A. H. C. GIBSON.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED NOV. 24, 1909.

1,146,864.

Patented July 20, 1915.

4 SHEETS—SHEET 1.

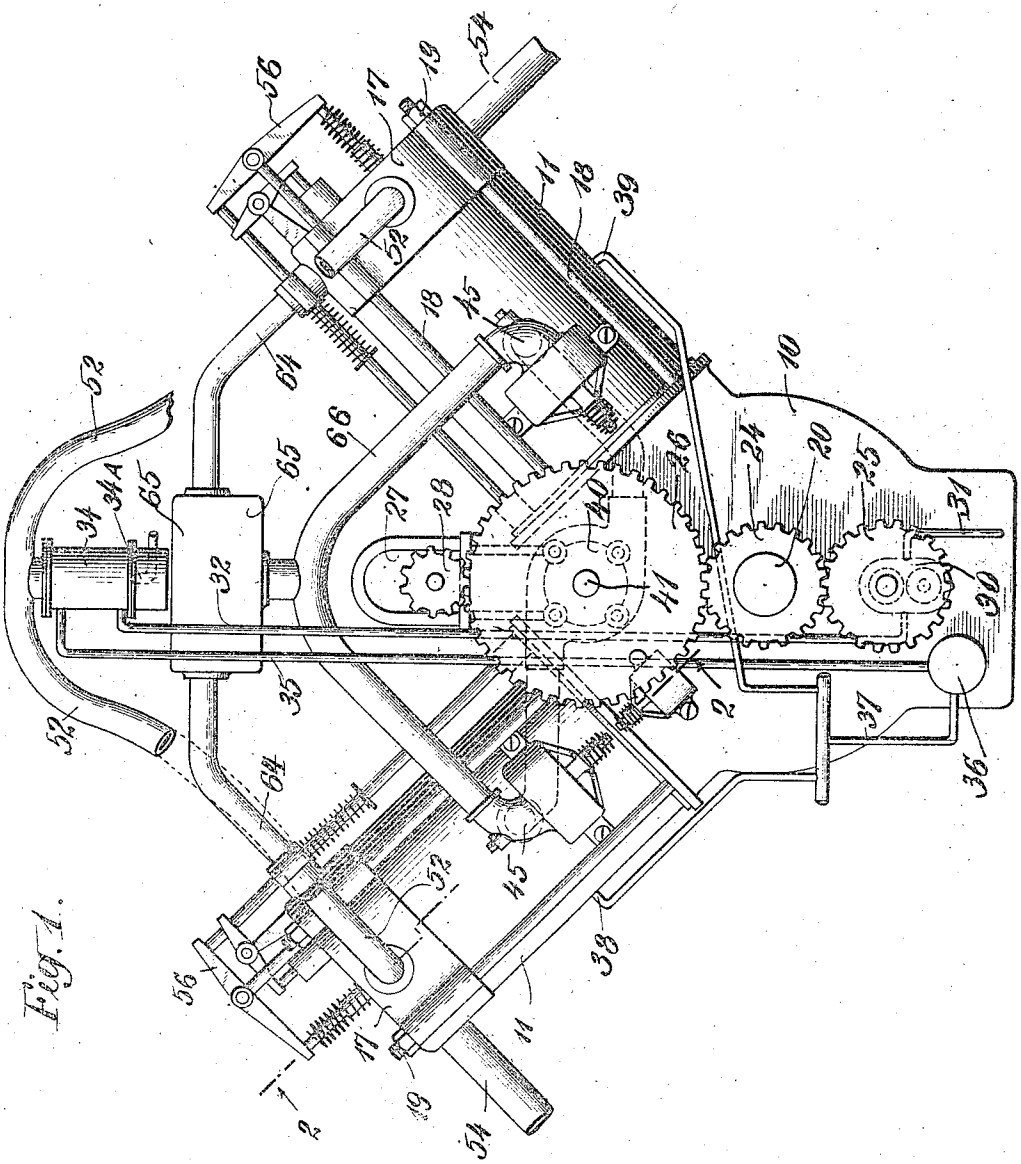

Fig. 1.

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4 SHEETS—SHEET 2.

Fig. 2.

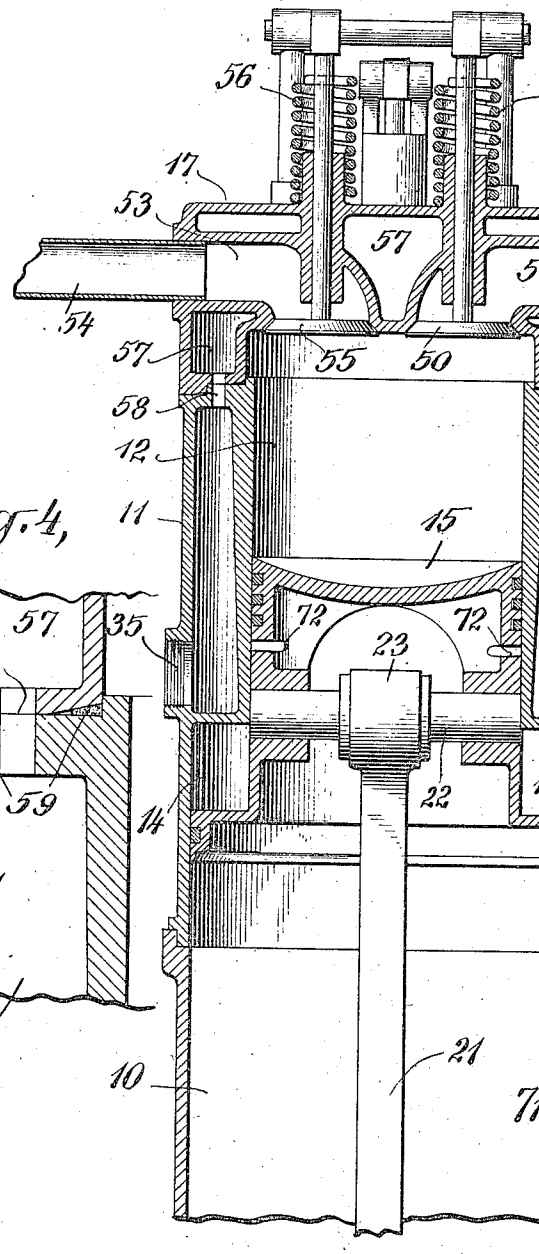

Fig. 3.

Fig. 4.

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4 SHEETS—SHEET 3.

Fig. 5,

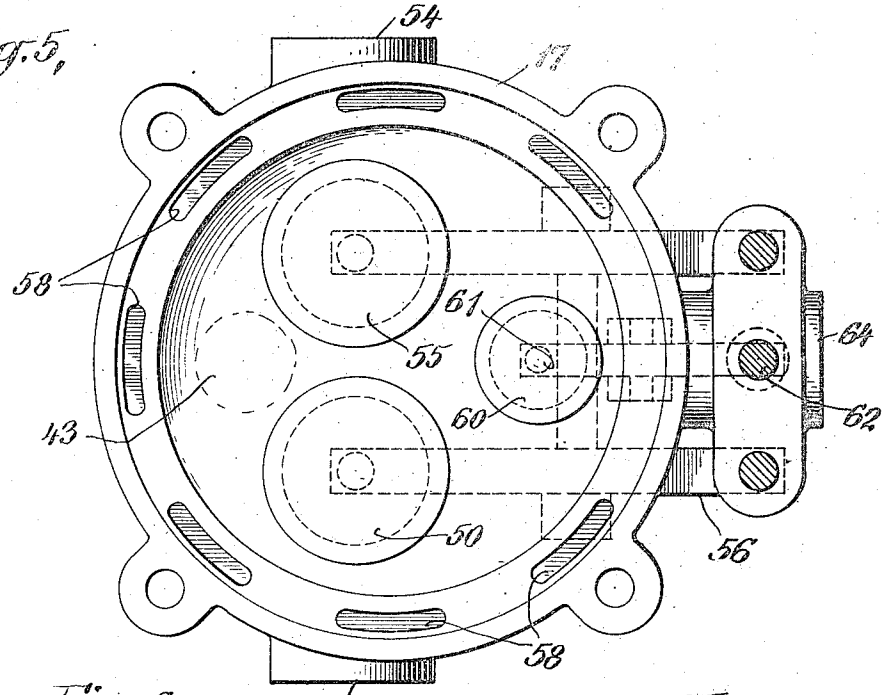


Fig. 6,

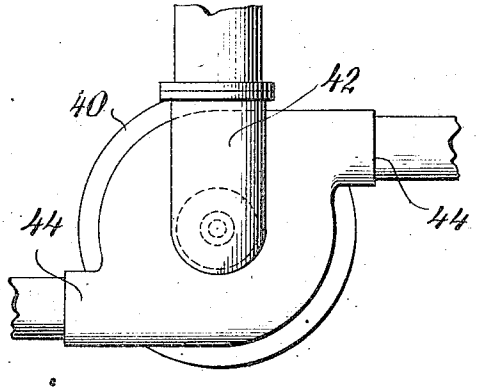
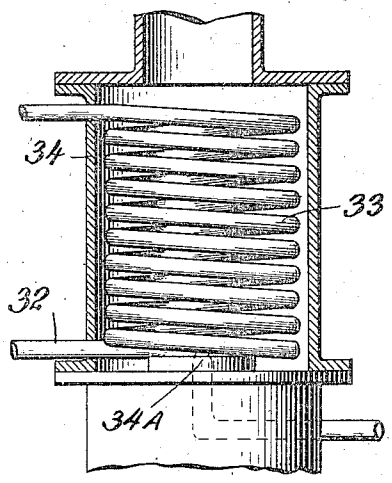


Fig. 7,



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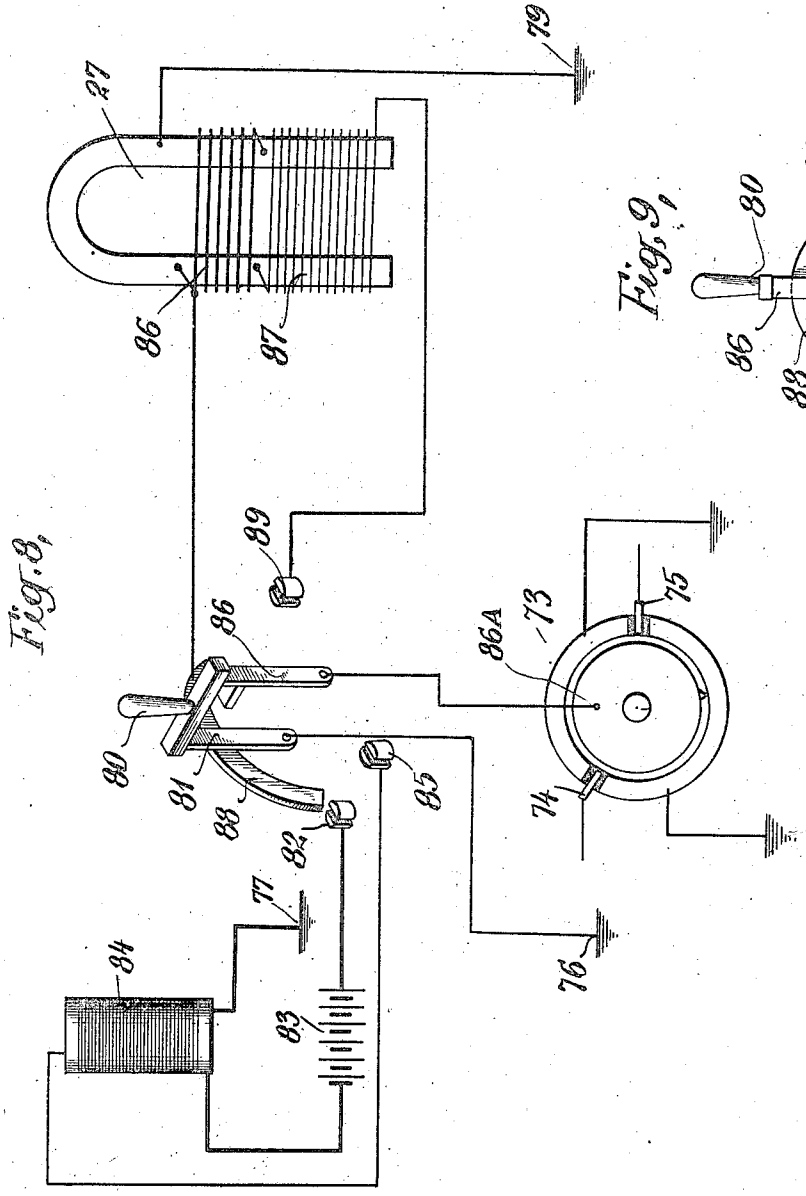

Fig. 8.

Fig. 9.

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UNITED STATES PATENT OFFICE.

ARTHUR HUGO CECIL GIBSON, OF NEW YORK, N. Y.

INTERNAL-COMBUSTION ENGINE.

1,146,864. Specification of Letters Patent. Patented July 20, 1915.

Application filed November 24, 1909. Serial No. 529,674.

To all whom it may concern:

Be it known that I, ARTHUR HUGO CECIL GIBSON, a subject of the King of Great Britain, and a resident of the borough of Manhattan, in the city of New York, in the county and State of New York, United States of America, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

My invention relates to internal combustion engines, and its object is to improve upon apparatus of this kind and to produce an engine of great efficiency which has advantages over those heretofore known in the art.

I will describe in the following specification an engine made according to my invention and will point out the novel features thereof in the appended claims.

Referring to the drawings, Figure 1 is an end elevation of an engine made according to my invention, with some of its parts broken away to more clearly show the construction. Fig. 2 is a section through one of the cylinders of this engine, the section being taken on the line 2—2 of Fig. 1. Fig. 3 is a section at right-angles to that shown in Fig. 2, through the upper end of one of the cylinder-heads. Fig. 4 illustrates a detail of construction. This figure is a transverse section on an enlarged scale through a portion of the cylinder and cylinder-head, showing the manner in which these parts are joined together. Fig. 5 is a bottom plan view of one of the cylinder-heads removed from the cylinder, showing the location of the valves and the manner in which the tappet rods therefor are guided. Fig. 6 is an elevation of the circulating-pump. In Fig. 7 an oil-cooling coil is shown in elevation, with its inclosing chamber shown in section. Fig. 8 is a diagram showing certain parts of the electrical equipment which I employ and a preferred arrangement of their connecting circuits. Fig. 9 designates a special form of switch used in conjunction with these circuits.

Like characters of reference designate corresponding parts in all of the figures.

10 designates the crank-case of the engine. This is inclosed to form a compression chamber.

11, 11 are casings, each of which is fitted to the crank-case and is constructed to form an engine cylinder 12 surrounded by a water-jacket 13, and to form another cylinder 14 of somewhat larger diameter. Within these cylinders is a differential piston, the upper portion of which is designated by 15, and fits into the cylinder 12 to form the working piston of the engine. Another portion 16 of this piston fits the cylinder 14 and acts as a pump or compressor piston. At the top of each cylinder casing is a cylinder-head 17.

18 are bolts extending from the crank-case up through lugs projecting from the sides of the cylinder-heads, and 19 are nuts screwed thereon by means of which the crank-case, cylinder and cylinder-heads are held together.

20 is the main shaft of the engine. This is provided with a crank within the crank-case to which the connecting-rods 21 are connected. Some of these parts are not shown but may be of any of the usual and well-known constructions or arrangements.

22 is a wrist-pin in the piston to which the upper end of the connecting-rod is connected at 23.

On shaft 20 is a gear 24 which is in mesh with a gear 25, which drives an oil-pump 30. Another gear 26 is on the shaft 41 of a water circulating-pump 40, which I will describe later.

27 is a magneto, on the shaft of which is a gear 28 in mesh with and driven by gear 26.

The base of the crank-case 10 is constructed, as is common practice, to form an oil-chamber. From this chamber the oil is drawn through a suction pipe 31 to and through the oil-pump 30; thence, it is forced upward through a pipe 32 into the base of a refrigerator 33. This refrigerator is within a cylindrical casing 34 which forms a part of the inlet pipe for the engine. From thence, the oil is led down through a pipe 35 to a small reservoir 36, and through pipes 37, 38, and 39, it is distributed to the desired parts of the engine.

The pump 40 is shown in Fig. 6. It is an ordinary centrifugal pump which is supplied by means of an intake pipe 42 which is connected by suitable piping and through radiators (not shown) with outlets 43 in the water-jacket of each cylinder-head, but the pump is constructed with two discharge ports 44, 44, which are piped to inlet ports 45, in the base of each water-jacket. The

object of this arrangement is obviously to give an even distribution to the flow of water to the cooling-jackets.

Referring now to Figs. 2 and 5, I will point out the construction of the cylinder-head 17 and its associated parts. This, as may be seen, is constructed to form the valve-seats and supports for the valves, and a part of their actuating mechanism. 50 designates the regular inlet-valve of the engine. This controls the passage 51 which leads from a pipe 52 to that portion of the engine cylinder which is above the portion 15 of the piston and which will herein be called the combustion chamber. The outlet passage 53 is connected with the exhaust pipe 54 and controlled by a valve 55. These inlet and exhaust valves are actuated in the usual manner. A part of this actuating mechanism is shown in the drawings and designated by 56. But I have not thought it necessary to show the actuating cams, etc., nor to specifically describe the parts shown, as in this part of my arrangement I do not depart from the usual four-cycle engine practice. This cylinder-head, however, with the passages therein, is water-cooled. It is provided with a water-jacket at 57 which is in communication with the cooling-jacket 13 of the cylinder through ports or openings 58. The joint between the cylinder-head and the cylinder is preferably made in the manner illustrated in Fig. 4. The top of the cylinder casing is made in the form of two or more concentric steps. The bottom of the cylinder-head is made to fit these steps, but a part of each of its horizontal portions is cut away to form wedge-shaped openings between the cylinder and head, in which packing 59, 59, is placed. Before leaving the description of the cylinder-head I will point out an auxiliary air-valve 60 which is placed in this head preferably between the inlet and exhaust valves as shown. 61 is its stem and 62 its actuating tappet-rod which is arranged to be moved by cams driven from the engine at desired periods of the engine's cycle in the usual manner. 63 is the passage which this valve controls. This is connected by a pipe 64 with a chamber 65 containing compressed air, which is obtained by the operation of the engine itself in the novel manner which I will presently explain. A pipe 66 connects this air-chamber with the compression-chamber 14 within the cylinder casing.

67 is a check-valve admitting air to the compression-chamber through port 68 upon the downward stroke of the piston, and 69 is a check-valve allowing compressed air upon the upward stroke of the piston to pass into pipe 66 and air-chamber 65. This arrangement by itself would effectively compress air to provide the desired supply for the operation of the engine which I shall describe hereinafter. But in order to increase the efficiency of its operation, I have invented the arrangement which I will now point out.

70 is a check-valve arranged to admit air to the inclosed crank-case 10 through a port 71.

72 are ports or openings in circumferential alinement with each other through the walls of the upper portion of the piston.

During the upward stroke of the piston air will be drawn into the crank-case and will be compressed therein by the piston's downward stroke. This downward stroke of the piston will at the same time cause air to be drawn into the compression chamber 14 through the check-valve 67 and port 68. But the air thus drawn into the compression-chamber must necessarily be at somewhat less than atmospheric pressure on account of the pressure of the closing spring of the check-valve and also on account of the speed of the engine. But the air within the crank-case has been raised to several pounds pressure and the parts are so arranged that when the piston has reached the lower limit of its movement, the ports 72 will be uncovered and will allow this compressed air in the crank-case to rush into and fill the compression-chamber 14. The up-stroke of the piston will, as before described, raise the pressure of this air and drive it through the check-valve 69 into the pipe 66.

I have described the manner in which the air is compressed during the running of the engine before describing the operation of the engine itself, so that we may now assume that we have a supply of explosive mixture connected with the engine through the chamber 34 and pipe 52, and also a supply of air under considerable pressure in the chamber 65 and its connected pipes.

The engine is operated on the four-stroke cycle principle. During the first downward stroke of the piston the intake valve 50 is open and a charge of explosive mixture is drawn into the combustion chamber in the usual manner, which means in high-speed engines, at a pressure considerably below atmospheric. But at the end of this first or suction stroke, and before the normal act of compression I add a substantial increment to this charge by opening the auxiliary air-valve 60 thus admitting some of this air under pressure. The second or compression-stroke will now compress this complemented charge and the result will be that either a larger fluid charge may be obtained or that a charge of usual volume may be forced up to greater compression. The compressed charge is now ignited by means of an electric spark, and the piston is driven downward. The exhaust-valve is

then opened, and during the fourth or last stroke of the engine's complete cycle, the waste products of combustion are ejected through the pipe 54. As the piston reaches the top of its stroke and before the exhaust valve is closed, the auxiliary air-valve is momentarily opened, and a charge of highly compressed air allowed to sweep in and force out the remaining spent gases, which, if allowed to remain, not only occupy some of the space which should be filled with fresh gases, but they seriously affect and lessen the calorific value of the charge. This scavenging effect takes place at the end of the exhaust stroke, when it is most needed, and when its effect may be obtained in the most efficient manner. If desired other fluids than air may be introduced through the auxiliary valve 60. While the fresh gases are being drawn into the combustion chamber, they pass through the chamber 34 and about the pipe-coil 33. The temperature of these gases is low and the effect of this will be to cool the lubricating oil and at the same time to increase the temperature of the explosive mixture. One manner of accomplishing this result effectively is to introduce liquid hydrocarbon through a spray nozzle at 34A into the chamber and against the pipe-coil 33.

I have shown a two-cylinder engine, but have described the construction and operation of but one of these cylinders. It is to be understood that the other cylinder and its associated parts operates in substantially the same manner. Of course, the number of cylinders may be multiplied indefinitely if desired. By the use of this simple arrangement the efficiency of an engine of this type is greatly increased. Engines constructed according to my invention may be run at extremely high speeds, so that high power may be obtained with an engine of low weight, and yet with its parts strongly and substantially built. Such results are desirable in engines used in aviation work, or for other purposes where minimum weight is desired. But the invention is also applicable to other types of engines, and makes the use of gases of low calorific value more valuable in internal combustion engines.

Referring now to Figs. 8 and 9, I will describe the various parts of the electrical equipment which I use. 73 is the usual distributer with brushes 74 and 75 connected with the spark-plugs in the combustion chamber of the engine. These plugs are not shown in the drawings. 80 is a manually operated switch by means of which the electrical supply to the distributer is controlled. When in its central position the supply is cut off. By moving the switch to the left, one arm 81 of this switch, which is grounded at 76, is connected through a stationary contact 82 with one side of a battery 83, the other side of which is connected through the primary winding of an induction coil 84 to the ground 77. One end of secondary winding of this coil is also connected with this ground 77. Its other terminal is connected with a stationay contact 85, which, now, through the arm 86 of the switch, is connected with the distributer 73 at 86A. Thus the engine is supplied with the ignition current from the battery 83. The magneto 27 is of the high-tension type, having a primary winding 86 and a secondary winding 87. One end of each of these windings is connected with the ground at 79. The other end of the primary winding 86 is connected with an arc-like contact 88 over which the arm 81 rides. When the switch is in the position above described the arm 81 will touch both contacts 82 and 88, and this will cause the two terminals of the primary winding 86 to be connected with the ground at 76 and at 79, and will be thus short-circuited. The magneto, then, will not generate. When it is desired to utilize the magneto for supplying the ignition current, the switch 80 may be moved over to the right. The first effect of this will be to cut off the power at 82. Then the arm 86 will be brought into contact 89 to connect the winding 87 with the distributer. The right-hand end of contact 88 is offset at 88A so that the connection between it and arm 81 will now be broken to render the primary winding 86 effective to cause the magneto to generate the required current. It will be noted that the primary winding of the magneto remains grounded until the secondary winding of the magneto is connected with the distributer. This arrangement has been devised for use with the parts of the apparatus herein described, but obviously it may be applied with advantage to other types of engines.

What I claim is—

1. A four-stroke cycle internal combustion engine having a working cylinder and a compression chamber, a differential piston fitting said working cylinder and compression chamber, one part of said piston being arranged to compress air, means including a positively opened valve for admitting said compressed air through the head into the working cylinder at the end of the suction stroke of the engine, and mechanism to open said valve at the end of the exhaust stroke.

2. A four-stroke cycle internal combustion engine having a working cylinder and a compression chamber, a differential piston therefor, one part of said piston being arranged to compress air, and means including a positively operated valve for admitting said compresed air to the working cylinder through its head at the end of the exhaust stroke of the engine.

3. A four-stroke cycle internal combustion engine having a casing arranged to

form a working cylinder and a compression chamber, a reciprocatory piston having portions fitting said cylinder and chamber, a check-valve arranged to admit fluid to the compression chamber, an inclosed crank-case, a check-valve arranged to admit fluid to the crank-case, said piston being constructed with ports arranged to connect the crank-case with the compression chamber when the piston is at the lower end of its travel, a passage between the compression chamber and the working cylinder, a check-valve admitting fluid to said passage, a chamber in said pasage, a main inlet valve, and an auxiliary valve for admitting said compressed fluid to the working cylinder.

4. A four-stroke cycle internal combustion engine having a casing arranged to form a working cylinder and a compression chamber, a reciprocatory piston having portions fitting said cylinder and chamber, a check-valve arranged to admit air to said compression chamber; an inclosed crank-case, a check-valve arranged to admit air to the crank-case, said piston being constructed, with ports arranged to connect the crank-case with the compression chamber when the piston is at the lower end of its travel, a passage between the compression chamber and the working cylinder, a check-valve arranged to admit air from said compression chamber to the passage, a main inlet valve, and an auxiliary air-valve in the upper portion of the working cylinder arranged to admit said compresed air to the working cylinder at desired parts of the engine's cycle.

5. A four-stroke cycle internal combustion engine having a casing arranged to form a working cylinder and a compression chamber, a reciprocatory piston having portions fitting said cylinder and chamber, a check-valve arranged to admit air to said compression chamber; an inclosed crank-case, a check-valve arranged to admit air to the crank-case, said piston being constructed with ports arranged to connect the crank-case with the compression chamber when the piston is at the lower end of its travel, a passage between the compression chamber and the working cylinder, a check-valve arranged to admit air from said compression chamber to the passage, a main inlet valve, and an auxiliary air-valve in the upper portion of the working cylinder arranged to admit said compressed air to the working cylinder at the end of the suction strok of the engine, and again at the end of the exhaust stroke of the engine.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ARTHUR HUGO CECIL GIBSON.

Witnesses:
ELLA TUCH,
J. R. MILLWARD.