E. W. CHRISTIE.

DRY VACUUM PUMP.

APPLICATION FILED FEB. 16, 1912.

1,093,313.

Patented Apr. 14, 1914.

3 SHEETS—SHEET 1.

Fig. 2

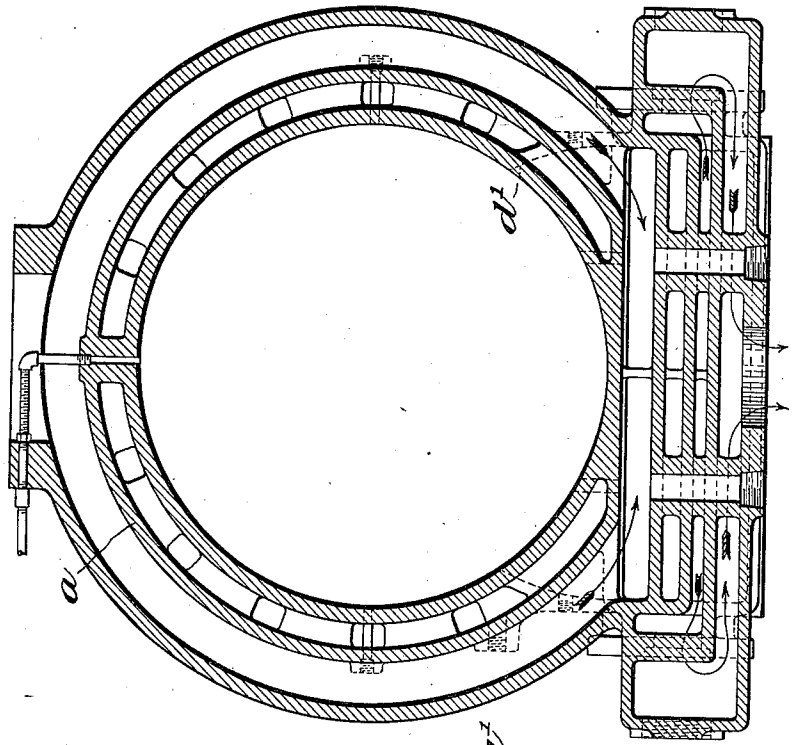
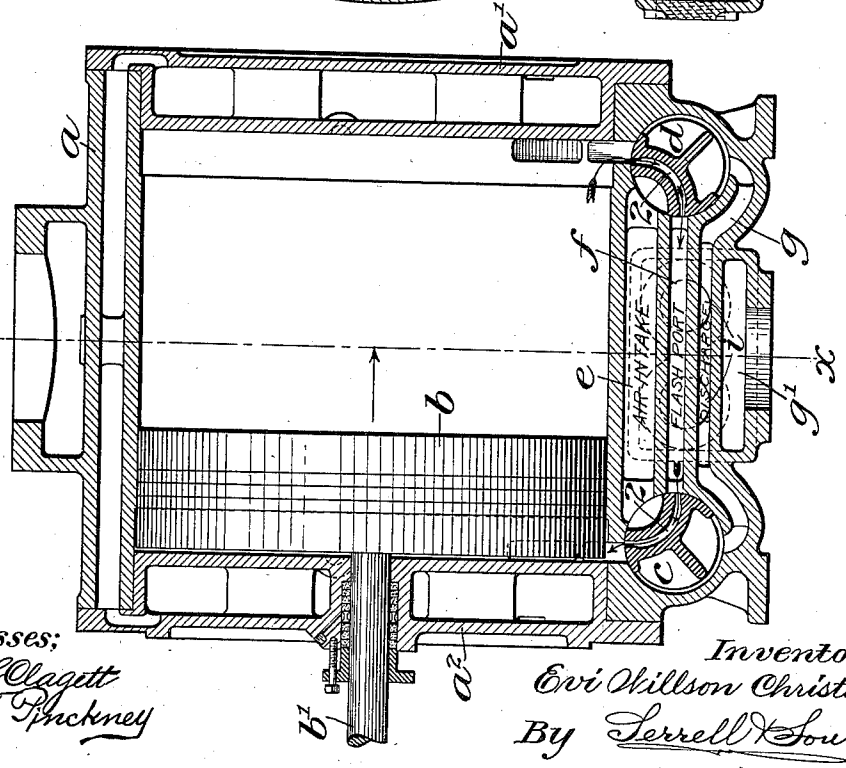


Fig. 1



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3 SHEETS—SHEET 2.

Fig. 4

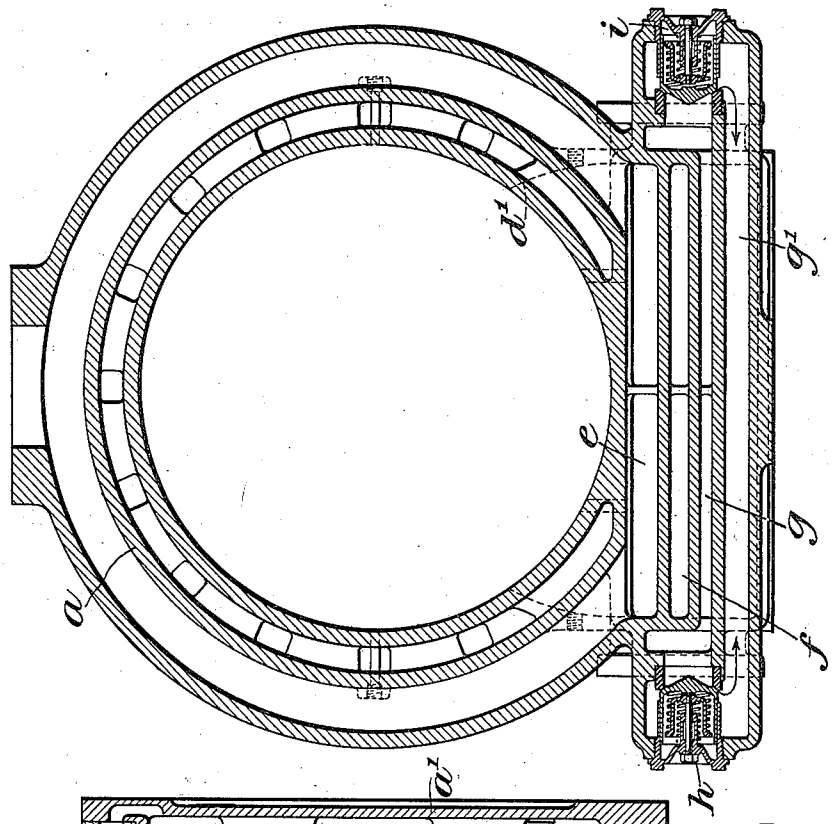
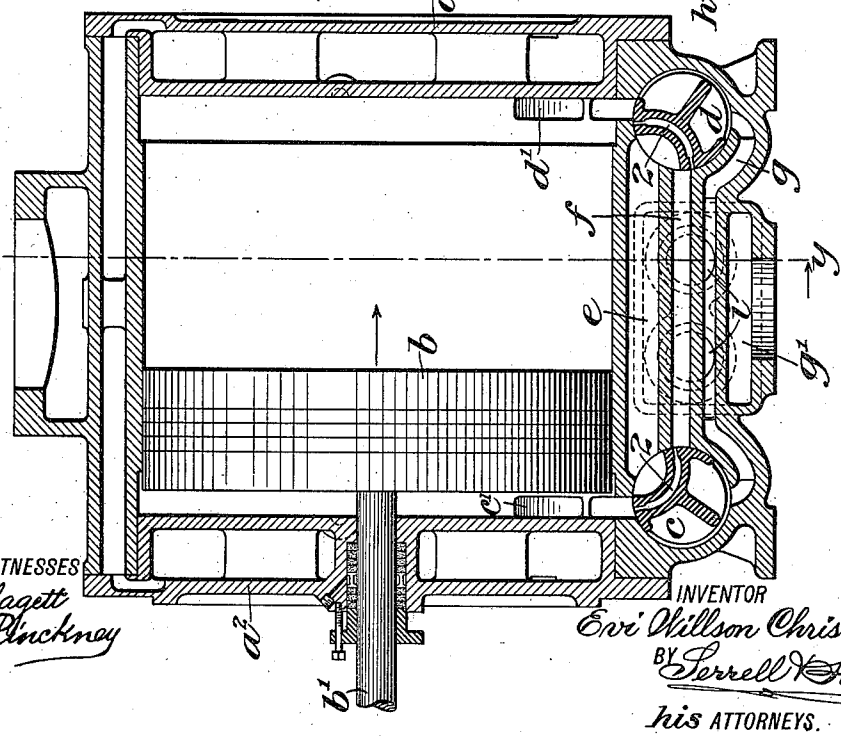


Fig. 3



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3 SHEETS—SHEET 3.

Fig. 7.

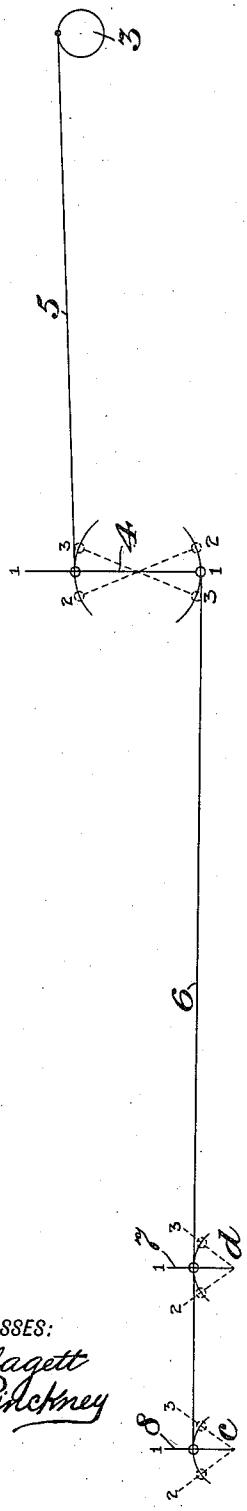


Fig. 6.

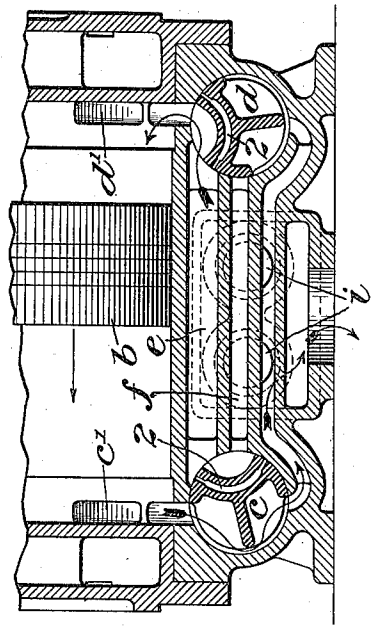
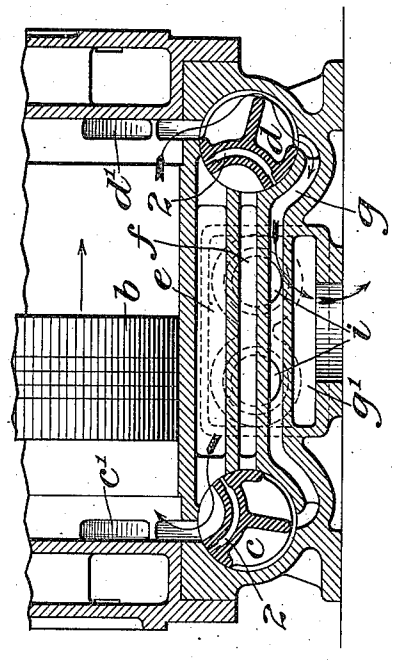


Fig. 5.



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UNITED STATES PATENT OFFICE.

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DRY VACUUM-PUMP.

1,093,313. Specification of Letters Patent. Patented Apr. 14, 1914.

Application filed February 16, 1912. Serial No. 678,030.

To all whom it may concern:

Be it known that I, EVI WILLSON CHRISTIE, a citizen of the United States, residing at Sewaren, in the county of Middlesex and State of New Jersey, have invented a certain new and useful Improvement in Dry Vacuum-Pumps, of which the following is a specification.

My invention relates to vacuum pumps, and particularly to the construction of the air cylinders of dry vacuum pumps, with the object of increasing the efficiency of existing structures by the location of active elements in the most advantageous position and relation for the performance of their functions with the greatest economy.

In carrying out my invention, I provide cylindrical oscillating valves closely adjacent to the ends of the air cylinder and at the bottom of the same for perfect drainage. These valves are oppositely disposed and are provided for the inlet and discharge of air and they are also provided with a curved intermediate port and these ports in like positions simultaneously connect with an intervening flashport and the cylinder ends, for equalizing the air pressure on opposite faces of the air piston at the moment of reversal of the movement of the air piston, or in other words, connecting the clearance space on the discharge side with the opposite end of the cylinder, allowing air present at atmospheric pressure to reëxpand into the vacuum on the suction side. This has the further utility of eliminating the effects of clearance, enabling the pump to draw from the condenser during the entire stroke, all of which is hereinafter more particularly described.

In the drawing, Figure 1 is a vertical longitudinal section through an air cylinder showing the devices of my improvement. Fig. 2 is a central cross section or vertical section at about the broken lines x x of Fig. 1. Fig. 3 is a vertical longitudinal section similar to Fig. 1, but with the parts in a slightly different position. Fig. 4 is a vertical cross section at about the broken lines y y of Fig. 3. Figs. 5 and 6 are vertical longitudinal sections at the lower portion of the air cylinder showing the piston in elevation and in different positions and the valves in different positions, and Fig. 7 is a diagrammatic view, illustrating the operation of the valves in the device of my improvement.

Similar letters and numerals of reference indicate similar parts in all the figures.

a represents the air cylinder, a^1 a^2 the cylinder heads, b the air piston and b^1 the piston rod. The air cylinder is advantageously hollowed, as shown, together with the heads for circulation of a cooling medium, and it is also preferably provided circumferentially with an air intake jacket for the air from the condenser to be drawn into the pump. The integral body of the cylinder at the base is provided with two valves c and d that are circular in cross section in circular openings adjacent to the respective ends of the air cylinder. The respective ends of the air cylinder are provided with a series of ports c^1 d^1, which communicate immediately with the valves c d, as between the location of these valves and the base of the body, I provide an air intake chamber e, at its ends communicating with these valves, also the flashport f, which at its ends also communicates with the valves and in a parallel plane below the flashport is a discharge port g, the ends of which dip toward the center of the valves c d. And still again below the discharge port g is a central discharge port g^1, these discharge ports g and g^1 being separated by the seating of puppet valves h and i, which come at opposite sides of the cylinder and at opposite ends of the discharge ports, and which valves permit the air forced past the valves c d and into the discharge port g to press the parts of the puppet discharge valves together and permit the escape of the air from the port g into the port g^1.

It will be noticed from the drawing, that the valves c and d are of peculiar shape, that they are provided with a curved upper portion, with a part in section of T-shape, between which and the upper portion is a curved port 2. It will also be noticed that these valves are set in opposition with their axes parallel and with their axes also extending at right angles to the line of direction and motion of the piston. It will also be apparent from the drawings, that the puppet valves h and i are only in communication with the discharge port g, the flashport f and the air intake port e being closed off therefrom. From Fig. 2, it will also be

apparent that the air intake port *e* is in communication all around the cylinder with the opening above the same, which is to be provided with any suitable cover and connections therefrom to the condensers well known in this art, but forming no part of my invention.

From Fig. 1, it will be noticed that the piston is at the left hand end of the cylinder, having completed its stroke in one direction and ready to move in the opposite direction. At this time, the valves *c d* occupy the position illustrated in this Fig. 1, in which their curved ports 2 are in communication with the flashport *f* and the ports c^1 d^1 at the opposite ends of the cylinder, consequently the clearance space on the discharge side is connected with the opposite end of the cylinder allowing air present at atmospheric pressure to reëxpand into the vacuum, equalizing the pressure, so as to more readily permit the reverse movement of the piston to be accomplished, or in other words, to permit the piston to start in the opposite direction unhampered by any vacuum influence.

Fig. 3 illustrates the next following position of the parts, that is, in which the piston has made a short movement, and the valve *d* has closed, the valve *c* having partially closed, that is, closed to the open communication between the respective ends of the piston that is shown in Fig. 1. The position Fig. 1 is only held momentarily, or just long enough to permit of the balancing of the pressure at the two ends of the cylinder and opposite faces of the piston. From the position Fig. 2, the valves are very quickly shifted so as to bring them into the position shown in Fig. 5, in which the piston moving to the right draws in the air from the air intake *e* into the left hand end of the air cylinder and at the same time, the piston is forcing the air from the right hand end of the air cylinder through the ports d^1 past the valve *d* and into the discharge port *g*, where the pressure causes the puppet valves to open and the air to be discharged from the port *g* into the port g^1.

From Fig. 4, it will be noticed that both puppet valves are in communication with the same common and transverse chamber *g*, consequently both valves act with each stroke of the piston in opposite directions and the air forced ahead of the piston is quickly discharged. When the piston reaches the right hand end of the air cylinder, the valves again come substantially into the position shown in Fig. 1, so that momentarily again the pressure at the two ends of the cylinder is the same and the piston is readily started from the right hand end toward the left hand end in reversing the operation. Fig. 6 shows this position, in which the piston is moving from the right toward the left hand end of the air cylinder, and in which in the position of the valve *d*, air from the intake chamber *e* is being drawn in through the ports d^1 into the right hand end of the air cylinder and the air from the left hand end is being forced out by the ports c^1 around the valve *c* and into the discharge port *g* and therefrom past both puppet valves or series of puppet valves into the chamber g^1 and so away. The valve *c* oscillates from the position Fig. 6 to the positions Figs. 1 and 5, then back to the position Fig. 6, while the valve *d* oscillates from the position Fig. 5 to the positions Figs. 1 and 6 and back, and in this oscillation and as hereinbefore described, connecting the opposite ends of the air cylinder at the extreme movement of the piston in each direction, opens up the air intake chamber *e* with either end of the air cylinder or opens up the discharge port *g* with either end of the air cylinder.

In the diagrammatic view Fig. 7, 3 indicates the fly wheel shaft of the pump, 4 an oscillating lever centrally pivoted and 5 a connecting rod from 3 to 4, and 6 a connecting rod from 4 to cranks upon the ends of the valves *c d*. In this figure, the position 1 agrees with the position of the valves in Fig. 1, the position 2 agrees with the position of the valves in Fig. 5, and the position 3 agrees with the position of the valves in Fig. 6, and the parts are so set and timed that the valves are moved automatically for the performance of their functions in the operation of the machine.

I claim as my invention:

In a dry vacuum pump, two similar oppositely disposed oscillating valves placed adjacent to the opposite ends of the cylinder and stroke and piston, and each having a curved port therethrough, an intervening flashport, an air intake chamber located above the flashport, a discharge chamber located below the flash port, series of puppet valves freely communicating with the opposite ends of the discharge chamber and a second discharge chamber located below the first aforesaid discharge chamber and with which the puppet valves establish communication when open.

Signed by me this 9th day of February, 1912.

EVI WILLSON CHRISTIE.

Witnesses:
J. J. Brown,
W. J. Best.