Jan. 7, 1941. C. F. COLEMAN 2,227,441

VACUUM PUMP

Original Filed Aug. 7, 1934 2 Sheets-Sheet 1

Fig. 1.

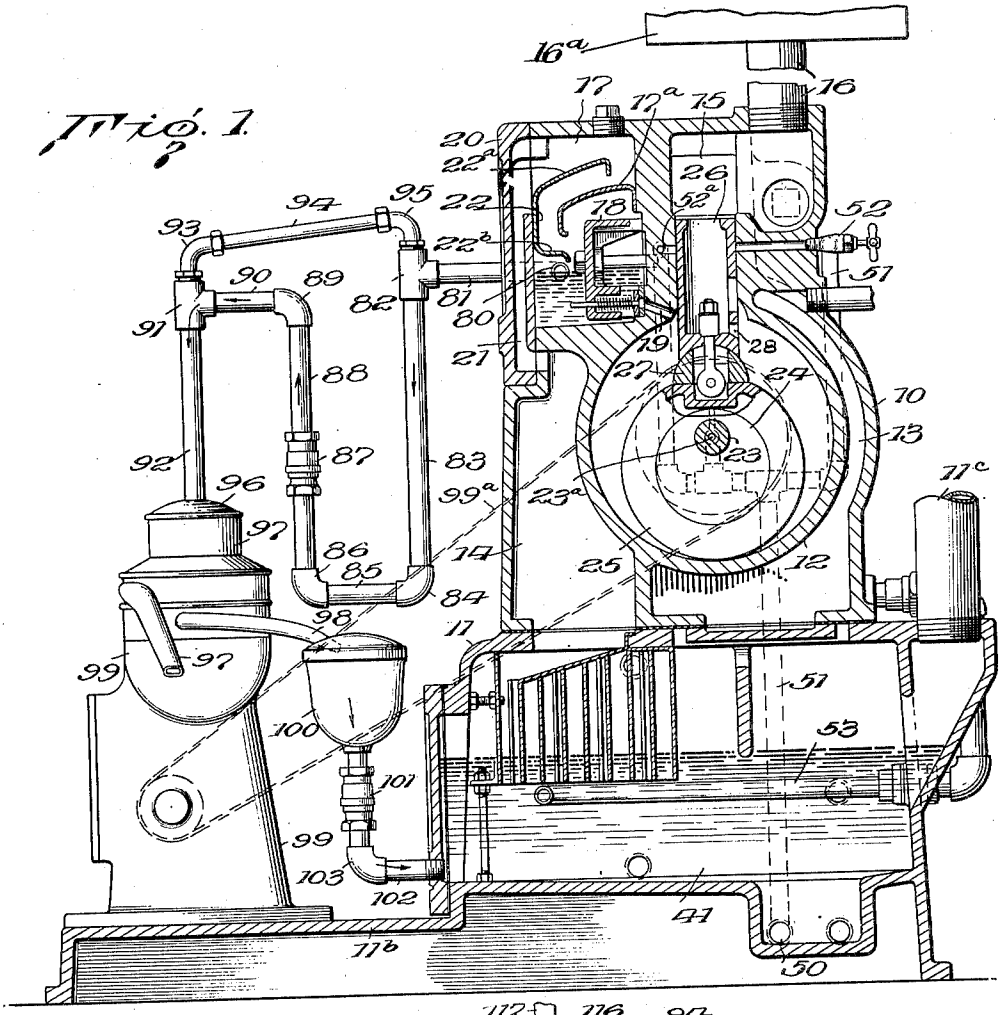


Fig. 2.

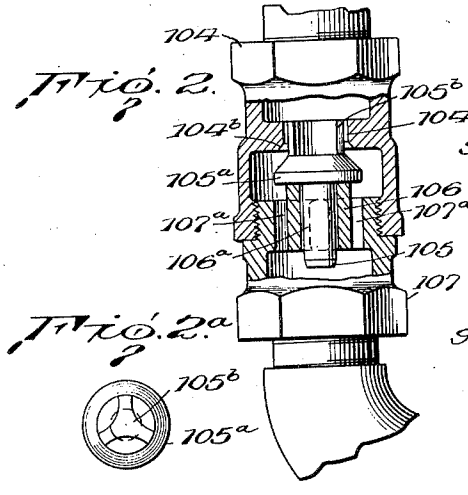


Fig. 2a.

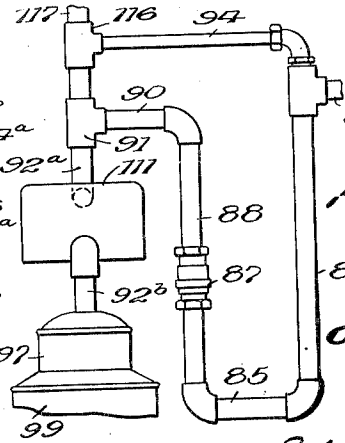
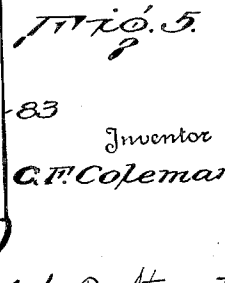


Fig. 5.



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VACUUM PUMP

Original Filed Aug. 7, 1934 2 Sheets-Sheet 2

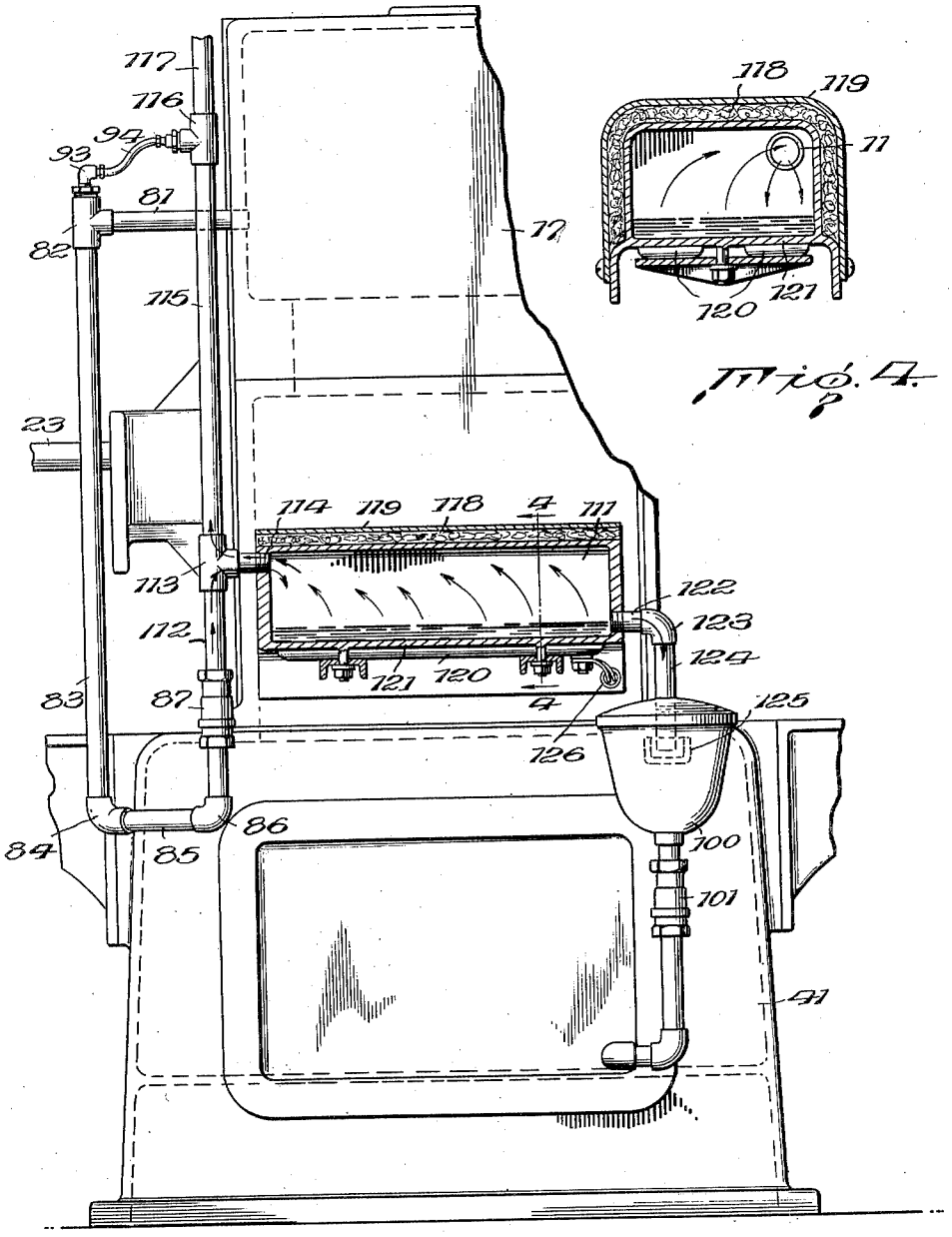


Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE

2,227,441

VACUUM PUMP

Charles F. Coleman, Philadelphia, Pa., assignor to F. J. Stokes Machine Company, a corporation of Pennsylvania

Application August 7, 1934, Serial No. 738,863
Renewed March 21, 1939

17 Claims. (Cl. 34—24)

My invention relates to improvements in mechanical gas pumps having a rotating piston and utilizing a liquid as a sealing medium, and particularly to the type used either as compressors or as high vacuum pumps and disclosed in U. S. Letters Patent No. 1,899,904, granted to O. S. Sleeper and C. J. Westin on February 28, 1933. An improved form of this pump is also disclosed in the application of Charles J. Westin Serial No. 724,974, filed May 10, 1934, now Patent No. 2,070,151, issued February 9, 1937.

One object of my invention is to provide new and improved means in a vacuum pumping system for clarifying or cleaning the sealing medium of foreign matter, such as dirt, coming over into the pump with the gases.

Another object is to dehydrate or separate out any vapors or moisture such as water which may be mixed or dispersed in the sealing medium.

Another object is to extract any solvent which may have gone into solution with the sealing medium.

It is also an object of my invention to provide means for taking the discharged sealing medium from the outlet compartment and passing this through the purifying and dehydrating means or solvent stripping means without having any of the vapors and gases coming over into this means.

A more specific object is to devise means whereby the purification and dehydration or solvent stripping of the sealing medium is made a continuous automatic process.

In one modification of my invention clarifying means is associated with and made a part of the pump by a novel arrangement of passages and valves so that the process is made continuous and automatic throughout.

In another modification of my invention solvent stripping means is embodied in the system in place of the clarifier.

In a third modification of my invention both a clarifier and a stripper are employed for completely purifying the sealing medium.

By means of these and other improvements which produce a continually cleaned sealing medium, free from moisture or solvents as will be understood from the specification, I obtain several benefits, such as: Higher vacuum, a more constant vacuum, the elimination of excessive wear of the moving parts, and a greatly increased life for the sealing medium.

In order to operate at practical efficiency, all moving parts must be machined to close fits or small clearance so that they will cooperate throughout the cycle with the lubricating and sealing medium, hereafter merely referred to as oil, in forming a perfect or nearly perfect seal between the low and high pressure side of the pump.

The construction of this type of pump is such that an ample supply of oil is continually circulating through the system. Dust and dirt, however, are drawn over with the gases into the pump and mixed with the oil so that through the continual recirculation of the oil it gradually becomes more and more polluted, thereby lowering the efficiency of the pump and causing excessive wear on the parts. Where a lot of dirt comes over, which often is the case, the oil must be changed frequently. This causes delays in operation and is also an item of considerable expense on account of the large amount of oil used.

Another problem seriously affecting the efficiency of the pump is the moisture that usually is present in the gases. This moisture will be dispersed in the oil of the system and is discharged with the oil and gases into the oil reservoir unless otherwise directed. In order to obtain a high vacuum it is necessary to remove all the moisture from the oil before it is recirculated through the pump. Although provision is made in the oil reservoir to have the larger drops of water settle out, this process is too slow on finely dispersed water, and a certain percentage of moisture will be carried into the system with the oil and thus aggravate the difficulty.

I might mention here, by way of explanation, the very serious effect a small drop of water will have on the vacuum if carried into the high vacuum side of the pump. For example, at a vacuum of 29", water vapor is formed at 80° F. and has a volume of 634 cubic feet per pound; at 29¾" vacuum, water vapor is formed at 40° F. and the volume is 2420 cubic feet per pound. If oil having water particles dispersed in it enters the high vacuum side, this water will vaporize at once and will very considerably lower the volumetric efficiency of the pump. This water vapor is again condensed on the pressure side and discharged with the oil into the outlet compartment.

The above difficulty is overcome by passing the oil as it comes from the outlet compartment through an oil clarifier where the dirt and water or other volatile material of different specific gravity than oil is removed and expelled from the system before the oil is returned to the oil reservoir for recirculation.

I have described above the detrimental effect of moisture and other volatile material if found as a finely divided suspension in the oil or as an

emulsion. Such mixtures can be separated by means of a clarifier due to their difference in specific gravity.

Some other volatile materials such as alcohol, benzol, naphtha, acetone, carbon bisulphite and various other solvents actually go into solution in the oil, producing a mixture of uniform specific gravity upon which the centrifugal separator or similar clarifier has no effect other than the removal of suspended mechanical impurities.

When operating a vacuum system containing this type of material, any air which is originally in the system, and such air as leaks in during the operation, passes through the condenser and vacuum pump and comes out saturated with solvent. The amount of solvent present depends on the temperature of the air and the volatility of the solvent. Even with a secondary condenser in the line it is impossible to remove all the solvents. Some of the solvent in passing through the pump is dissolved in the oil. If this is not removed from the oil it will gradually thin the oil to such an extent that the required operating vacuum cannot be maintained.

To overcome this difficulty I take the oil from the outlet compartment and pass it through a solvent stripper before it is returned to the oil reservoir.

By these means I obtain a very efficiently operating pump regardless of the impurities mixed or dissolved in the oil, as the oil is maintained in a pure condition and therefore, may be used for a much longer time without the need for renewing it.

The principles of construction and novel arrangement of parts will be readily understood by reference to the annexed specification and drawings.

In the drawings:

Figure 1 is an end elevation, partly in section, illustrating one modification in which a clarifier is associated with the pump;

Figure 2 is a view partly in section illustrating the details of the check valve employed in Figure 1;

Figure 2*a* is a plan view of the valve poppet of Fig. 2;

Fig. 3 is a view of a pump with an attached solvent stripper, the stripper being shown in cross-section;

Figure 4 is a sectional view along line 4—4 of Fig. 3, and

Figure 5 is a fragmentary view illustrating an arrangement employing both a clarifier and a stripper.

Referring to the drawings, there is shown a rotary pump having a housing **10** mounted on a hollow base **11**. In the housing is formed a cylinder **12**, closed at both ends by end-plates, and partially surrounded by a jacket **13**, adapted to receive water or other cooling medium, and having a passage **14** furnishing communicating means with the hollow base **11** for the escaping gases. The housing **10** is extended at the top to form an inlet compartment **15** of rectangular outline connected directly to and extending the full length of cylinder **12** and being closed at both ends by extension on the cylinder end-plates. Provision is made at **16** for an intake connection to a chamber or space **16***a* to be evacuated. Alongside the intake compartment **15** in the extension of housing **10** is formed the outlet compartment **17** with suitable accommodations for the outlet valve **18** which may be of the general construction shown. The outlet compartment is connected on the one side to the interior of the cylinder **12** by a row of cylindrical discharge ports **19**, and closed on the other or outer side by a cover-plate **20** which is made hollow so as to provide a free passage **21** for the discharged gases into the corresponding passage **14** of the housing to which it is connected. The inside wall **22** of the passage **21** in cover-plate **20** is made with a projection **22***a* extending in over valve **18** so that it will prevent the oil from following the gases on their way down into the base. Another baffle **17***a* is secured to the pump wall and is arranged to cause the gases to pass in a tortuous path from the outlet valve to the passage **21**. The passage taken by the oil into the reservoir **41** of the base **11** will be described later.

Through the center of cylinder **12** is mounted a shaft **23** with supporting bearings in the cylinder end-plates and driven from any suitable source of power. Keyed or otherwise fastened to shaft **23** is the rotary eccentric **24** which carries on the outer surface the tube-shaped oscillating piston **25**. A slide valve **26** is fastened to the piston **25** by means of a hinge **27** of such construction as to provide a gas-tight, although flexible connection, and through this connection valve **26** receives a reciprocating rectilineal motion in the rectangular inlet compartment **15**, and as the valve **26** slides back and forth the inlet ports **28** connect the inlet compartment **15** with the cylinder **12** at the proper time of the cycle.

The oil drains off through an opening **80**, placed at a suitable height in the wall of the outlet compartment so as to retain within the compartment a sufficient amount of oil for completely covering the outlet valve **18**, only the excess oil running out through the connecting pipe line into the oil clarifier **99**.

The oil clarifier may be any suitable emulsion separator, such as the De La Val centrifugal separator, placed at such a level that the oil will run by gravity from compartment **17** into the receiving funnel **97** of clarifier **99**. The clarifier **99** may be an entirely separate unit, mounted aside from the pump and driven from a source of power separate from that driving the pump. I prefer, however, to mount the clarifier **99** on an extension **11***b* of the base **11** and drive it as an attachment of the pump direct from the pump shaft **23** by means of any suitable transmission such as gearing or belting **99***a*. By so doing it is at all times properly synchronized with the pump and is automatically started and stopped with the pump.

While it is quite possible to lift or force the oil from compartment **17** to a higher level by means of the pressure created at each discharge, such arrangement would establish an undesirable back pressure and I have, therefore, only shown the gravity draining system.

This system consists in general of a novel arrangement of pipe connections which forms a trap, preventing the escape of any gases through this passage and still permits free draining of the oil. It also includes, in combination with the trap, the novel construction and positioning of a check-valve to prevent the oil from rushing over too fast when pressure is created on it or a head is built up within compartment **17**, and to prevent emptying of the trap by sudden rushes of the exhaust gases. Considerable pressure is created on the oil in compartment **17** at each discharge of the pump

and this would force so much oil out that the valve 18 would be left bare and unsealed unless the current of oil in the line is temporarily retarded while the pressure is relieved through the escape of the gases. Particularly is this the case when starting the pump or when operating at a low vacuum.

The preferred construction and arrangement of parts may be described as follows: An outlet pipe 81 is connected at one end to the opening 80 in the wall of compartment 17 and has a T 82 at the other end. The lower opening of 82 is connected to the vertical pipe 83, which forms one leg of the trap. The bottom of the trap is formed by the horizontal pipe 85 connected through elbows 84 and 86 to 83 on the one side and to the vertical check valve 87 on the other side. The check valve 87 together with the pipe 88 fastened to its top constitutes the other vertical leg of the trap. It should be noticed that pipe 88, which is connected by elbow 89 to the horizontal over-flow pipe 90, is of such length that pipe 90 is at a slightly lower level than intake pipe 81, thus establishing a gravity drain for the oil. At the far end, pipe 90 terminates in a T 91, which has at its lower end the vertical pipe connection 92 leading down through cover 96 into the clarifier funnel 97.

At the top of the two T's 82 and 91 is connected, by means of reducer elbows 93 and 95, a vent pipe-line 94 which serves the purpose of equalizing the pressures in lines 81 and 90 and prevents any possibility of the oil hanging up in line 83 after the check valve 87 has been momentarily closed by the discharge pressure in compartment 17. Open vents at the top of the T's 82 and 91 might be used but at such times as the pressure is applied to the oil in leg 83, closing the check valve 87, some oil would be forced out of the vent and squirt all over the machine which, of course, is objectionable and is entirely eliminated by the connection 94. It may also be stated that this connection is of a very small size so that only small quantities can pass over this way. Normally no oil will pass through pipe 94 although some gases might, but on account of the small size of the pipe, the amount of gases passing is so small as to be unnoticeable.

As described, the oil enters the clarifier through pipe 92, passes through the centrifuge or other dehydrating and purifying means, and the dirty water is separated out and discharged through nozzle 97, while the clean oil passes through nozzle 98 into the funnel 100 and thence into the oil reservoir 41. The funnel 100 is connected through check valve 101, elbow 103 and pipe 102 with reservoir 41 of the base 11. The check valve 101 is normally open so that the oil can pass freely by gravity into the base, the funnel being placed at such a level that it is above the oil level maintained in reservoir 41. At times when there is a large discharge of gases from the pump, sufficient pressure is momentarily created on the oil in reservoir 41 to force oil out and spill over the top of funnel 100. This is prevented by the novel construction and positioning of check valve 101.

Both valves, 87 and 101, are identical in construction, and when placed in the relative position shown in Fig. 2, operate in the same manner and produce the same results. Fig. 2 may therefore, represent either one. When first examining Fig. 2, the valve shown will appear to be of exactly the same construction as most of the common check-valves of this type, but there is a decided difference as will be explained below.

The common check valves are normally closed, and are opened and kept open by the pressure of the current flowing through the line. The moment the pressure discontinues, the valve closes so that nothing can flow through either way. In my construction the valves 87 and 101 are normally held open by gravity, permitting the slow moving current of oil to pass freely by gravity through it in either direction, and they can only be closed by a rapid building up of pressure on the oil in compartments 17 or 41, which pressure would create a rush of oil of sufficient volume to lift the poppet in the valve and thus close the valve. It will be noticed that the gravity flow of oil from outlet compartment 17 through lines 81—92 is in the direction of the arrows and the momentary pressure referred to above builds up a rush of oil in the same direction as the gravity flow. In the line 102, connecting funnel 100 with reservoir 41, the flow of oil by gravity is normally in the direction of the arrows but the momentary pressure creates a rush of oil in the reverse direction and in this case therefore, produces a back current. From this it will be understood that the valves 87 and 101 are located in their lines with respect to the direction of the anticipated momentary current-rush without any consideration being given to the normal gravity flow. The valves are, therefore, placed in their respective lines so that an increase in the flow of oil or a current-rush against the valve poppet 105*a* will lift this against the seat 104*b* and close the valve momentarily.

Ordinarily the valve poppet is made from bronze or iron but I sometimes find it desirable to make this part of a lighter material such as aluminum or dow-metal in order to make the valve more sensitive and responsive to less pronounced increases in current flow.

The valve consists of the customary two piece housings 104 and 107 with suitable provisions at both ends for connection to the pipe lines. A bearing 106, supported by a cross-rib 106*a* in the lower part 107 of the housing, is provided as a central guide and support for the stem 105 of the valve-poppet. The rib 106*a* is of such narrow outline so that ample spaces 107*a* are allowed on both sides for the free passage of liquid in either direction. An upper guide 104*a* is formed in the diaphragm of the upper housing-part 104 for the poppet head 105*b*. The lower part of guide 104*a* is shaped into a suitable valve seat 104*b* which will cooperate with the shoulder 105*a* of the poppet to shut the passage if and when the poppet is lifted and pressed against this seat. Normally poppet-shoulder 105*a* rests on top of guide 106 and the shoulder 105*a* is of such size that it extends out over the guide 106 into the path of any current-rush set up in the line from below. The head 105*b* is serrated or grooved on the side as indicated in Fig. 2*a* so that any liquid can flow freely through the guide 104*a* when the valve is open or in the position shown in Fig. 2.

When it is desired to remove the volatile solvents a stripper 111, Figs. 3 and 4, is used in place of clarifier 99. The stripper may consist of a simple trough with electric heaters 120 clamped to the bottom 121, so that the oil coming through the inlet 114 and flowing over the hot bottom 121 will be heated sufficiently to boil off the solvent, the solvent vapors being allowed to escape to the atmosphere. To make the sol-

vent stripper more effective and obtain greater efficiency from the electric heaters, I prefer to make it enclosed, as shown in Figs. 3 and 4, and with a bottom of sufficient area so that the oil will spread out in a thin layer over the heated surface. In order to retain the heat within the boiling chamber, the sides and top may be covered with some insulating material 118, held in place by some form of a guard 119. The heater compartment may also be enclosed if desired. While I have shown the boiling chamber of rectangular cross section, Fig. 4, this might be circular or of any other convenient outline providing sufficient heating surface and ample head room for the vapors to pass off. In the embodiment of my invention, chosen to illustrate the principles of construction, I have shown two electric heaters 120 fastened to the bottom 121, but in some cases one heater may be sufficient, and then again if more heat is desired, as for example if it is desired to boil off any water dispersed in the oil, which would require more heat on account of the higher boiling point, provision might be made for several more heaters and some additional heaters may also be clamped to the sides. The heaters may be connected at 126 to the line of current supply. This line may be connected to the switch controlling the prime mover of the pump so that when the pump is started the current supply for the heaters is also connected. Heat controlling means such as thermostats may be provided in this line so as to maintain a uniform and constant temperature in the stripper. Other means of heating may be used such as gas or steam. If steam heating is preferred the boiling chamber may be completely or partly enclosed in a steam jacket or a steam coil placed on the bottom of the chamber. The inlet 114, is in this case made large enough to serve as inlet for the oil and outlet for the vapors, but separate oil inlet and vapor outlets may be provided.

The oil is drawn off from the pump outlet compartment 17 through the drain 81, trap 83—85, check valve 87 and connections 112—113 into the stripper 111. Here the solvents and also the moisture, if so desired, are boiled off, passing out through the duct 113—117 while the purified oil drains into the funnel 100 through the connections 122—124. A trap 125 is provided on the end of line 124 so that no vapors can pass out through this line. From the funnel 100 this oil passes into the reservoir 41 as described in connection with the clarifier. The funnel 100 may not be necessary but this provides space for the simple trap 125 (any form of trap may be used), and also makes it more convenient to change from a system using the clarifier 99 into a system using the stripper 111. The drain line and trap 81—87 with pressure equalizer 94 operates the same here as was described in connection with the clarifier, the only difference being in providing the vapor outlet 115—117, which may be connected to the outside of the building or, if it is desired to reclaim the solvents, to the secondary condenser. A separate condenser and receiver may, of course, be used.

The heat in the oil that has passed through the stripper 111, is readily taken care of by radiation in the reservoir 41 and the cooling system 53 provided here. The temperature of the stripped oil is only a few degrees higher than the normal operating temperature of the oil.

Actual operating tests with alcohol vapors passing through the pump and allowed to dilute the oil show that the vacuum is decreased to as low as 22" while by the efficient automatic removal of the solvents and purifying of the oil through the use of the stripper, the pump will operate and maintain a vacuum within a fraction of a millimeter.

When the sealing medium contains both types of impurities, both the clarifier and the stripper may be used at the same time. In Fig. 5 I have shown a fragmentary view of connections for using both kinds of purifiers, the arrangement being like that of Fig. 1 with a stripper 111 inserted in the pipe 92 leading to the clarifier 99, the inlet being at 92a and the outlet at 92b. A vent pipe 117 is provided as in Fig. 3, to carry off the vaporized solvents. Such an arrangement frees the oil of both solvents and foreign matter. It will be understood that the stripper 111 could be inserted between the clarifier 99 and the funnel 100 instead of in the position shown.

It is desirable to have all the oil, except as needed for sealing, drain out of compartment 17 through opening 80 and thus pass through the clarifier 99 or stripper 111 so that only pure oil returns into the reservoir 41 for recirculation. The arrangement of and construction of the valve assembly 18 in cooperation with the deflector plates 17a, 22a, and 22b within compartment 17, is such that the liquid matter, oil and water, entering is prevented from passing over with the gases and vapors into passages 21 and 14.

Outlet compartment 17 is of such area that ample space is provided for sufficiently large passages between the several deflector plates within it to permit the compressed gases, discharged through ports 19, to expand the moment they enter this compartment in order to lower the pressure and incidentally the speed at which the gases and vapors flow out of the compartment into passages 21 and 14 on their way to the degaser and devaporizer 42 in the base 11.

The gases and vapors come down through passages 21 and 14 into the base 11 and thence through a degaser and devaporizer and out of the pump at 11c into the atmosphere or into a secondary condenser. The oil on the other hand returns purified and dehydrated from the clarifier 99 or the stripper 111 through connection 102 into the reservoir 41 of the base 11. This is of such construction as to provide ample space for the storing of the oil in reservoir 41 and also provides head-room or air space above the oil level for the gases to pass out of the system. Connections are made from the reservoir 41 at 50, through pipe line 51 or other means at a suitable point in the reservoir, so that the clean oil is forced into the pump system and ejected at suitable points such as 52, 52a and 23a for lubricating and sealing purposes.

From the above description it can readily be understood that through my invention a very efficient system of automatically purifying the oil is obtained regardless of the amount of water and dirt or solvents that may come over into the pump. A small amount of water in the form of water vapors may come over and be condensed out in the devaporizer. This water will settle down at the lowest point in the reservoir 41 and from here be drawn off at 50 together with the oil. I have found, however, that this is not constant but rather periodic and the amount of water settling out is so small that it does not have any appreciable effect on the efficiency of the pump, because it is not allowed to accumu-

late but is instantly removed by the rapid recirculation of the oil.

It will be understood that the vacuum pump as disclosed herein is employed as a component part of a vacuum system, several different forms of which are known in the art, such as vacuum drying systems, vacuum impregnating systems, and vacuum processing systems. All such systems involve a vacuous chamber or space to which the vacuum pump is connected and from which the pump draws gases which may be ladened with dirt, dust particles, moisture and other vapors as hereinabove indicated.

I have herein described the principle of my invention and illustrated three embodiments thereof. Various modifications will occur to those skilled in the art, and I desire it to be understood that all modifications which fall within the terms of the appended claims are to be considered as falling within the scope of my invention. The term "purifier" as used in the appended claims is to be interpreted broadly to cover either a separator or a stripper.

What I claim is:

1. In combination, a vacuum pump having a discharge valve chamber, an oil reservoir therefor, an oil purifier for removing liquid impurities from oil, means for pumping oil through the pump into the discharge valve chamber of the pump, a pipe connection from the valve chamber for passing the discharged oil into said purifier, said connection including a trap to prevent gases from entering said purifier, and means for returning oil from the purifier to the reservoir.

2. In combination, a pump having a discharge valve chamber, an oil reservoir therefor, means for pumping oil through the pump into the discharge valve chamber of the pump, an oil purifier, a pipe connection for passing the discharged oil from the valve chamber to said purifier including a trap to prevent the passage of gases, and a check-valve in said connection normally biased open to permit a steady continuous flow of oil to the purifier but being operable upon increased flow in the same direction to close said connection and thereby prevent the emptying of said trap.

3. In combination, a pump having a discharge valve chamber, an oil reservoir therefor, means for pumping oil through said pump into the discharge valve chamber of the pump, an oil purifier, a pipe connection for gravity draining oil from the valve chamber to said purifier including a U-shaped trap to prevent the passage of gases, a bleeder pipe connecting the upper ends of the legs of the trap to equalize the pressure therein, and a check-valve in said connection normally biased open to permit a steady continuous flow of oil to the purifier and being operable upon increased flow in the same direction to close said connection and thereby prevent the emptying of said trap.

4. In combination, a pump having a hollow base and an exhaust valve chamber, an oil reservoir in said base, means for circulating oil through said pump into the exhaust valve chamber thereof, means for passing the exhaust gases from the exhaust chamber through the hollow base, an oil purifier, a pipe connection for passing the discharged oil from the valve chamber to said purifier including a trap to prevent the passage of gases, a check valve in said connection normally biased open to permit a steady continuous flow of oil to the purifier and being operable upon increased flow in the same direction to close said connection, and a connection for returning the purified oil from said purifier to said reservoir including a check valve to prevent back-flow from said reservoir.

5. In combination, a pump having a hollow base and an exhaust chamber, an oil reservoir in said base, means for passing the exhaust gases from the exhaust chamber through the hollow base, a separator arranged within said hollow base in the path of said gases, an oil purifier, a pipe connection for gravity draining oil from the valve chamber to said purifier including a U-shaped trap to prevent the passage of gases, a bleeder pipe connecting the upper ends of the legs of the trap to equalize the pressures therein, a check valve in said connection normally biased open to permit the steady continuous flow of oil to the purifier and being operable upon increased flow in the same direction to close said connection, and means for returning the purified oil from said purifier to said reservoir, including a check valve to prevent back-flow from said reservoir.

6. In combination, a vacuum pump having a discharge valve chamber, an oil reservoir therefor, a solvent stripper for stripping liquid solvents from oil, means for pumping oil through the pump into the discharge valve chamber of the pump, means in the discharge valve chamber for separating the oil from the discharge gases, and pipe connections for returning the separated oil from the valve chamber through said stripper back to said reservoir.

7. In combination, a vacuum pump having a discharge valve chamber, an oil reservoir therefor, a centrifugal separator for separating solid and liquid impurities from oil, means for pumping oil through the pump into the discharge valve chamber of the pump, means in said valve chamber for separating the oil from the discharge gases, and pipe connections for returning said separated oil from said valve chamber through said centrifugal separator and back to said reservoir.

8. In combination, a vacuum pump having a discharge valve chamber, an oil reservoir therefor, a centrifugal separator for separating solid and liquid impurities from oil, a solvent stripper for stripping liquid solvents from oil, means for pumping oil through the pump into the discharge valve chamber of the pump, means in said valve chamber for separating the oil from the discharge gases, and pipe connections for returning said separated oil from said valve chamber through said centrifugal separator, through said stripper and back to said reservoir.

9. The herein described art which includes the steps of continuously withdrawing moisture and particles from a space to be evacuated, forcing the moisture and particles into an oil sealed space wherein the oil moisture and particles are mixed into a sludge, immediately separating the sludge into its component parts, immediately returning the oil to said oil sealed space, and discharging the moisture and particles.

10. The combination with apparatus having a vacuous chamber from which solids, moisture and gases are drawn off during evacuation thereof, of evacuating means utilizing a sealing lubricant, means connected to said evacuating means for supplying sealing lubricant to said evacuating means, said evacuating means being constructed so that the solids and liquids taken therein are mixed with said lubricant to form a sludge, separating means adapted to separate the lubricant

from the solids and liquids, means for conveying said sludge from said evacuating means to said separating means, and means for returning said lubricant from said separating means to said second mentioned means.

11. The combination with apparatus having a vacuous chamber from which solids, moisture and gases are drawn off during evacuation thereof, of a rotary pump utilizing a sealing lubricant, means connected to said pump for supplying sealing lubricant thereto, said pump being constructed so that the sealing lubricant runs through the interior thereof and mixes with the solids and liquids drawn therein to form a sludge, separating means adapted to separate the lubricant from the solids and liquids, means for conveying said sludge from said pump to said separating means, and means for returning said lubricant from said separating means to said first mentioned means.

12. The combination with apparatus having a vacuous chamber from which solids, moisture and gases are drawn off during evacuation thereof, of evacuating means utilizing a sealing lubricant, means connected to said evacuating means for supplying sealing lubricant to said evacuating means, said evacuating means being constructed so that the solids and liquids taken therein are mixed with said lubricant to form a sludge, a centrifugal separator, means for conveying said sludge from said evacuating means to said separator, and means for returning said lubricant from said separator to said second mentioned means.

13. The combination with apparatus having a vacuous chamber from which solids, moisture and gases are drawn off during evacuation thereof, of a rotary pump utilizing a sealing lubricant, means connected to said pump for supplying sealing lubricant thereto, said pump being constructed so that the sealing lubricant runs through the interior thereof and mixes with the solids and liquids drawn therein to form a sludge, a centrifugal separator, means for conveying said sludge from said pump to said separator, and means for returning said lubricant from said separator to said first mentioned means.

14. The combination with apparatus having a vacuous chamber from which solids, moisture and gases are drawn off during evacuation thereof, of evacuating means utilizing a sealing lubricant, a storage tank connected to said evacuating means for supplying sealing lubricant to said evacuating means, said evacuating means being constructed so that the solids and liquids taken therein are mixed with said lubricant to form a sludge, separating means adapted to separate the lubricant from the solids and liquids, means for conveying said sludge from said evacuating means to said separating means, and means for returning said lubricant from said separating means to said storage tank.

15. The herein described art, which includes the steps of removing water and other foreign matter from a space to be evacuated, transferring the water and foreign matter to a chamber sealed by oil so that the water and foreign matter are mixed with the oil, removing the resultant mixture from said oil-sealed chamber, immediately centrifuging the mixture to separate the water and foreign matter from the oil before any substantial emulsion of the oil occurs, and returning the oil to said oil-sealed chamber.

16. The combination with apparatus having a vacuous chamber from which a condensable vapor is drawn off during evacuation thereof, a pump for evacuating said chamber, a source of lubricant for lubricating and sealing said pump, means for continuously supplying lubricant from said source through the interior of said pump and discharging the same at the discharge port of said pump, said pump being operable to compress the vapor drawn from said chamber whereby a portion thereof is condensed and at least a part of the condensate is mixed with the lubricant and is discharged from said pump in the form of an emulsion, separating means adapted to separate the condensate from the lubricant, means for continuously conveying the emulsion from the discharge port of said pump to said separating means, and means for returning the condensate-free lubricant from said separating means to said source of lubricant.

17. The combination with apparatus having a vacuous chamber from which water vapor is drawn off during evacuation thereof, a pump for evacuating said chamber, a source of oil for lubricating and sealing said pump, means for continuously supplying lubricating oil from said source through the interior of said pump and discharging the same at the discharge port of said pump, said pump being operable to compress the vapor drawn from said chamber whereby a portion thereof is condensed and a part of the condensate is mixed with the oil discharged from said pump to form an emulsion, a centrifugal separator, means for continuously conveying the emulsion discharged from said pump to said centrifugal separator, and means for returning the condensate-free oil from said separator to said oil source.

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