the piston during the remaining exhaust stroke. Upon the completion of this stroke, the intake stroke again begins, taking in air through the port 21, as shown in Fig. 1 this air causing the products to move downward with the piston so as to be located at the lower end of the cylinder and to be driven out through port 53 when the piston begins its return stroke. By this arrangement it will be readily understood that the products of combustion are separate from the next explosive charge by the introduction of the air through port 21 during the beginning of the intake stroke of the piston, these products being carried out through port 53 during the beginning of the compression stroke. In addition, this particular operation provides for cooling the cylinder, the incoming air on the intake stroke, acting to cool the cylinder walls, especially that portion wherein the explosive mixture is subsequently located, by the passage of the cool air over the cylinder surface, practically providing a circulation of air from one end of the cylinder to the other, being taken in through the port 21 and exhausted through the port 53, this air acting both as a scavenger and as a cooling medium.

The shaft 32 is revolved at one-half of the speed of the shaft 5 and is timed to properly open and close the valve 23, while the shaft 45 operates in unison with the shaft 5.

It is through the medium of the operating lever 38, link 36 and the lower angular end 34 of the rod 27 that the valve 23 can be delayed in closing or can be maintained in an open position. This is accomplished by shifting the angular extension of the rod 27 into engagement with the nose of the cam.

From the foregoing it will be observed that I have devised novel means for completely clearing an engine cylinder of products of combustion and for cooling the cylinder without resorting to the use of water jackets or other similar devices.

What I claim is:—

1. An internal combustion engine of the four stroke type comprising a cylinder and a piston, an intake valve arranged to admit

combustible mixture to the engine cylinder, an exhaust valve, a mechanical means for opening said exhaust valve to exhaust the products of combustion from the engine cylinder, a port arranged in the wall of the engine cylinder at a point intermediate the ends of the stroke of the piston, and a valve commanding said port to open and close the same, said valve being arranged to open said port as the piston reaches the limit of its power stroke and to maintain said port open until the piston closes the said port on its exhaust stroke, the said exhaust valve being arranged to be opened at a time prior to the closing of the said port by the said piston on its exhaust stroke in such manner as to complete the exhaust of the said cylinder through the said exhaust valve, said exhaust valve being arranged to be maintained in an opened position during the early portion of the intake or suction stroke of the piston, the said intake valve being arranged to be opened upon the closing of the said exhaust valve to admit to the engine cylinder a combustible mixture, the said valve commanding the said port maintaining the said port closed during the whole of the intake or suction stroke and being arranged to open the said port during the early portion of the compression stroke of the piston in such manner as to provide a passage from the said port for the residue of the exhaust gases left from the preceding operation of the engine and for the exit of the air which was drawn in through the exhaust valve during the early portion of the intake or suction stroke of the piston, substantially as described and for the purposes set forth.

2. An internal combustion engine of the four stroke type comprising a cylinder and a piston, an intake valve arranged to admit a combustible mixture to the engine cylinder, an exhaust valve, means for opening and closing said exhaust valve mechanically to exhaust the said engine cylinder, a port arranged in the wall of the engine cylinder, a valve commanding said port to open and close the same, said valve commanding said port being adapted to open the said port as the piston reaches the limit of its power stroke and to maintain said port in open position to exhaust the said cylinder during the early portion of the exhaust stroke of the piston, the said piston closing said port on its exhaust stroke, the said exhaust valve being arranged to be opened at a time prior to the closing of the said port so as to complete the exhaust of the engine cylinder through the said exhaust valve, said exhaust valve being arranged to be maintained in an open position during the early portion of the intake stroke of the piston in such manner as to draw into the engine cylinder air through the exhaust valve, the intake valve being arranged to open upon the clos-

ing of the said exhaust valve, the said valve commanding the said port maintaining the said port closed during the whole of the intake or suction stroke of the piston and
5 being arranged to open the said port during the early portion of the compression stroke so as to permit passage of the residue of the exhaust gases and the air which was drawn into the engine cylinder through the
10 exhaust valve in such manner that the engine cylinder is scavenged and cooled, substantially as described and for the purposes set forth.

3. An internal combustion engine of the
15 four stroke type comprising a cylinder and a piston, an intake valve arranged to admit a combustible mixture to the engine cylinder, an exhaust valve, means for opening and closing said exhaust valve mechanically
20 to exhaust the said engine cylinder, a port arranged in the wall of the engine cylinder, a valve commanding said port to open and close the same, said valve commanding said
25 port being adapted to open the said port as the piston reaches the limit of its power stroke and to maintain said port in open position to exhaust the said cylinder during the early portion of the exhaust stroke of the piston, the said piston closing said port
30 on its exhaust stroke, the said exhaust valve being arranged to be opened at a time prior

to the closing of the said port so as to complete the exhaust of the engine cylinder through the said exhaust valve, said exhaust valve being arranged to be maintained in an
35 open position during the early portion of the intake stroke of the piston in such manner as to draw into the engine cylinder air through the exhaust valve, the intake valve being arranged to open upon the closing of
40 the said exhaust valve, the said valve commanding the said port maintaining the said port closed during the whole of the intake or suction stroke of the piston and being arranged to open the said port during the early
45 portion of the compression stroke so as to permit passage of the residue of the exhaust gases and the air which was drawn into the engine cylinder through the exhaust valve in
50 such manner that the engine cylinder is scavenged and cooled, and means for regulating the time of closing of the exhaust valve so as to control the time of opening of the inlet valve, substantially as described
55 and for the purposes set forth.

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

JOSEPH MUNDEN.

Witnesses:

MAX H. SROLOVITZ,
CHRISTINA T. HOOD.