R. W. COFFEE.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED MAY 8, 1908.

982,251. Patented Jan. 24, 1911.

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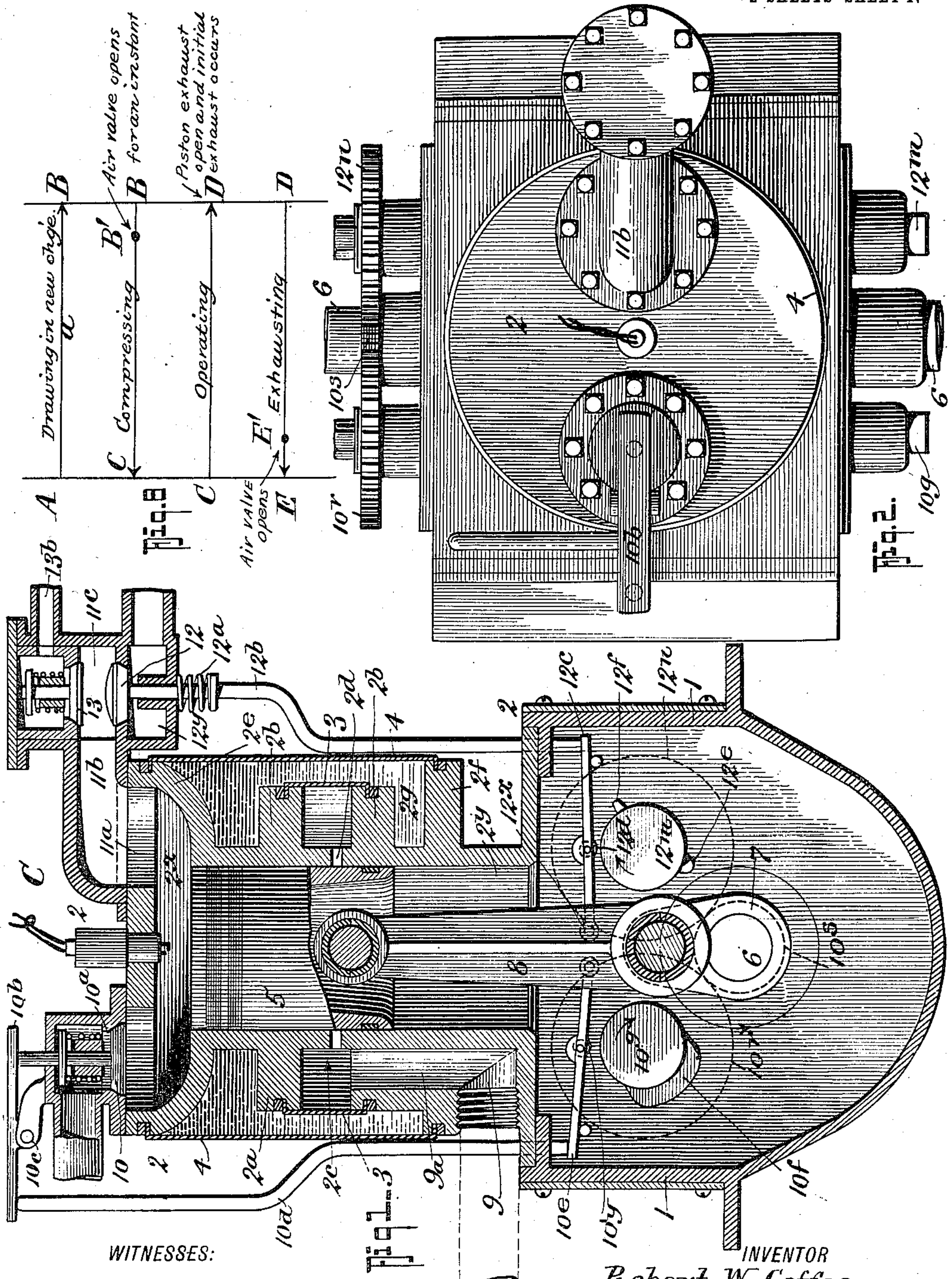

WITNESSES:

John J. Schrott

Charles H. Wagner

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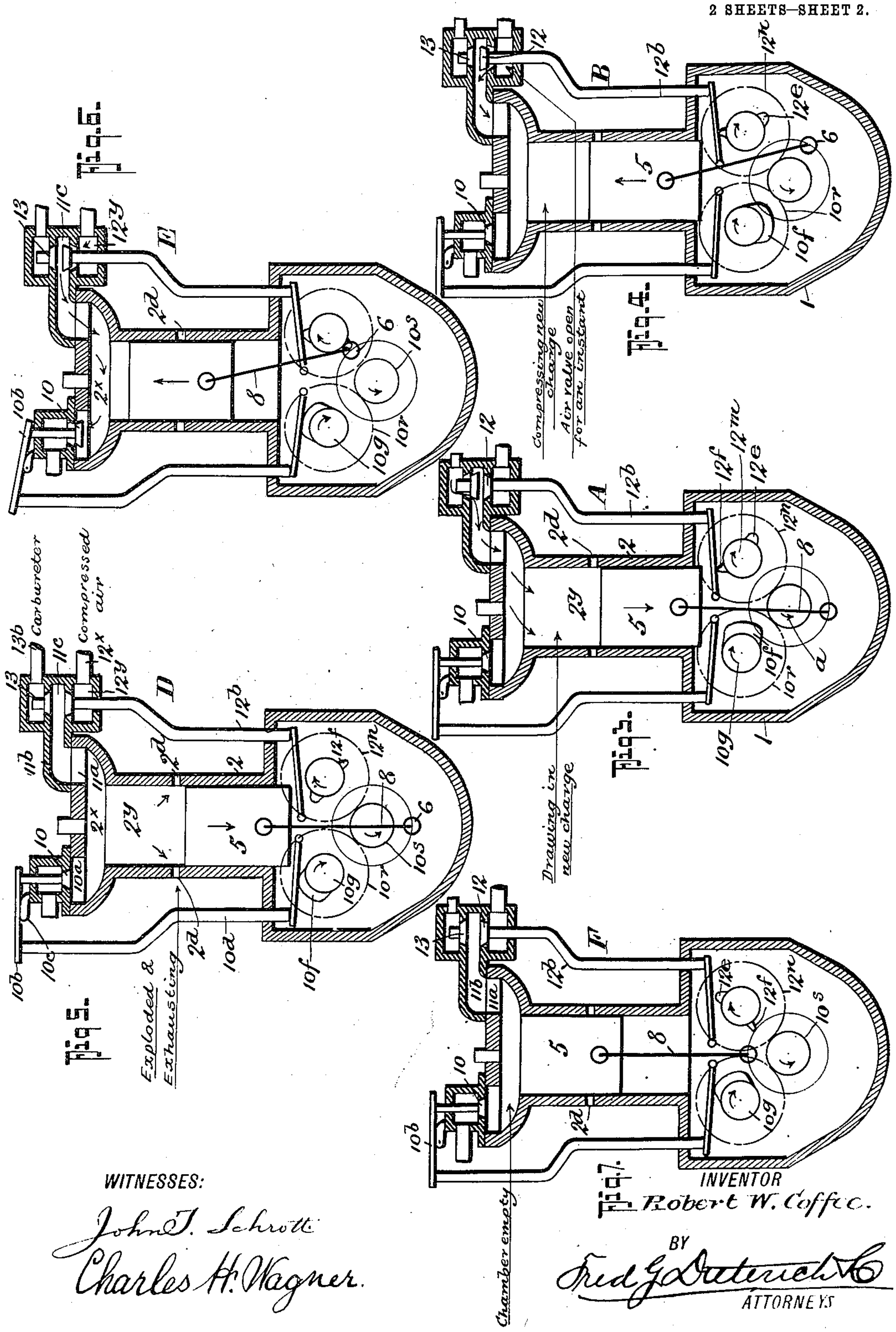

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UNITED STATES PATENT OFFICE.

ROBERT W. COFFEE, OF RICHMOND, VIRGINIA, ASSIGNOR TO LEWIS M. KEIZER, OF BALTIMORE, MARYLAND.

INTERNAL-COMBUSTION ENGINE.

982,251. Specification of Letters Patent. Patented Jan. 24, 1911.

Application filed May 8, 1908. Serial No. 431,646.

To all whom it may concern:

Be it known that I, ROBERT W. COFFEE, residing at Richmond, in the county of Henrico and State of Virginia, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

My invention relates to certain new and useful improvements in internal combustion engines, and has for an object to provide an engine wherein a main piston controlled exhaust coöperates with a supplemental valved exhaust and air scavenger means to relieve the engine of the original exploded charge without over-heating the exhaust valve and hence prolong the life of the engine.

Another object of my invention is to provide an improved scavenging means for the working cylinder and a means for imparting an initial compression to the new charge within the working cylinder. These features are used separately and in combination.

With other objects in view, which will be apparent to those skilled in the art to which the invention appertains, the invention also includes those details of construction combination and arrangement of parts, which will be first duly described, and then specifically pointed out in the appended claims, reference being had to the accompanying drawings, in which:—

Figure 1, is a central vertical cross section of a single cylinder type of my invention. Fig. 2, is a top plan view thereof. Figs. 3, 4, 5, 6 and 7, are views illustrating the various positions of the piston and valves during the different portions of the movement to effect a complete cycle of operation. Fig. 8, is a diagram of the cycle of the engine, which will be hereinafter referred to in detail.

Referring now to the accompanying drawings, in which like numerals and letters of reference indicate like parts in all of the figures, 1 designates the bed of the engine which also forms the crank case and in bearings in which the crank shaft 6 is journaled. The crank shaft 6 is provided with the crank 7 to which the piston rod 8 is coupled, and the piston rod 8, in turn, couples with the piston 5 that operates in the working cylinder of the engine.

2—2 represents the working cylinder, on the outside of which a pair of spaced annular flanges 2^a—2^b, are formed, the flanges 2^a and 2^b being provided with grooves on their peripheral surfaces to receive a thin plate 3, to form an exhaust chamber 2^c between the plate and the flanges 2^a and 2^b.

2^d is a series of piston controlled exhaust ports which communicate between the explosion chamber of the cylinder 2 and the exhaust chamber 2^c, the exhaust passing from the chamber 2^c through a passage 9^a, to a main exhaust outlet 9, from which the exhaust may be piped to any desired place.

4 represents a casing held in peripheral grooves in flanges 2^f and 2^e, respectively, of the engine cylinder to form a water jacket for the exhaust chamber 2^c, as clearly indicated in Fig. 1, of the drawings.

The cylinder 2 is provided with an explosion chamber 2^x, coöperating with the piston chamber 2^y and in communication with the inlet port 11^a and the supplemental exhaust port 10^a, hereinafter again referred to.

The passage of the exhaust through the port 10^a is controlled by a valve 10, which is spring pressed to its closed position and opened through the medium of a lever 10^b fulcrumed at 10^c to a fixed support on the engine.

The lever 10^b is operated through a rod 10^d, by a lever 10^e and a cam 10^f, the cam 10^f being formed on the cam shaft 10^g that is geared with the crank shaft 6, as shown, by gears 10^r and 10^s, respectively. The cam 10^f operates on the lever 10^e through the medium of an anti-friction roller 10^y, or in any other approved manner.

The inlet port 11^a of the cylinder communicates through a pipe 11^b with the double valved chamber 11^c into which the working agent is passed, as is also the compressed air from a suitable storage reservoir. The working agent from the carbureter is passed into the pipe 11^b through a valve 13 that is normally spring pressed to its closed position, the valve 13 closing the passage 11^b from the connection 13^b that comes from the carbureter.

In carrying out my invention any suitable means is provided for storing up air in a suitable reservoir or pump, and the air from this reservoir, under a pressure of say five pounds to the square inch is led through the pipe 12^x into the valve chamber 12^y from which it passes into the pipe 11^b through the medium of a valved opening, the opening being closed by a valve 12 that is pressed by a spring 12^a to its closed position and is opened through the medium of a rod 12^b that is operated by a lever 12^c, fulcrumed at 12^x, and carrying antifriction rollers 12^d, the lever 12^c being operated by a cam 12^e on a cam shaft 12^m that is geared by gears 12^n—12^s with the crank shaft 6. The cam 12^m is provided with a pair of cam members 12^e and 12^f that coöperate with the anti-friction roller 12^d to operate the lever 12^c at predetermined times.

The engine shown operates on the four stroke cycle and a brief reference to Fig. 8 of the drawings will make the operation clear. Assuming the point A to be the beginning of the first stroke of the cycle, and the piston is moving in the direction of the arrow *a*, and drawing in a new charge. As soon as the piston reaches the point B, it will have drawn in a complete new charge through the valve 13, it being understood that during this first stroke of the cycle the valves 12 and 10 are closed. The working agent drawn in on the first stroke of the cycle is very rich in gasolene and poor in air, for a purpose which will be presently more fully understood. At the end of the first stroke of the cycle the piston having drawn in a complete new charge, the parts will be in the position shown in Fig. 3. As the piston moves on its second stroke of its cycle, from the position B, toward the position C, in Fig. 8 of the drawings, and and soon as the piston 5 has again closed the exhaust port 2^d, (the parts being in the position shown in Fig. 4) the cam 12^f will be momentarily open the valve 12 from the source of compressed air supply and permit the compressed air to flow into the explosion chamber of the engine in back of the new charge and impart an initial compression thereto. The additional air supplied from the compressed air tank, by this operation is sufficient to reduce the richness of the mixture of working agent to its proper proportion for explosion. When the piston is in the position shown in Fig. 4, the point B′ will have been reached in Fig. 8, that is to say, the piston will have moved a slight distance on its second stroke of the cycle. As the piston continues to complete the second stroke of its cycle, moving from the point B′ to the point C in Fig. 8, or from the position shown in Fig. 4, to the position shown in Fig. 1, it will be compressing the new charge of working agent, and when the piston has reached the position shown in Fig. 1, the new charge in the explosion chamber 2^x will be ignited, thus forcing the piston on its third stroke of its cycle, from the point C in Fig. 8, to the point D in Fig. 8, the piston thus operating under the effect of the exploded charge. As the piston uncovers the exhaust 2^d, the exploded mixture will be initially exhausted into the exhaust chamber 2^c and from thence conveyed by the passage 9^a to the exhaust outlet 9. The parts will then be in the position shown in Fig. 5, with the piston at the lowermost limit of its stroke, and all valves closed. As the piston moves from the position shown in Fig. 5, to the position shown in Fig. 6, the cam 10^f will open the auxiliary exhaust valve 10, just as the piston starts on the third stroke of its cycle, so that the piston forces the residue of burned mixture out through the auxiliary valve 10, it being understood that the primary exhaust, which took place through the exhaust 2^d, carried off the hottest part of the charge. As the piston nears the end of its fourth stroke, and arrives at the position shown in Fig. 6, which is equivalent to the position of the point E′, in Fig. 8, the cam 12^e will again open the air valve 12 and allow compressed air to be forced into the chamber 2^x and expel the residue of burned mixture, the valve 12 being again closed as soon as the piston reaches the end of its fourth stroke, or the point E, in Fig. 8. The point E in Fig. 8, coincides with the point A in Fig. 8, and is both the end of the cycle and the beginning of the next.

From the foregoing it will be seen that in operation my engine first draws in a new charge and then compresses said charge, first by an air pressure and then by the continuous movement of the piston, causing a piston compression. As soon as the charge has been thus completely compressed, an explosion occurs and operates the piston one stroke under its force, the exploded mixture exhausting through the piston controlled exhaust at the end of the stroke, and the piston on its return stroke forcing out the remainder of the burned mixture, this action of the piston in forcing out the remainder of the burned mixture, through a positively operated valve, being aided through the medium of an air scavenging means.

Numerous modifications in the design and application of my initial compression and air scavenging means may be made as well as numerous variations in the construction of the engine may be made, without departing from the spirit of the invention or the scope of the appended claims and I particularly desire to have it understood that the term "valve controlled" herein is used in its broadest sense as relating to any means for controlling a port or passage.

From the foregoing description taken in connection with the accompanying drawings, it is thought the complete construction, operation and advantages of my invention will be readily understood by those skilled in the art to which the invention appertains.

What I claim is:—

1. In an internal combustion engine, a valve-controlled inlet for fuel, means for opening the fuel inlet while the cylinder

space is expanding, means for supplying air under pressure, a valve-controlled air inlet, and means for opening the air valve during the compression stroke to admit compressed air to the charge.

2. In an internal combustion engine of the four-cycle type, a valve-controlled inlet for fuel, a valve-controlled inlet for air, a source of air under pressure and means for opening the air valve during the first part of the compression stroke.

3. In an internal combustion engine, a piston-controlled initial exhaust port and a supplemental valve-controlled exhaust port, means for opening the valve during the exhaust stroke, a valve-controlled inlet for mixture, a valve-controlled inlet for air, means for supplying air under pressure, and means for opening the air valve for a short period during compression and for another short period while the supplemental exhaust valve is open.

4. In an internal combustion engine of the four-cycle type, a piston-controlled initial exhaust port, and a supplemental valve-controlled exhaust port, means for opening the valve during the exhaust stroke, a valve-controlled inlet for mixture, a valve-controlled inlet for air, means for supplying air under pressure, and means for opening the air valve for a short period during compression and for another short period while the supplemental exhaust valve is open.

5. In an internal combustion engine, a valve-controlled inlet for fuel, a valve-controlled inlet for air, means for supplying air under pressure, and means for opening the air valve for a short period during compression and for another short period during exhaust.

6. In an internal combustion engine, a valve controlled inlet for fuel, means for controlling the fuel valve whereby it is permitted to open while the cylinder space is expanding, means for supplying compressed air, a valve controlled inlet for air and means for opening the air valve during the early part of the compression stroke to admit air to the partly compressed charge.

7. In an internal combustion engine, means for maintaining a supply of non-combustible mixture, an inlet to the combustion chamber to which the mixture is supplied, a valve in said inlet, means controlling the valve to permit it to open while the cylinder space is expanding, a source of air under compression, a valve controlled air inlet and means for opening the air valve during the early part of the compression stroke to admit air to the partly compressed non-combustible mixture and thereby render the same combustible.

8. In an internal combustion engine of the four-cycle type, means for supplying non-combustible mixture, a valve controlling the supply, opening toward the cylinder, and means for maintaining it normally closed, means for supplying air under pressure, an air valve, a passage leading to the cylinder into which both valves open, means for opening the air valve during the early part of the compression stroke, the fuel valve being opened during the admission stroke, an exhaust port and means for opening and closing the same.

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Witnesses:

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