F. ARONSON.

VACUUM PUMP.

APPLICATION FILED OCT. 1, 1909.

999,290. Patented Aug. 1, 1911.

Fig. 1

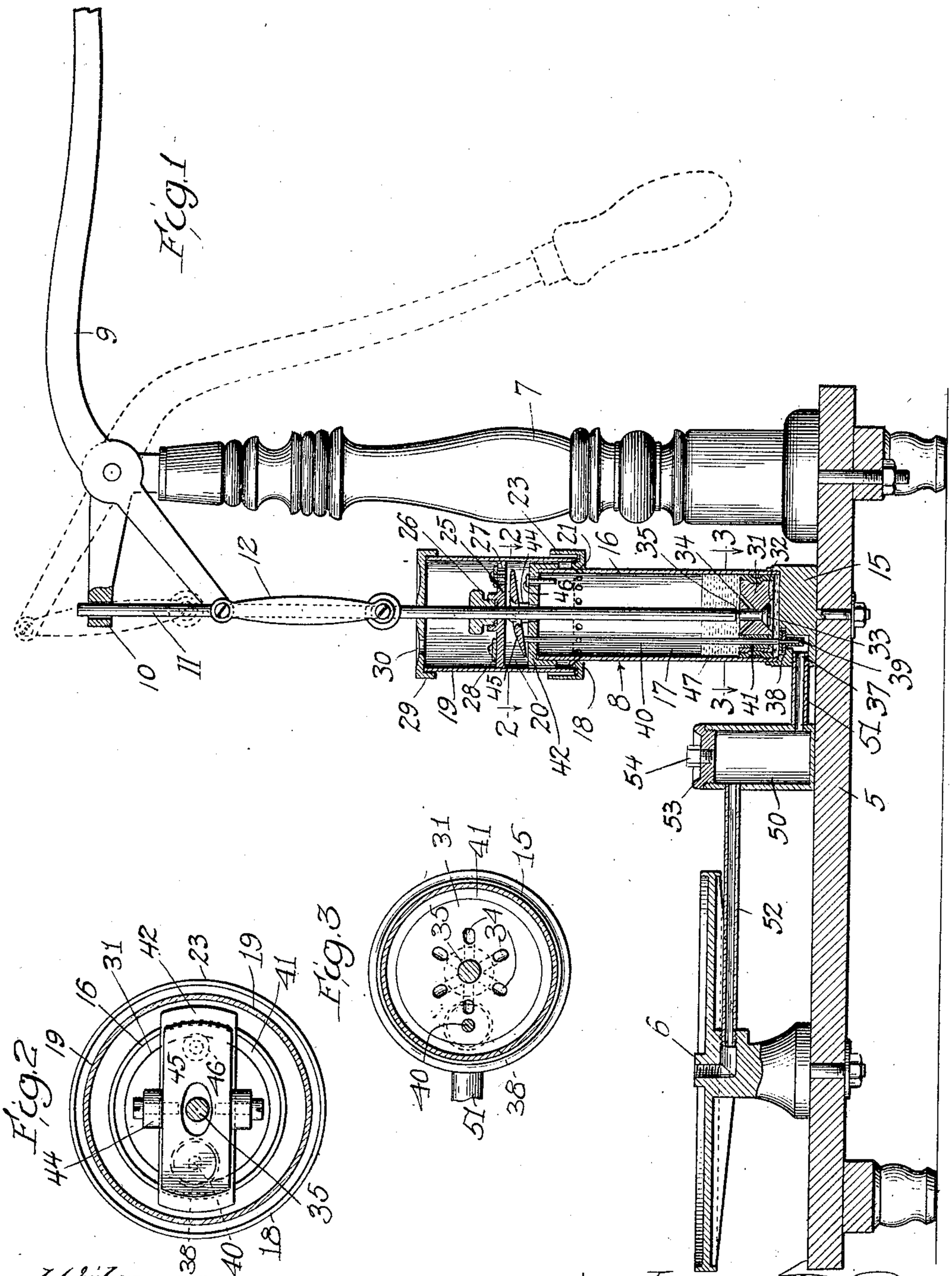

Fig. 2

Fig. 3

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UNITED STATES PATENT OFFICE.

FRANK ARONSON, OF EVANSTON, ILLINOIS, ASSIGNOR TO CENTRAL SCIENTIFIC CO., OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

VACUUM-PUMP.

999,290. Specification of Letters Patent. **Patented Aug. 1, 1911.**

Application filed October 1, 1909. Serial No. 520,573.

To all whom it may concern:

Be it known that I, FRANK ARONSON, a citizen of the United States, residing at Evanston, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Vacuum-Pumps, of which the following is a specification.

My invention relates to improvements in vacuum pumps such as are employed in laboratories and factories for exhausting air from suitable vessels, and has for its general object to provide a powerful, rapid-acting pump, capable of exhausting air to a high degree of attenuation with rapidity and ease.

A further object of my invention is to provide a pump of the character described wherein oil is employed as a moving packing for the piston and its valves, and wherein provision is made to prevent the accidental flow of oil from the cylinder to the suction base.

Other and further objects of my invention will become apparent to those skilled in the art from the following description taken in conjunction with the accompanying drawings, in which—

Figure 1 is a central vertical section, with parts in elevation, of a complete pump embodying my invention; Fig. 2 is a horizontal section on line 2—2 of Fig. 1; and Fig. 3 is a horizontal section on line 3—3 of Fig. 1.

For laboratory purposes the pump may conveniently be constructed as follows:

5 is a stand supporting a vacuum base, 6, of any convenient form, standard 7, and pump structure, 8, the standard pivotally supporting the prime mover or handle, 9, and providing a bearing projection, 10, in which reciprocates the piston rod, 11, connected, as by links 12, with the handle 9.

The pump provides a base, 15, which forms the cylinder head and to which is secured the tubular cylinder, 16, the interior of which forms what I will term the "piston chamber," 17. To the exterior of the cylinder 16, at a suitable distance below its upper end, is secured an annulus, 18, upon which is mounted a cylindrical head, 19, spaced apart somewhat from the cylinder 16 and inclosing what I will term the "head chamber," 20, of larger diameter than the piston chamber, 17. Communication is established from the head chamber to the piston chamber below the upper end of the cylinder 16 by a series of ports, 21, preferably passing through the annulus 18; and the head and cylinder chambers are further in communication through the open end of cylinder 16. Preferably the annulus 18 extends out beyond the head 19,—which may conveniently be threaded thereto—and is provided with an upturned wall, 23, forming a drip cup beyond the head, to receive surplus oil as hereinafter described.

The head chamber 20 is preferably divided transversely by a partition 25, having a suitably packed gland, 26, for the piston rod 11 and openings, 27, covered by leather valves, 28, or similar downward closing check valves. The portion of the head chamber above the partition is open to the exterior air, as through openings, 30, provided in a suitable cap, 29.

The piston 31 upon the piston rod, 11, is arranged to sweep, during the movement of the lever, 9, from a point very close to the bottom of the piston chamber to a point above and clearing the ports between the head chamber and the piston chamber, as indicated by a dotted line in Fig. 1, thereby to control communication of the head chamber with the "suction" side of the piston chamber; and said piston is provided with a port and valve means whereby the port is closed on the up-stroke and open on the down-stroke. To this end the piston 31 is preferably provided upon its under face with a valve seat, 32, for coöperation with a valve, 33, upon the extremity of the piston rod 11, said seat 31 opening to ports 34 extending through the body of the piston beyond the valve to the upper side thereof. The stem of the piston rod is shouldered, as at 35, so that when the rod is depressed the valve 33 may be moved a short distance from the seat 31 to open communication through the ports 34 and the valve seat 33 between opposite sides of the piston.

The piston in its movement controls not only the constantly open ports 21 between the head chamber 20 and piston chamber 17 but controls also a positive valve for the inlet opening to the pump. The inlet port, 37, opens into the pump base and communicates with an enlarged valve recess, 38, in which works a valve, 39, carried by a vertical stem, 40, which extends up through an open-

ing in the piston, packed, as at 41, for efficient sealing and for frictional effect, and passing through a guiding aperture in a bridge, 42, which spans but does not close the upper end of the cylinder 16.

The frictional connection of the valve rod 40 with the piston is such that the valve tends to move up or down according to the direction of progress of the piston, but means are provided whereby the piston, when approaching the end of its up-stroke and while continuing its upward course, positively moves the valve to closed position. To this end I provide the bridge 42 with upturned side ears, 44, between which is pivotally mounted a lever 45, having one end overlying the extremity of the valve rod 40 and its opposite extremity overlying a pin, 46, mounted for vertical reciprocation in the bridge 42 and having its lower end extending into the path of movement of the piston. Thus it will be seen that as the piston 35 rises and nears the upper extremity of its range of movement, it strikes the pin 46, lifts the latter and the corresponding end of lever 45, and depresses the valve rod 40 to close the valve 30 notwithstanding the continuing upward movement of the piston.

The pump is completed by the introduction of a body of oil, 47, into the piston chamber, said body being of suitable proportion for the particular size of pump to afford efficient oil seal for the pump in its action hereafter to be described.

The inlet, 37, of the pump is connected with the suction opening in the base 6, but preferably in the course of such connection an oil chamber is provided. Specifically, 50 indicates an oil chamber having connection by pipe 51 from a point near its bottom to the pump inlet 37, and by pipe 52 from a point near its top to the opening in the suction base 6. The chamber 50 is preferably of large enough capacity to hold the entire body of oil introduced into the pump and is preferably provided with a tight head, 53, having a vent opening therein, closable as by a screw cap, 54.

The operation of the pump is as follows: Assuming the pump to be in the condition shown in Fig. 1 with the handle 9 elevated and the automatic valve 39 closed and the oil body substantially all resident within the piston chamber above the piston, now depression of the handle-lever 9 elevating the piston rod, causes the valve 33 of the piston to close, as shown in Fig. 1, and elevates the piston with the oil body thereabove. As the piston starts in motion upward, it lifts the valve rod 40, tilting the lever 45 to opposite position from that shown in Fig. 1 and opening the piping communication between the piston chamber and the suction head 6, so that during the up-stroke of the piston air may flow into the piston chamber, through the open valve 39, while air above the piston is forced out through vents 27 and 30. As the piston approaches the end of its up-stroke oil runs out of the piston chamber through the ports, 21, into the head chamber and it may also flow over the top of the cylinder into said head chamber until such time as the piston nears the end of its up-stroke. Just before the piston reaches the position where its lower edge clears the ports 21, it raises the pin 46, throwing over the lever 45 and forcibly depressing the valve rod 40 so as to seat the valve 39 and close the pump inlet. Then, as the piston clears the ports 21, putting the head chamber into communication with the "suction" side of the piston chamber, oil may flow from the head chamber 20 back into the piston chamber 17 below the piston, or on its suction side, and during the subsequent down-stroke, the piston valve 33 being open, oil may also flow downward through the piston valve—counter to the air passing upward through the piston,—thereby to oil-seal the lower valve 39, assisting in preventing backward flow of air from the pump cylinder to the suction piping. As the air is lifted by the piston and its sealing oil, it passes out readily through the check valves 28 and the opening 30, and it will be observed that any oil forced out of the pump by the same path,—either in atomized form entrained by the air or in a stream occasioned by overfilling of the piston chamber with oil—will find its way down the sides of the head 19 into the drip cup 23. Enough oil always finds its way above the partition 25 to keep the valves 28 in working order, and the parts lubricated and oil-sealed. On return-stroke of the piston, the valve 39 is forcibly held closed by the action of the piston upon the rod 40 and, valve 33 in the piston being open, the air body within the cylinder is forced through the piston and the oil thereon, such oil as has passed down below the piston passing up through the piston to enhance the sealing body above mentioned. If for any reason the valve 39 should fail to operate properly and oil should flow through the valve opening 38, it is received in the reservoir 50 and prevented from flowing into the vessel being exhausted upon the suction base 6. To break the seal from any vessel on the base 6, the cap 54 on said reservoir is removed and air permitted to enter the suction piping through said opening.

It will be observed that the present structure is simple and easy of manufacture and that from an operating view point it is rapid in its action. On every up-stroke of the piston, the latter displaces the entire air content of the piston chamber, and its vacuum side is open during substantially its entire stroke. The control of the inlet valve is rapid and effective and the arrangement

whereby the piston acts to control the return of flow of the oil around the piston at the end of its out-stroke, makes the pump particularly effective for rapid action.

While I have herein described in some detail a particular embodiment of my invention, it will be apparent to those skilled in the art that numerous changes might be made in the specific construction without departure from the spirit and scope of the invention and within the scope of the appended claims.

What I claim is:

1. In a vacuum pump, the combination of a cylinder providing a piston chamber, and a head structure providing a head chamber encompassing the outer end of the cylinder, and having direct openings of communication with said cylinder sufficient to permit rapid flow of substantially the entire contents of the cylinder into the head chamber, a piston in the cylinder having a path of travel to control communication of said head chamber with the suction side of the piston, and a body of oil movable into the head chamber by the piston and returnable below the piston through the portion of said head chamber encompassing the cylinder.

2. In a vacuum pump, the combination of a cylinder providing a piston chamber and a head chamber, having openings for communication therebetween and said openings including ports through the side of the piston chamber near the outer end thereof, said head chamber having a valved outlet to atmosphere, a piston having a path of travel across the side ports aforesaid of the piston chamber, and a body of fluid for sealing the piston, movable by the piston into said head chamber substantially in its entirety, and returnable through said side ports to the suction side of the cylinder after said piston has passed the ports.

3. In a vacuum pump, the combination of a piston chamber, a head chamber encompassing the outer end of said piston chamber provided with openings for communication with the piston chamber through the side wall of the latter, said head chamber having a valved outlet opening to atmosphere and said piston chamber having a valved inlet opening, and a valved piston having a path of reciprocation past the side openings of the piston chamber near the end of its out-stroke.

4. In a vacuum pump, the combination of a piston chamber, a head chamber in constantly open communication therewith at the end of said piston chamber, and having openings for communication therewith through the side of said piston chamber near its outer end, a body of fluid for sealing the piston chamber, a valved piston arranged to force the sealing body substantially in its entirety into the head chamber and to pass said side openings to permit return of said body to the suction side of the piston, there being a valved inlet opening to the inner end of the piston chamber and a valved outlet to atmosphere from the head chamber, and means for operating the inlet valve mechanically controlled by the piston in its travel.

5. In an oil-sealed vacuum pump, the combination of a piston chamber, a piston therein, and a means to provide an opening through said piston during its in-stroke and to close said piston during its out-stroke; a head chamber communicating with said piston chamber at the top of the latter, and also through side ports adjacent its top, said ports being arranged to be passed by the piston near the end of its out-stroke; a valve for the inlet, and means whereby the piston opens the valve during the early stages of its out-stroke and closes the valve approximately as it passes the side ports of the piston chamber.

6. In an oil-sealed pump, the combination of a piston chamber having an inlet, a top opening, and a port through its sides adjacent the top opening, a piston arranged to travel in a path of reciprocation passing the side port near the end of its out-stroke, said piston providing an oil passage therethrough, and valve means open on the in-stroke of the piston and closed on its out-stroke, a valve for the inlet, a frictional connection between said piston and the inlet valve whereby said piston on its out-stroke opens the inlet valve, a rocking lever operable by the piston near the end of its out-stroke for moving said valve to closed position approximately as the piston passes the side ports, and a head chamber communicating with said piston chamber through said side opening and the open top of the piston chamber.

7. In a vacuum pump, the combination of a piston chamber having a bottom inlet, and ports through its sides adjacent its outer end, a piston arranged to travel in a path of reciprocation passing the side ports near the end of its out-stroke, said piston providing a valved oil-passage therethrough, a valve for the inlet, operating connections between said piston and inlet valve whereby said piston on its out-stroke opens the inlet valve, and thereafter closes the same approximately as it passes the side ports, and a head chamber encompassing the outer end of said cylinder, and in open communication with said side ports, said chamber having a valved outlet opening to atmosphere.

8. In a vacuum pump, the combination of a piston chamber, a valved piston therein, a head chamber providing openings for communication with the piston chamber, through the side walls of said piston cham-

ber, near its outer end, said openings being arranged to be passed by the said piston near the end of its out-stroke, an inwardly-closing outlet valve controlling an outlet aperture from the head chamber, a valve controlling an air inlet to the suction side of the piston chamber, a body of fluid to be raised into the head chamber on the outlet-stroke of the piston, and return to the suction side of the piston through the side opening near the end of the piston out-stroke and pass through the valved-piston on the in-stroke of the latter, a valve controlling an air inlet on the suction side of the piston chamber, and means whereby the piston opens the valve at the initial stage of its out-stroke and closes said valve approximately as it passes the side opening to the head chamber.

9. In an oil-sealed vacuum pump, the combination of a suction base, a cylinder providing an inlet, a piston in said cylinder, a reservoir having a single inlet connected to the suction base and a single outlet opening connected to the pump inlet, the inlet of the said reservoir being higher than its single opening to the pump cylinder, and a valve for the pump inlet operable to prevent communication between the cylinder and the reservoir during the instroke of the piston; said reservoir constituting a means for intercepting any oil back-flowing through the inlet valve to prevent its reaching the suction base.

10. In a vacuum pump, the combination of a piston chamber, a valved piston therein arranged to be closed on its out-stroke and open on its in-stroke, a head chamber opening to said piston chamber at its outer end and through its side walls adjacent its outer end, a partition in said head chamber having apertures valved to open outwardly, means for reciprocating the piston to pass the side openings to the head chamber near the end of its out-stroke, a valve controlling an air inlet to the suction side of the piston chamber, and means whereby the piston opens the valve in the initial stages of its out-stroke and closes the valve approximately as it passes the side opening to the head chamber.

11. In a vacuum pump, the combination of a piston chamber, a valved piston therein arranged to be closed on its out-stroke and open on its in-stroke, a head chamber opening to said piston chamber at its outer end and through its side wall adjacent its outer end, a partition in said head chamber having apertures valved to open outwardly, means for reciprocating the piston to pass the side opening to the head chamber near the end of its out-stroke, a valve controlling an air inlet to the suction side of the piston chamber, means whereby the piston opens the valve in the initial stages of its out-stroke and closes the valve approximately as it passes the side opening to the head chamber, suction piping communicating with the inlet opening, and a reservoir in said suction piping having inlet and outlet openings at higher and lower levels respectively.

In testimony whereof I hereunto set my hand in the presence of two witnesses.

FRANK ARONSON.

In the presence of—

GEO. T. MAY, JR.,

WALTER H. GARASHA.