R. WARNOCK.

AIR PUMP.

APPLICATION FILED NOV. 17, 1916.

1,322,273.

Patented Nov. 18, 1919.

4 SHEETS—SHEET 1.

Fig. 2.

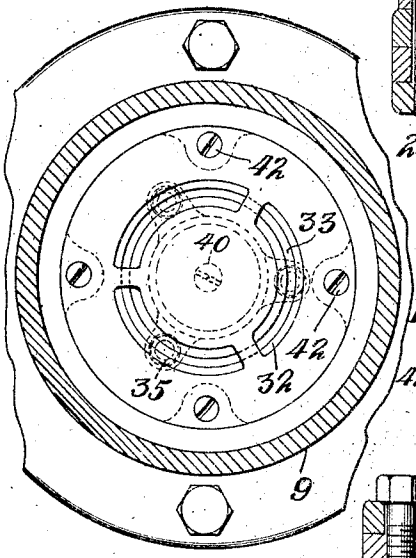

Fig. 1.

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4 SHEETS—SHEET 2.

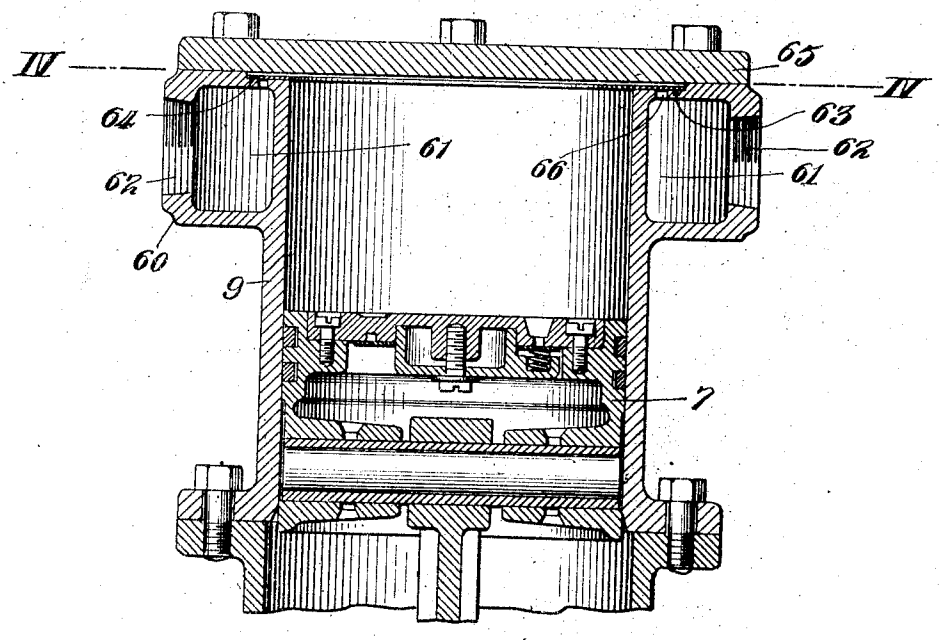

Fig. 3.

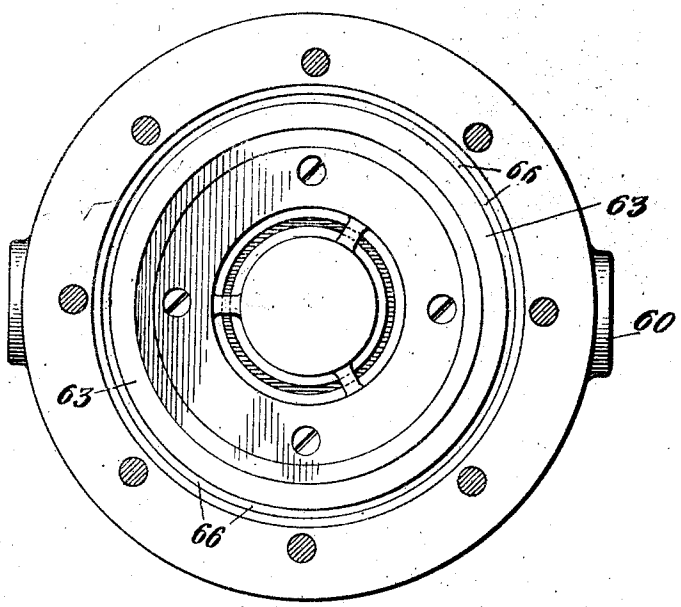

Fig. 4.

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4 SHEETS—SHEET 3.

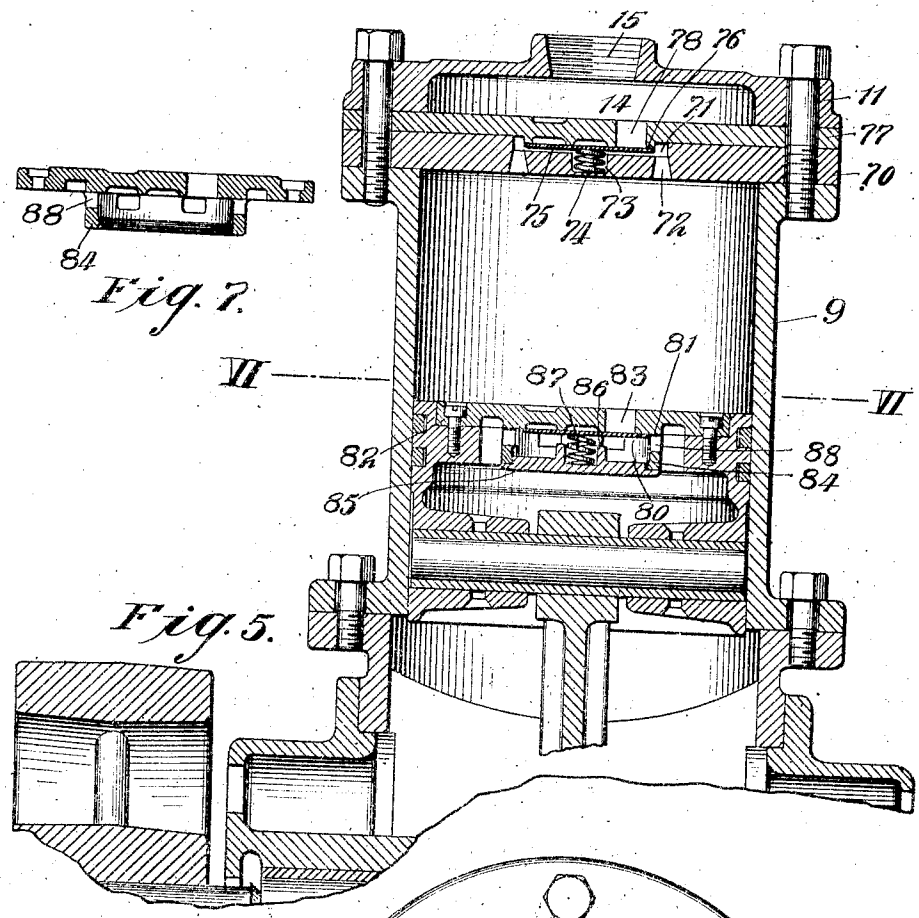

Fig. 7.

Fig. 5.

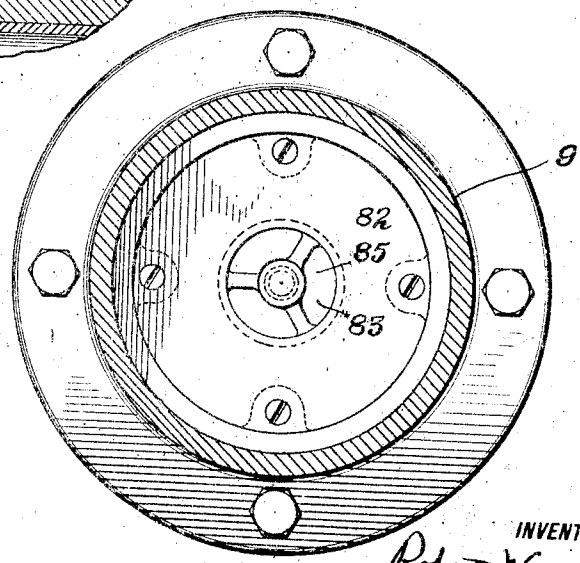

Fig. 6.

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4 SHEETS—SHEET 4.

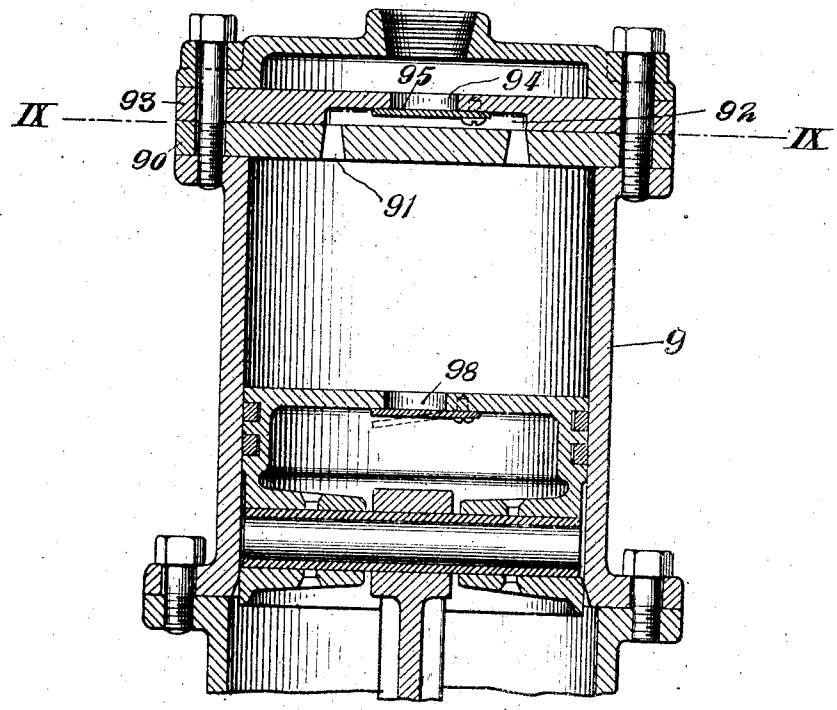

Fig. 8.

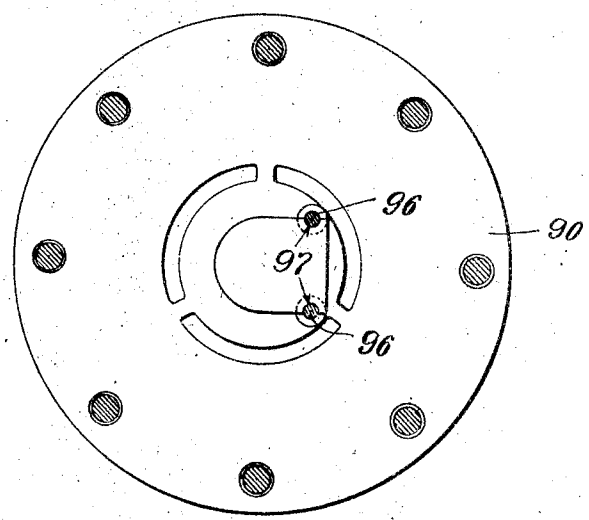

Fig 9.

INVENTOR

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UNITED STATES PATENT OFFICE.

ROBERT WARNOCK, OF BLOOMFIELD, NEW JERSEY, ASSIGNOR TO EMPIRE CREAM SEPARATOR COMPANY, OF BLOOMFIELD, NEW JERSEY, A CORPORATION OF NEW JERSEY.

AIR-PUMP.

1,322,273. Specification of Letters Patent. Patented Nov. 18, 1919.

Application filed November 17, 1916. Serial No. 131,830.

To all whom it may concern:

Be it known that I, ROBERT WARNOCK, a citizen of the United States, residing in Bloomfield, county of Essex, and State of New Jersey, have invented certain new and useful Improvements in Air-Pumps, of which the following is a specification.

This invention relates to pumps for handling fluids, such as air or other gases or vapors, and is particularly applicable to vacuum or suction pumps, although the invention may in some cases be applied to compression pumps.

In my application for patent, Serial No. 105,014, filed June 21, 1916, I have disclosed certain improvements in pumps by which certain advantages are attained with relation to lubrication and also to the silencing of the exhaust. The present invention relates to improvements in pumps of the character set forth in said application and designed to accomplish similar results. The present invention also includes means for recovering lubricant from shaft bearings, such as the crank shaft bearings of the pump.

In the accompanying drawings which form a part of this specification, I have illustrated certain preferred embodiments of my invention which are to be understood as illustrative of the principle thereof, but to the details of which the invention is not confined otherwise than as hereinafter specified.

In these drawings, Figure 1 is a vertical section of a form of vacuum pump, embodying the invention. Fig. 2 is a horizontal section on line II—II of Fig. 1. Fig. 3 is a vertical section of the cylinder and piston of a modified form of pump. Fig. 4 is a horizontal section on line IV—IV of Fig. 3, the annular inlet valve being removed. Fig. 5 is a vertical sectional view of the upper part of a modified form of pump. Fig. 6 is a horizontal section on line VI—VI of Fig. 5. Fig. 7 is a detail view in vertical section of the exhaust valve plate. Fig. 8 is a vertical sectional view of the piston and cylinder of another modified form of pump. Fig. 9 is a horizontal view on line IX—IX of Fig. 8.

Referring in detail to the construction shown in Figs. 1 and 2, the numeral 1 designates the pump base upon which is mounted the crank case 2 carrying the main bearings 3. Journaled in the main bearings is the crank shaft 4, the crank 5 of which is connected by means of the connecting rod 6 to the piston 7. The crank shaft may be rotated in any suitable manner as by means of the driving pulley 8. The piston 7 reciprocates in the cylinder 9, which is supported on the crank case. In the construction illustrated in these figures, the cylinder is provided with a compound head, which comprises an inner head member 10, an outer head or cover 11, and an intermediate plate 12, all of which are shown as clamped in position by a series of cap screws 13. The outer head member 11 is formed with a chamber 14 and with an inlet opening 15 into which may be screwed the inlet pipe (not shown). The intermediate plate 12 has ports formed in the same, these ports being preferable, but not necessarily, of the construction described in my application for patent, Serial No. 70,903, filed January 8, 1916, and as illustrated comprising a plurality of recesses 16 formed in the upper surface of the plate preferably by casting and a groove 17 machined in the lower surface of the plate to a depth sufficient to intersect the recesses 16 but leaving the webs 18 between the recesses. In this way passages are formed through the plate, webs are provided for supporting the central part of the plate and a smooth walled groove of the desired dimensions is provided in the inlet valve seat. The inlet valve seat is formed by the surface 20 of the plate 12 and upon this surface seats the inlet valve 21, which is illustrated as a thin flat metal ring. This ring is supported in position and limited in its movements by the inner head 10, which has a central boss 22 adapted to extend up within the recess 23 formed in the bottom of the plate 12. The annular valve 21 fits loosely about this boss and is centered thereby but is capable of moving freely up and down thereupon. The valve is received within the annular recess 24 formed in the head member 10, and is normally held against its seat by the light springs 25 mounted in recesses 26 in the inner head 10. The inner head 10 is also provided with inlet ports 27 which connect the recess 24 with the interior of the cylinder. It will be seen that on the down stroke of the piston the suction produced in the

cylinder will cause the valve 20 to move downward away from its seat in opposition to the force of the springs 25 so as to permit the air or other fluid to be drawn into the cylinder through the opening 15, chamber 14, ports 16 and 17, recess 24 and ports 27. On the up stroke of the piston, the valve 20 will close upon its seat under the influence of the springs 25 and of the pressure created in the cylinder.

In the form of the invention illustrated, the discharge takes place through the piston into the crank case. In the construction shown for this purpose, the piston 7 is formed with a recess 30 in which fits a valve plate 31 which is provided with a series of ports preferably formed by recesses 32 intersected by a groove 33. The discharge port formed by the groove is adapted to be intermittently closed by an annular valve 34 preferably of thin flat metal which is adapted to be held against its seat by a plurality of springs 35. A spider 36 is provided which has seats 37 for the springs and which is formed with a central boss 38 adapted to center and guide the annular valve 34 and to fit within a recess 39 formed in the underside of the valve plate. The spider 36 may be supported in position in any suitable manner as by means of a screw 40 screwing into a boss 41 in the center of the valve plate. The valve plate is shown as attached to the piston by means of a number of screws 42. When the piston moves up, the air or other fluid which has been drawn into the cylinder on the previous down stroke is compressed and caused to flow through the ports 32—33, thereby opening the valve 34 so as to permit the air to escape through the hollow piston into the crank case. Upon the down stroke of the piston, the valve 34 will close against its seat under the influence of the springs 35 and the difference in pressure due to the partial vacuum formed in the cylinder.

The pump of the form shown is intended to be lubricated by oil contained in the lower part of the crank case and caused to be splashed over the working parts by the lower end of the connecting rod and crank as the latter rotates. Some of the oil splashes over the lower part of the piston and cylinder walls and so lubricates the piston and a part of this oil is likely to find its way above the piston. Owing to the discharge taking place through the piston and into the crank case, however, this oil is not wasted but is returned to the crank case with the air discharged through the piston. As the discharge takes place directly over the wrist pin bearings 45, it will also increase the efficiency of lubrication of such bearings. As the volume of the crank case is relatively large, the air discharged thereinto will lose much of its velocity thereby depositing the oil which it carries. The loss of velocity of the air also results in the muffling of the sound of the exhaust, as the air which eventually is discharged through suitable openings in the crank case, such as the openings 46, will pass out more or less steadily and silently instead of in sharp puffs.

Owing to the fact that the discharge takes place through the oil reservoir or crank case, an excess of lubricant may be utilized as such excess instead of being rapidly dissipated as in pumps where the exhaust takes place in some other manner, will be conserved and will circulate through the pump indefinitely. This insures the highest degree of lubrication and makes the pump particularly adapted to give satisfactory service in the hands of unskilled operators.

As illustrated, means are provided for preventing the loss of oil from the main bearings and providing for the return of any excess of oil passing through these bearings to the crank case. In the construction shown, the main bearings are lubricated from small reservoirs 50, into which some of the oil from the lower part of the crank case is splashed. This oil works through the bearings toward the outer ends thereof and in order to catch this oil and throw the same back into the crank case, I provide the portions of the shaft immediately outside of the bearings with grooves 51 having vertical walls forming abrupt shoulders 52 adjacent to the ends of the bearings and having inclined walls 53 flaring outwardly. The oil when it reaches these grooves will be thrown from the shaft by centrifugal force and so be caught in the recesses 54 of the crank case instead of finding its way out through the openings 55 in the sides of the latter.

In Figs. 3 and 4, I have illustrated a modified form of my invention, in which I have shown a different form of inlet valve construction. In this construction the cylinder 9 has formed at its upper end an enlargement 60 in which is an annular chamber 61 having openings 62 for connection with the inlet pipe or pipes (not shown). The recessed valve seat 63 is formed in the top of the enlargement 60, a thin annular valve being mounted in this recess. A head 65 which may be in the form of a flat plate retains the valve in its recess and limits its movement. An annular port 66 connects the recess 63 with the chamber 61. A piston provided with a suitable exhaust valve construction for discharging the air into the crank case is utilized. As illustrated the piston 7 is provided with an outlet valve construction substantially the same as that shown in Figs. 1 and 2.

In Figs. 5, 6 and 7, I have shown another form of my invention in which disk valves

are employed in place of the annular valves shown in Figs. 1, 2, 3 and 4. As here illustrated, the cylinder 9 is provided with an inner head 70, in the upper surface of which is a recess 71 which communicates with the interior of the cylinder through a plurality of ports 72. In the center of the inner head is a small recess 73 which carries a spring 74 adapted to support a thin metal disk valve 75 in engagement with a seat 76 formed on the underside of the valve plate 77. The latter has formed through it a plurality of ports 78 which are adapted to be closed by the valve 75. The ports 78 communicate at their upper ends with the chamber 14 of an outer head member or cover 11 of the form shown in Fig. 1. The discharge from the cylinder takes place through the piston which may be provided with a discharge valve construction of any suitable character. As illustrated the piston is provided with a disk discharge valve similar to the inlet valve. This valve which is designated by the numeral 80 is adapted to seat against a seat 81 formed on the underside of the valve plate 82, which is provided with outlet port 83. The valve is retained within a cage 84 formed on the underside of the plate 82 as shown in Fig. 7, being held within the cage by a screw-cap 85 screwing into the lower end of the cage and having a central recess 86, which carries a spring 87, bearing against the underside of the valve. The cage is provided with a series of ports 88 for the escape of the air. The operation of this form of pump is substantially the same as that shown in Figs. 1 and 2.

In Figs. 8 and 9, I have shown another modified form of my invention in which thin, spring metal, flap valves are employed. As here illustrated, the cylinder 9 is provided with an inner head 90 formed with inlet ports 91 which communicate with a recess 92 formed in the underside of a valve plate 93. The latter has a central port 94 which is normally closed by a flap valve 95 secured in the recess 92 by means of a pair of screws 96 engaging notches 97 in the sides of the valve. The latter owing to its flexibility and to the fact that some play is left between it and the heads of the screws and the underside of the supporting plate is capable of moving toward and away from the seat so as to alternately close and open the air passage.

The discharge from the pump takes place through the piston into the crank case in the manner and for the purposes heretofore described. As illustrated, the piston of the pump is provided with a flap valve similar to the inlet valve, this flap valve closing a port 98 in the head of the piston.

While I have shown in the drawings and described in detail certain preferred embodiments of my invention, these are to be understood as illustrative of the principle thereof and I do not, therefore, desire to be limited to the details of construction any further as specified in the appended claims, but intend to cover my invention broadly in whatever form it may be embodied.

Having thus described my invention, I claim:

1. In apparatus of the character described, the combination of a cylinder, a head thereon including a lower member having an inlet port therethrough and a second member on said lower member having an inlet port therethrough and having an annular valve seat on its lower surface, said members being formed to inclose an inlet valve chamber between them, the ports in both of said members communicating with said chamber and an annular inlet valve in said inlet chamber adapted to close upwardly against said valve seat.

2. In apparatus of the character described, the combination of a cylinder, a head thereon including a lower member, an intermediate member and a cover member, said members being formed to provide recesses therebetween, an inlet opening into the recess between the cover member and the intermediate member, an inlet port connecting the interior of the cylinder with the recess between the intermediate member and the lower member, a port extending through said intermediate member and connecting the recess between the cover and the intermediate member with the recess between the intermediate member and the lower member, a downwardly-opening valve mounted in the recess between the intermediate member and the lower member and adapted to close upwardly against the seat on the intermediate member, and a piston in the cylinder.

3. In apparatus of the character described, the combination of a crank case constituting an oil reservoir, a cylinder mounted thereon, a piston therein having a discharge port therethrough discharging into the crank case and a valve seat thereon, a thin, flat metal valve adapted to move upwardly against said seat to close the passage through said discharge port and adapted to move downwardly away from said seat to open said port, a spring for urging said valve upwardly against said seat and a spring carrying member connected to the piston for supporting said spring.

4. In apparatus of the character described, the combination of a crank case constituting an oil reservoir, a cylinder mounted thereon, a piston therein having an opening through its head, a plate attached to the head of the piston and having a discharge port therethrough and having a valve seat and a discharge valve adapted to

close against said seat and to open to permit passage through said discharge port into said crank case.

5. In apparatus of the character described, the combination of a crank case constituting an oil reservoir, a cylinder mounted thereon, a piston therein having an opening through its head, a plate attached to the piston head having a discharge port therethrough discharging into said crank case and having a valve seat on its underside, a thin, flat metal valve adapted to close against said valve seat, a spring for urging said valve against its seat and a carrier for said spring carried by said plate.

ROBERT WARNOCK.