

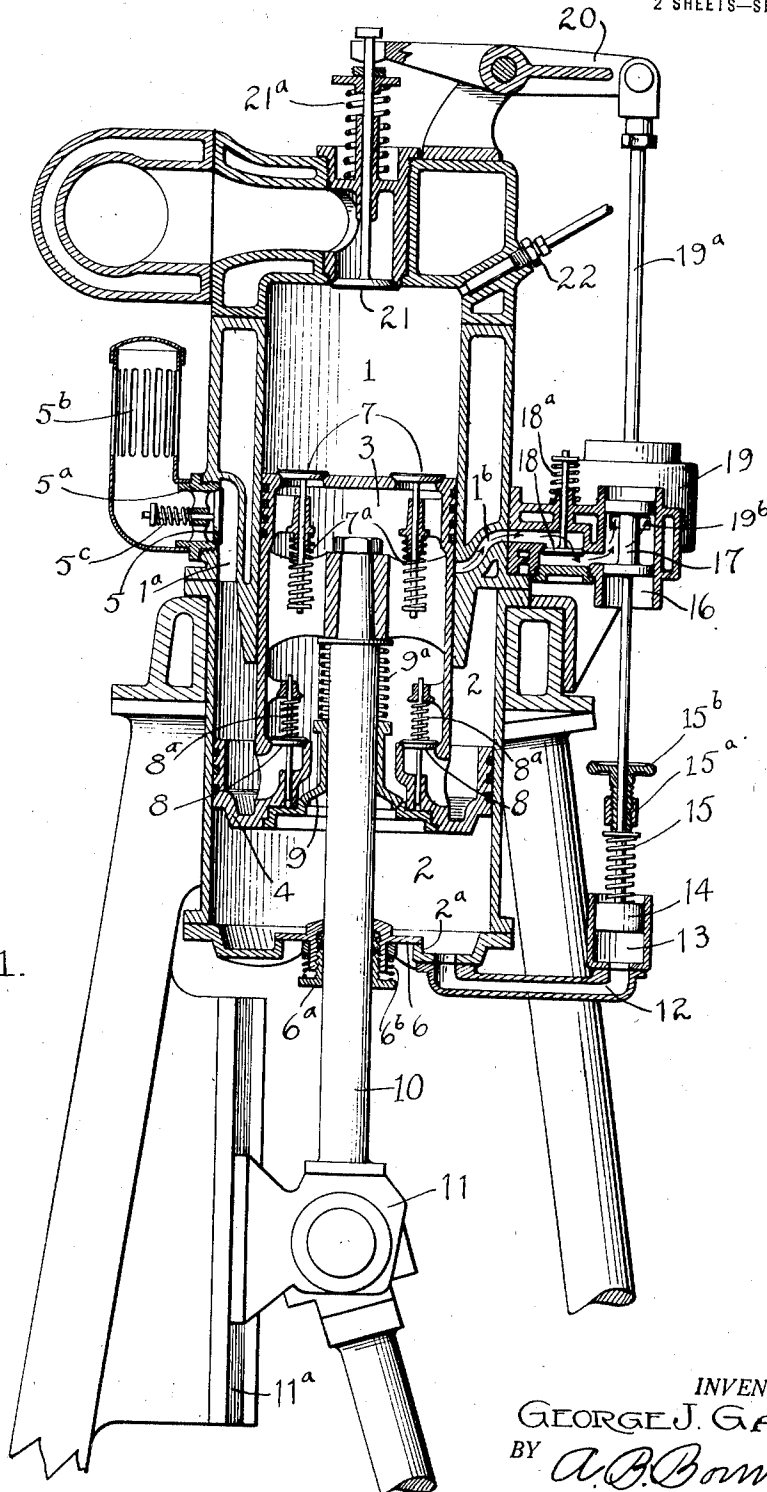
G. J. GALL.
TWO-CYCLE INTERNAL COMBUSTION ENGINE.
APPLICATION FILED JULY 7, 1919.

1,367,037.

Patented Feb. 1, 1921.

2 SHEETS—SHEET 1.

FIG. 1.



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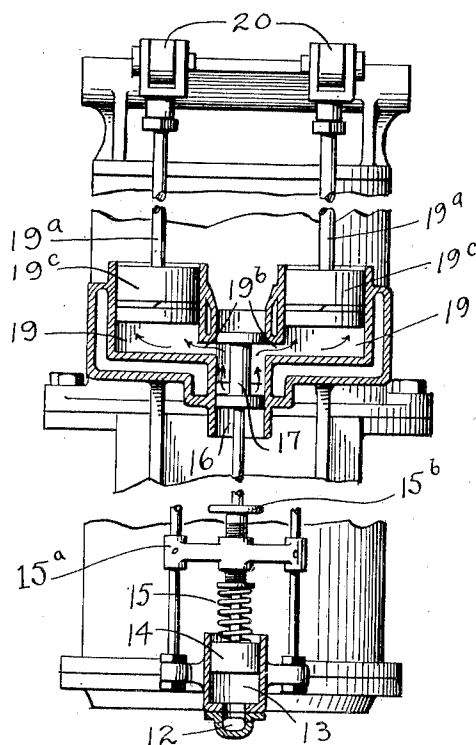


FIG. 2.

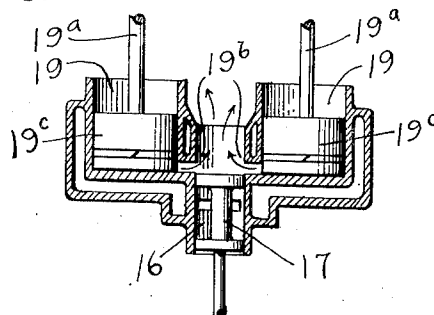


FIG. 3.

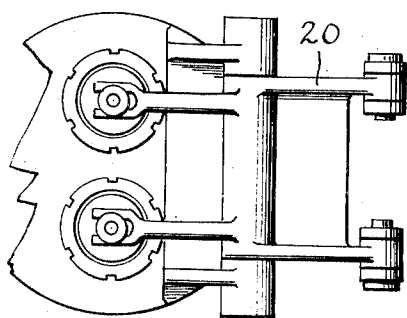


FIG. 4.

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GEORGE J. GALL, OF SAN DIEGO, CALIFORNIA.

TWO-CYCLE INTERNAL-COMBUSTION ENGINE.

1,367,037.

Specification of Letters Patent.

Patented Feb. 1, 1921.

Application filed July 7, 1919. Serial No. 309,041.

To all whom it may concern:

Be it known that I, GEORGE J. GALL, a citizen of the United States, residing at San Diego, in the county of San Diego and State of California, have invented a certain new and useful Two-Cycle Internal-Combustion Engine, of which the following is a specification.

My invention relates to two cycle internal combustion engines more particularly to a means and method of scavenging and supercharging internal combustion engines of either the two cycle constant pressure or the constant volume type, and the objects of my invention are: first, to provide a novel means and method of scavenging two cycle engine cylinders; second, to provide novel means and method of supercharging two cycle internal combustion engines; third, to provide a combined means and method of scavenging and supercharging two cycle internal combustion engines; fourth, to provide a means and method of operating all the control valves of a two cycle internal combustion engine by varying vapor pressure; fifth, to provide a means and method of this class in which the compression pressure for the cylinder is developed in two stages, the one in the cylinder of a double acting pump operative in connection with the working cylinder and developing pressure by its movement in both directions; sixth, to provide a novel valve actuating mechanism for two cycle internal combustion engines and seventh, to provide an internal combustion engine of this class which is simple and economical of construction, durable, easy to operate, very efficient in its action and which will not readily deteriorate or get out of order.

With these and other objects in view as will appear hereinafter, my invention consists of certain novel features of construction, combination and arrangement of parts and portions and the methods of scavenging, supercharging and operating the valves of two cycle internal combustion engines as will be hereinafter described in detail and particularly set forth in the appended claims, reference being had to the accompanying drawings and to the characters of reference thereon which form a part of this application, in which:

Figure 1 is a longitudinal sectional view of my internal combustion engine showing

the crank case portion broken away (the crank case structure and its internal working parts being no part of my present invention) and showing some of the parts and portions in elevation to facilitate the illustration; Fig. 2 is a fragmentary broken side elevational view at right angle thereto showing portions broken away and in section to facilitate the illustration; Fig. 3 is a sectional view of the middle portion of Fig. 2 showing the exhaust valve actuating pistons positioned at the other end of their stroke and Fig. 4 is a fragmentary top view of the engine.

Similar characters of reference refer to similar parts and portions throughout the several views of the drawings.

The working cylinder 1, pump cylinder 2, working piston 3, pump piston portion 4, air inlet valves 5, air inlet valves 6, valves 7, valves 8, valve 9, piston rod 10, piston rod guide 11, conductor 12, cylinder 13, piston 14, spring 15, piston valve cylinder 16, piston valve 17, valve 18, cylinders 19, pistons 19^a, piston rods 19^a, exhaust valve operating lever 20, exhaust valves 21 and fuel injector 22 constitute the principal parts and portions of my improved engine structure.

My engine generally speaking is a two diameter cylinder type; the cylinder portion 1 being the working or operating cylinder and the cylinder 2 which is of increased diameter is an air pumping or charging cylinder. The pistons 3 and 4 are preferably integrally connected together and the piston 3 is reciprocally mounted in the cylinder 1 and the piston 4 is reciprocally mounted in the cylinder 2. The cylinder 1 and the cylinder head are water jacketed in the conventional manner. Mounted in the sides of the cylinder 1 and communicating with the cylinder 2 are air inlet ports 1^a which communicate with the interior of said cylinder through the air inlet valves 5 which are positioned in the sides of the cylinders in valve seats 5^a secured in said cylinder and said valves are provided with springs 5^c tending to keep them seated and are opened by vacuum formed in the cylinder 2 by the outward movement of the piston 4. Mounted in the lower side of the cylinder 2 is an air inlet valve 6 which seats on the casing portion 2^a and is opened by vacuum formed in the cylinder 2 by the inward

movement of the piston 4 in the cylinder 2. Said valve 6 is provided with a stuffing box gland 6^a surrounding the piston rod 10 and said stuffing box gland moves with the valve. compressing the spring 6^b which tends to hold the valve closed. The extended end of the piston rod 10 is guided by means of a guide member 11, which engages a grooved guide member 11^a in the conventional form (this guide structure being no part of my present invention.) The pistons 3 and 4 are hollow chambered pistons adapted to receive the air under pressure from the pumping cylinder 2, the air passing from the lower side of the piston 4 into the interior of the piston 3 through the valve 9 which is held seated by means of the valve spring 9^a and the air passes from the cylinder 2 from above the piston 4 through the valves 8 which valves are held seated by means of the spring 8^a into the piston 3 and passes out into the working cylinder 1 through the valves 7 at such times as the pressure in the working cylinder is lower than the pressure of the air in the interior of the working piston 3, the valve springs 7^a tending to hold the valves 7 closed.

The exhaust valves 21 are mounted in the head of the cylinder preferably in pairs as shown and are actuated and controlled automatically by the difference in air pressure with the operation of the engine as follows: As the piston 4 moves outwardly in the cylinder 2 and the pressure in the cylinder 2 becomes high enough, the air passes through the conductor 12 into the cylinder 13, exerting pressure on the plunger 14 compressing the spring 15 and raising the piston valve 17. The operation of the piston 14 is regulated by means of a spring 15 supported by a bar 15^a which is provided with an adjusting screw 15^b which sets against the spring 15, it being desirable to provide adjustment for the required pressure for actuating the piston 14 after the engine has run awhile and developed heat which changes the required pressure. As soon as the piston 3 passes the end of the port 1^b the pressure of combustion in the working cylinder 1 passes into the port 1^b passing through the valve 18, compressing the spring 18^a and into the cylinders 19, through ports 19^b controlled by the position of the piston valve 17 which in turn operates the valve operating lever 20, opening the exhaust valves 21.

It will be here noted that the area covered by the pistons 19^c is larger than the area covered by the exhaust valves 21 to permit the opening of the valves 21, although the pressure is equal, as the source for both come from the pressure in the working cylinder. It will also be noted that the rocker lever 20 is a double rocker lever as shown best in Fig. 4 of the drawings, so that the valves 21 operate in unison, actuated by the pistons

19^c. Mounted in the working cylinder 1 is a fuel injector 22 which is of the ordinary or conventional type (being no part of my present invention). When the exhaust valves 21 are opened and the pistons 3 and 4 move outwardly on their outward stroke the port 1^b, having been uncovered, the valves 21 are held open by the exhaust gases trapped in the cylinders 19 by the valve 18 until such time as the pressure is reduced in the cylinder 13, when the piston valve 17 recedes and permits this exhaust gas to pass through the ports into the open when the valve spring 21^a moves the pistons down to the lower end of their stroke as shown in Fig. 3 of the drawings.

It will be noted that as soon as the pressure of the exhaust gas in the working cylinder 1 is relieved by the opening of the exhaust valves 21 the air in the piston 3 passes through the valves 7 into the working cylinder and moves upward in said cylinder in volume form as the exhaust gases recede through the exhaust valve ports.

Though I have shown and described a particular construction, combination and arrangement of parts and portions and methods of scavenging, supercharging and operating valves by pressure I do not wish to be limited to this particular construction, combination and arrangement nor said methods but desire to include in the purview of my invention the construction, combination and arrangement and methods substantially as set forth in the appended claims.

It is obvious that with this construction there is provided a new and novel means and method of scavenging, supercharging and operating the valves of a two cycle, internal combustion engine that nearly doubles the volume of air introduced into the working cylinder and whereby, air under multiplied atmospheric pressure enters the working cylinder then expands, its pressure decreasing to nearly double atmospheric pressure which is compressed in said cylinder forming a high charge, and that the exhaust gases are forced out through the exhaust valves 21 by a pressure in volume form by the new charge entering, which starts as soon as the pressure in the interior of the working piston is more than the pressure of the exhaust gas in the working cylinder, both pressures decreasing at the same rate so that the springs 7^a are overcome by the pressure so that the new charge enters the cylinder in volume form retarded from mixing therewith by reason of the aforesaid equal rate of decrease of the pressure of the exhaust gases and the pressure of new charge from the time it enters so that complete scavenging of the working cylinder is effected, and that the exhaust valves and actuating means are actuated and controlled by the difference in pressure caused by the operation of the

engine and atmospheric pressure on the opposite sides of said valves and actuated means.

Having thus described my invention what I claim as new and desire to secure by Letters Patent, is:

1. In a two cycle, internal combustion engine, a two dimension cylinder, a two dimension piston reciprocally mounted therein provided with an air pressure chamber, pressure actuated valve means in said piston adapted to open and close ports communicating with the small diameter cylinder, pressure actuated valves in said piston adapted to open and close the ports on opposite sides of the large diameter piston and pressure actuated valves adapted to admit air into said cylinder on opposite sides of said large diameter piston.

2. In a two cycle, internal combustion engine, a two dimension cylinder, a two dimension piston reciprocally mounted therein provided with an air pressure chamber, pressure actuated valve means in said piston adapted to open and close ports communicating with the small diameter cylinder, pressure actuated valves in said piston adapted to open and close the ports on opposite sides of the large diameter piston, pressure actuated valves adapted to admit air into said cylinder on opposite sides of said large diameter piston, and pressure actuated exhaust valves mounted in the head end of said small diameter cylinders.

3. In a two cycle, internal combustion engine, a working cylinder, a pump cylinder communicating therewith, a piston provided with a working portion and a pumping portion reciprocally mounted therein, pressure actuated valve means mounted in the walls of said cylinder for admitting air into said pumping cylinder on opposite sides of said pumping portion of said piston, pressure actuated valves mounted in said pumping portion for admitting air into the interior of said piston from either side of said pumping portion of the said piston, pressure actuated valve means mounted in said working piston for admitting air into the working cylinder from the interior of said piston and pressure actuated exhaust valve, means operated by the exhaust gases from said working cylinder and controlled by the pressure in the pump cylinder adapted to permit the passage of the exhausted products of combustion from said working cylinders.

4. In a two cycle, internal combustion engine, a working cylinder, a pump cylinder communicating therewith, a piston provided with a working portion and a pumping portion reciprocally mounted therein, pressure actuated valve means mounted in the walls of said cylinder for admitting air into said pumping cylinder on opposite sides of said pumping portion of said piston, pressure

actuated valves mounted in said pumping portion for admitting air into the interior of said piston from either side of said pumping portion of the said piston, pressure actuated valve means mounted in said working piston for admitting air into the working cylinder from the interior of said piston and pressure actuated exhaust valves operated by the exhaust gases from said working cylinder controlled by the pressure in the pump cylinder adapted to permit the passage of the exhausted products of combustion from said working cylinder, consisting of pistons operatively connected with said exhaust valves, cylinders in which said pistons are reciprocally mounted provided with ports communicating with the interior of the working cylinder, a piston valve in said port, a trap valve in said port between said piston valve and said working cylinder, a piston secured to the piston rod of said piston valve and a cylinder in which it is reciprocally mounted with a port communicating with the interior of said pump cylinder.

5. The herein described method of scavenging a two cycle engine cylinder consisting in releasing the exhaust products of combustion in the working cylinder then as soon as the pressure of a fresh charge is greater than the exhaust products of combustion admitting fresh air into said cylinder in volume form and removing the exhaust products of combustion by reason of the unequal pressure of the incoming and the outgoing charge, then renewing the fresh charge in the working piston to approximately double atmospheric pressure by a pump operating in unison with said working piston.

6. The herein described method of supercharging and scavenging a two cycle gas engine cylinder consisting in pumping air into the interior of the working piston upon its outward stroke to nearly double atmospheric pressure, then pumping another charge into said piston upon its inward stroke to nearly five times atmospheric pressure, then releasing the exhaust products of combustion in the working cylinder, then as soon as the pressure in the working cylinder is reduced to below the pressure of the supercharge in the pistons admitting said supercharge into the cylinder in volume form and removing the exhaust products of combustion by the varying and decreasing pressure of both.

7. The herein described method of operating the exhaust valves of a gas engine consisting in pumping air above atmospheric pressure into a cylinder which operates a piston valve, which opens a port to other cylinders, then when the working piston has reached the end of its outward stroke admitting exhaust products of combustion into

said cylinders from the working cylinder which operates pistons connected with the exhaust valve, then relieving the pumping pressure which changes the port to said cylinder to the atmosphere relieving the valve actuating pistons which closes the valves.

8. In a two cycle internal combustion engine, an operating cylinder, a pump cylinder communicating therewith, an operating piston mounted in said pump cylinder, means for admitting air under pressure into said pump cylinder on either side of said pump piston, and means for admitting air under pressure into the interior of said operating piston from both sides of said pump piston in said pump cylinder and means for admitting the air from the interior of said operating piston into the operating cylinder when the pressure in the operating cylinder is reduced to below the pressure in said operating piston.

9. In a two cycle internal combustion en-

gine, an operating cylinder, a pump cylinder communicating therewith, an operating piston mounted in said pump cylinder, means for admitting air under pressure into said pump cylinder on either side of said pump piston, means for admitting air under pressure into the interior of said operating piston from both sides of said pump piston in said pump cylinder, means for admitting air from the interior of said operating piston into the operating cylinder when the pressure in the operating cylinder is reduced to below the pressure in said operating piston, and vapor actuated valve and piston means for actuating exhaust valves in the head of said working cylinder determined by the pressure in the pump cylinder.

In testimony whereof, I have hereunto set my hand at San Diego, California, this 2nd day of July, 1919.

GEORGE J. GALL.