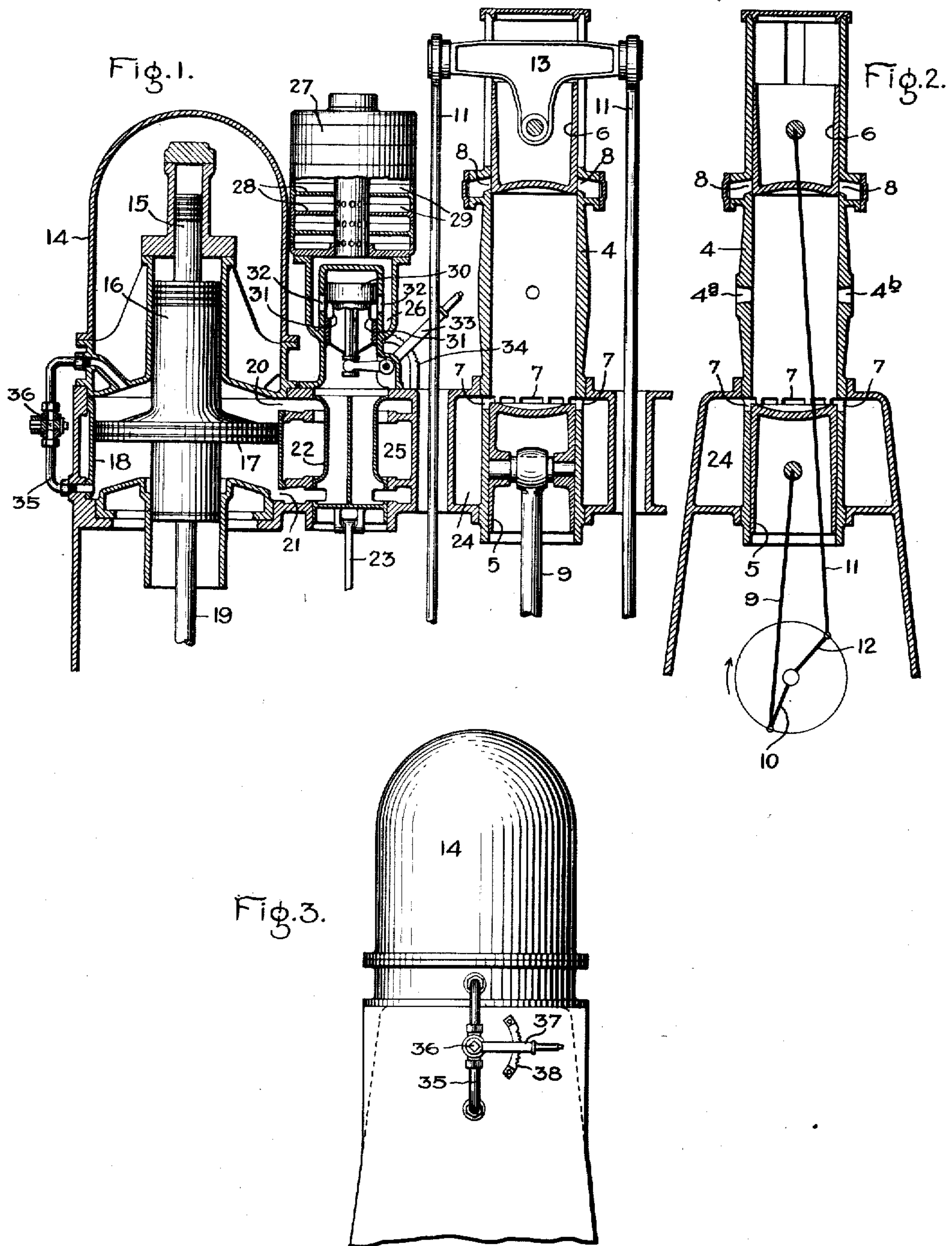


H. LEMP.
VARIABLE OUTPUT TWO-CYCLE ENGINE.
APPLICATION FILED JUNE 18, 1914.

1,166,916.

Patented Jan. 4, 1916.



Witnesses:
Marcus L. Byng.
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Inventor:
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UNITED STATES PATENT OFFICE.

HERMANN LEMP, OF ERIE, PENNSYLVANIA, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

VARIABLE-OUTPUT TWO-CYCLE ENGINE.

1,166,916.

Specification of Letters Patent.

Patented Jan. 4, 1916.

Application filed June 18, 1914. Serial No. 845,936.

To all whom it may concern:

Be it known that I, HERMANN LEMP, a citizen of the United States, residing at Erie, in the county of Erie, State of Pennsylvania, have invented certain new and useful Improvements in Variable-Output Two-Cycle Engines, of which the following is a specification.

The present invention relates to internal combustion engines of the two-cycle type having two pistons which move in unison and which serve to cover and uncover the inlet or scavenging and the exhaust ports, and in which the pistons are so arranged relative to each other that the piston controlling the exhaust port or ports leads that controlling the inlet port or ports. The advantages of this arrangement are that on the out stroke the exhaust port uncovers prior to the inlet port so as to permit the pressure in the cylinder to decrease to a value substantially equal to or slightly below that of the scavenging air so there will be no danger of exhaust gases escaping by way of the scavenging port, and on the compression stroke the exhaust port is covered prior to the scavenging port so as to permit of the scavenging air building up a certain amount of pressure in the cylinder and thus increasing the charge.

From the above it will be clear that the output of an engine of this type may be varied within certain limits by varying the pressure of the scavenging air since if this pressure is greater the amount of pure air forced into the cylinder after the exhaust port or ports have closed and before the scavenging ports close will be greater and vice versa.

The object of the present invention is to provide an improved means for varying the charge of air which will be forced into the cylinder between the closing of the exhaust port and the closing of the inlet port and to thus vary or control the output of the engine.

In the accompanying drawing wherein I have illustrated an embodiment of my invention, Figure 1 is a sectional view of a more or less diagrammatic nature showing an engine cylinder and scavenging pump arranged side by side; Fig. 2 is a similar view of an engine showing one arrangement whereby the piston controlling the exhaust ports may be caused to lead the other, and

Fig. 3 is an end elevation of the scavenging pump.

In carrying out my invention I provide a scavenging pump which will preferably have excess capacity for the normal output of the engine, and in connection therewith I provide suitable means for varying the output of the pump. To this end I preferably provide both a means for throttling the conduit on the suction side of the pump, and a waste passage, as a by-pass, leading from the suction to the delivery side of the pump, but it will be understood that either may be used alone or any other suitable means may be used.

Referring to the drawing, 4 indicates the cylinder of a two-cycle engine and 5 and 6 the pistons. The piston 5 controls the inlet or scavenging port or ports 7, and the piston 6 controls the exhaust port or ports 8, 9 is a connecting rod connecting the lower or inner piston 5 to its crank 10, and 11 are side rods connecting the upper or outer piston 6 to its crank 12, the connection to this piston being through a suitable cross-head 13. The rods 9 and 11 are shown diagrammatically in Fig. 2, as are also the cranks 10 and 12. The cranks 10 and 12 are displaced relative to each other, the angle between them being less than 180° . By this means the piston 6 is caused to lead the piston 5, the direction of rotation being clockwise as indicated by the arrow. At 4^a and 4^b are shown suitable openings for the introduction of fuel and starting air. The fuel injector and the air starting valve are not shown however, as their specific structures form no part of the present invention. Any suitable or known forms may be used.

Although in the present instance the engine is of a type having oppositely moving pistons with displaced cranks for obtaining the desired relation between the strokes of the piston, I am by no means limited to this arrangement, as any other arrangement which will produce the desired result may be used.

14 indicates the casing of a multi-stage compressor and a scavenging pump. The compressor is provided with a high pressure piston 15 and a low pressure piston 16 which operate in suitable cylinders. The details of the compressor are not illustrated as they form no part of the present invention. Moving with the pistons of the compressor is the

piston 17 of the scavenging pump, the cylinder thereof being indicated at 18. The pistons 15, 16, and 17 may be operated through the connecting rod 19 from a suitable crank on the main shaft.

The scavenging pump is of the double acting type and its cylinder is provided with ports 20 and 21 located at opposite ends. These ports are controlled by a slide valve 22 which is operated by the rod 23 which in turn may be operated by a suitable eccentric on the main shaft (not shown).

24 indicates a receiver for the scavenging air which surrounds the lower end of the engine cylinder and communicates with the scavenging ports 7 and with the region 25 surrounding the slide valve.

26 is a suction conduit having arranged on its outer end a suction silencer 27. The suction silencer is analogous to the muffler for the exhaust gases and may resemble the same in structure. In the present instance it is shown as comprising a plurality of plates 28 forming there between cells 29. The openings between these cells are staggered with relation to each other so as to present a tortuous or zigzag path for the air. It will be understood that any suitable form of silencer may be used. Controlling the passage of air through the suction conduit 26 is a slide valve 30 having a suitable opening or openings 31 in its side adapted to be moved into and out of register to a greater or less extent with the ports 32. The position of the valve is controlled by the hand lever 33 having a suitable latch for engagement with the notched segment 34 to hold the same in any adjusted position. By means of this valve the suction conduit can be throttled to any desired extent, or it may be entirely closed. Connecting opposite ends of the scavenging pump cylinder 18 is a by-pass pipe 35 having arranged therein the valve 36. This valve may be adjusted to any desired position by the hand lever 37, Fig. 3, and is held in adjusted position by a suitable catch which coöperates with the notched segment 38. This by-pass pipe acts in the nature of a waste pipe permitting a certain amount of leakage from the delivery side of the pump on each stroke. By the arrangement shown a single pipe and valve function for both sides of the piston and insure the same adjustment on each side.

In the position of the ports as shown in the drawing the pump piston 17 is about to complete a stroke in the upward direction, and the slide valve 22 is in such position as to connect the port 20 by way of the region 25 surrounding the valve 22 to chamber 24 in the receiver, and the port 21 to the suction conduit. On the reverse stroke the slide valve 22 will be shifted downward to reverse the connections with the ports 20 and 21.

When it is desired to vary the output of

the scavenging pump the valve 30 may be moved so as to throttle the suction conduit to a greater or less extent, or the valve 36 may be adjusted to permit of more or less leakage from the delivery side of the pump, or both may be adjusted. By this means the amount of air delivered by the pump may be varied which will result in a variation in the amount forced into the engine cylinder upon each cycle and hence the output of the engine.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. The combination in an internal combustion engine, of a cylinder, two pistons moving therein, exhaust and scavenging ports controlled by the pistons, the piston controlling the exhaust port leading the other, a scavenging pump for supplying air to the scavenging port, and means for varying the output of said pump.

2. The combination with a two-cycle internal combustion engine having two pistons which move substantially in unison and control the exhaust and scavenging ports, the piston controlling the exhaust port leading the other, of a scavenging pump for supplying air to the scavenging port, and means for varying the output of said pump.

3. The combination with a two-cycle internal combustion engine having two pistons which move substantially in unison and control the exhaust and scavenging ports, the piston controlling the exhaust port leading the other, of a scavenging pump for supplying air to the scavenging port, a suction conduit therefor, and valve means for throttling the passage through the conduit.

4. The combination with a two-cycle internal combustion engine having two pistons which move substantially in unison and control the exhaust and scavenging ports, the piston controlling the exhaust port leading the other, of a scavenging pump for supplying air to the scavenging port, a waste pipe connected with the cylinder of the pump, and an adjustable valve in said pipe.

5. The combination with a two-cycle internal combustion engine having two pistons which move substantially in unison and control the exhaust and scavenging ports, the piston controlling the exhaust port leading the other, of a scavenging pump for supplying air to the scavenging port, a suction conduit therefor, valve means for throttling the passage through the conduit, a waste pipe

connected with the cylinder of the pump, and an adjustable valve in said pipe.

5 6. The combination with a two-cycle internal combustion engine having two pistons which move substantially in unison and control the exhaust and scavenging ports, the piston controlling the exhaust port leading the other, of a scavenging pump for supplying air to the scavenging port comprising a
10 cylinder, a piston therein, ports leading to the cylinder on opposite sides of the piston, a suction conduit, a delivery conduit, valve means for alternately connecting the ports to the suction conduit and the delivery conduit respectively, a by-pass connecting opposite
15 ends of the pump cylinder, and a valve controlling said by-pass.

7. The combination with a two-cycle internal combustion engine having two pistons which move substantially in unison and control the exhaust and scavenging ports, the
20 the other, of a scavenging pump for supply- piston controlling the exhaust port leading the other, of a scavenging pump for supplying air to the scavenging port comprising a
25 cylinder, a piston therein, ports leading to the cylinder on opposite sides of the piston, a suction conduit, a delivery conduit, valve means for alternately connecting the ports to the suction conduit and the delivery conduit respectively, a by-pass connecting opposite
30 ends of the pump cylinder, a valve con-

trolling said by-pass, and a valve in the suction conduit for throttling the passage through the same. 35

8. In an internal combustion engine, the combination of a cylinder, oppositely moving pistons therein, scavenging and exhaust ports controlled by the pistons, said pistons having their cranks displaced
40 angularly relative to each other so that the piston controlling the exhaust ports leads the other, a wall which surrounds one end of the cylinder and forms a chamber communicating with the scavenging ports, a scavenging
45 pump for supplying scavenging air to said chamber, and means for varying the output of said pump.

9. In an internal combustion engine, the combination of a cylinder, oppositely moving
50 pistons therein, scavenging and exhaust ports controlled by the pistons, the piston controlling the exhaust port leading the other, a scavenging pump for supplying air to the scavenging port, a suction conduit
55 therefor, a valve therein for controlling the flow of air through it, and a hand lever for setting the valve.

In witness whereof, I have hereunto set my hand this 15th day of June 1914.

HERMANN LEMP.

Witnesses:

OTTO F. PERSSON,
O. T. FOUCHE.

It is hereby certified that in Letters Patent No. 1,166,916, granted January 4, 1916, upon the application of Hermann Lemp, of Erie, Pennsylvania, for an improvement in "Variable-Output Two-Cycle Engines," an error appears in the printed specification requiring correction as follows: Page 3, claim 7, strike out line 22; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 1st day of February, A. D., 1916.

[SEAL.]

Cl. 123-51

J. T. NEWTON,
Acting Commissioner of Patents.