

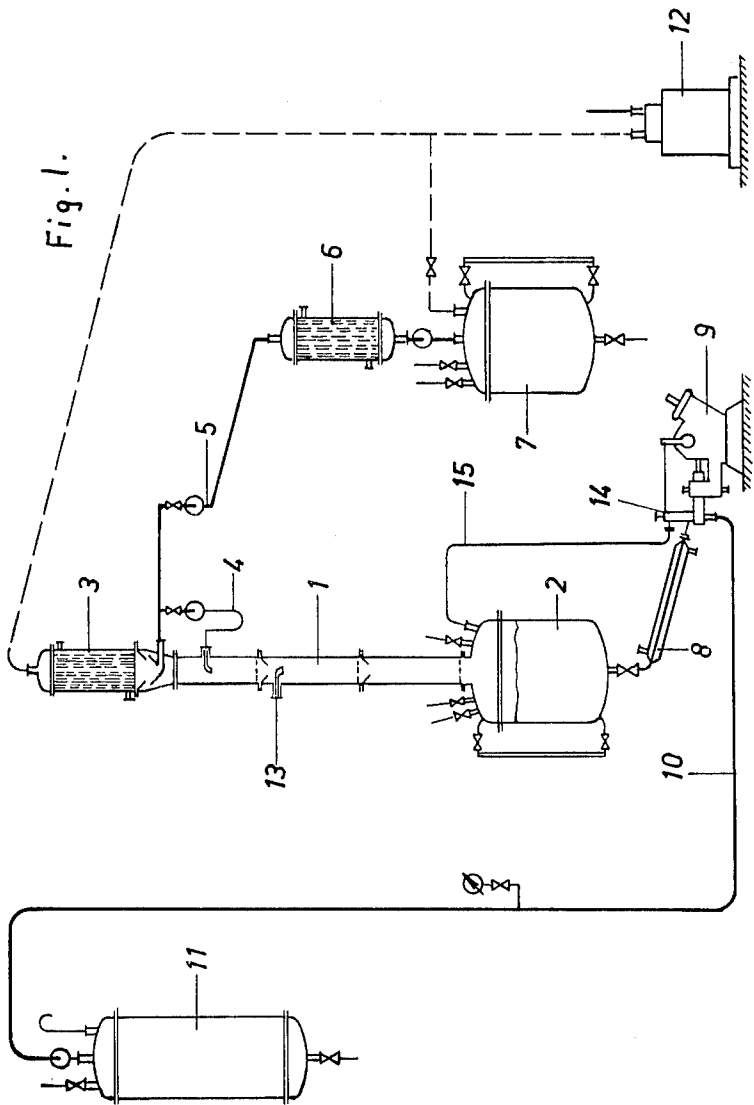
March 8, 1966

B. THIER ETAL
PUMP APPARATUS

3,238,891

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2 Sheets-Sheet 1



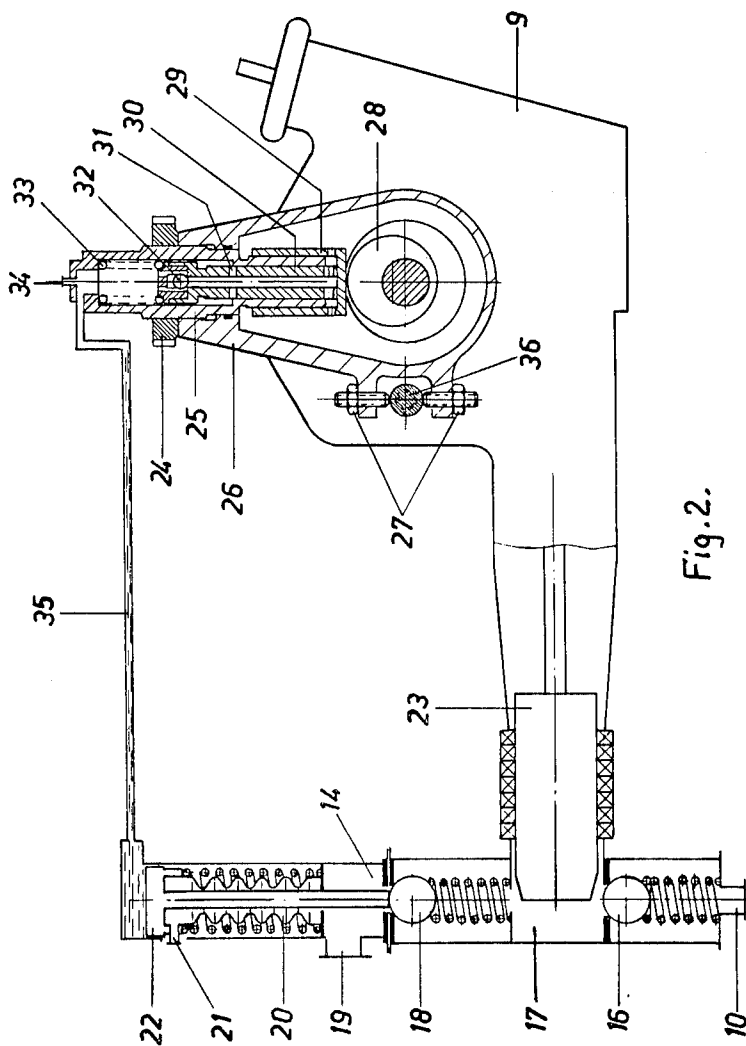
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PUMP APPARATUS

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1 Claim. (Cl. 103—203)

Research technique comprises various processes which are carried out under low pressure. In particular, the thermal treatment of compounds of high molecular weight in distillation-rectification- and evaporator plants requires in many instances very high vacua in order to prevent decomposition of the compounds which react easily to thermal influences.

When distillation processes are continuous there exists for example the problem to deliver the sump as well as the head product uniformly from the vacuum system to receptacles which are under atmospheric pressure.

If a piston pump is fed in a standard manner it is impossible to deliver in a satisfactory volume any fluid from plants that are operated at low pressure because, due to the low pressure at the intake side, the valve ball has the tendency to remain on its seat and will not lift up sufficiently to clear the intake suction profile.

However, the area of delivery is still available during each lift at full capacity whether or not the appropriate bulk of the fluid is admitted; consequently either evaporation will occur or undesirable air will be drawn in. There exists especially the danger that distillation products, their temperature being just below the boiling point, will become vaporized or gasified, causing in many instances an interruption in the flow of the liquid.

It is possible with the aid of a barometric drain pipe to attain proper operation of the pump because the column of liquid then will compensate the vacuum and create atmospheric pressure directly at the intake connection of the pump with the result that vaporization or gasification of the product as well as the drawing in of undesirable air will be prevented. However, use of a barometric drain pipe requires extraordinary outlays with respect to construction. The same problem will arise if liquid media which have the tendency to gasify are to be delivered at standard or increased pressure by means of specific, vibrating positive displacement pumps if, for example, the substances to be drawn in are liquids or liquefied gases which are gas-loaded or are near the boiling point.

A process has been found which makes it possible to deliver and evacuate pumpable liquid media which are under reduced pressure and/or have the tendency to gasify during the intake suction by means of vibrating positive displacement pumps by evacuating the pump area of delivery during the suction stroke, at least intermittently.

This process can be accomplished in practice in a simple manner, namely by turning the standard pump head assembly with freely operating valves by 180° so that the suction valves appears on top. The evacuation of the area of delivery takes place through the feed line for the medium so that it will flow from the top to the bottom while the gas bubbles will rise up in the feed line from the area of delivery.

The above described disadvantages can be overcome by this simple measure. For example, liquids can be delivered from vacuum systems into condensers at higher pressure, and any gas possibly created by gasification or evaporation will be drawn off immediately and automatically during each intake stroke. This measure makes

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it not only possible to attain delivery by the pumps under the desired critical conditions but also to start up the pumps without the need for manually operated venting, which represents a particular improvement.

In case of the above described arrangement the suction valve body is raised as well as placed in closed position by the compression stroke of the pump; obviously a certain counter flow toward the suction side will occur which is immaterial in many instances.

It has been found also that a delivery free of counter flow with simultaneous venting can be accomplished in this manner that the suction valve is controlled positively and connected with the feed line of the medium as well as with the vacuum system.

The suction valve is operated in a manner known per se: either hydraulically, mechanically, pneumatically or electrically. The positive control offers the advantage that the suction valve will be locked by mechanical forces or by shape and that its capacity can be adjusted in accordance with the rhythm of flow of the pump system so that a precisely defined delivery can be attained. For example, the suction valve can remain open throughout the entire duration of the suction stroke but it will be advantageous in many instances to reduce the rate of opening of the suction valve. By means of such adjustment optimum efficiency can be obtained for diverse speeds, especially for the purpose of avoiding the occurrence of a counter flow. The devices in question are particularly suitable for metering purposes.

A preferred species of the process and the apparatus for its practical application is illustrated in the accompanying drawings in which:

FIGURE 1 depicts a continuous vacuum distillation column where the sump product is drawn off by means of a pump, and

FIGURE 2 shows the details of a pump.

The mixture to be separated is introduced at the filler neck 13 and enters the separation column 1. The substance with a lower boiling point will flow in the form of vapor to the dephlegmatizer 3 and condense. One portion of the fluid will flow back into the column by way of the return pipe 4 while the distillate so obtained will flow through pipe 5 and the cooler 6 into the receiver 7. The product with a higher boiling point will travel through the separating column 1 downward into the sump receiver 2; a certain level is maintained within this receiver. The product flows from there through the cooler 8 into the positive displacement pump 9 which delivers the fluid through the pressure line 10 to the vented container 11. The evacuation of the apparatus up to the containers 1 and 11 is accomplished by the vacuum pump 12. The positive displacement pump 9 shown is a piston pump but can be designed also as a diaphragm or bellows metering pump. It has a suction valve 14 which is controlled positively by hydraulic means and is turned 180°—in contrast to standard pump head arrangements—and thereby place on top of the pump. At the upper part of the positively controlled suction valve 14 a venting nozzle is arranged, with the vacuum-compensating line connected thereto.

When the piston of the positive displacement pump performs its suction stroke, the suction valve 14 is pushed open, for example by a hydraulic system, so that a direct connection is established to the apparatus by way of the vacuum-compensating line 15. Therefore, the delivery area of the pump is evacuated in conformity with the magnitude of the pressure within the sump receiver with the result that a genuine inflow pressure exists, created by the height of the column of liquid, so that the product can flow into the pump area through the cooler 8.

Immediately prior to the beginning of the pressure

stroke the suction valve 14 is closed by positive action and the fluid is forced from the pump chamber 17 into the pressure line 10 through the spring-loaded pressure valve.

It was found finally that the process can be realized in practice in a particularly precise and advantageous manner if the positive control is accomplished by a device which comprises a positive displacement pump 9 with a suction valve 14 where said suction valve is controlled hydraulically through a camshaft 28, a recuperator piston 30 and a control piston 22 and is provided with a fitting 21 for the connection to the vacuum system.

FIGURE 2 depicts such oleo-hydraulic mechanism for the control of the suction valve. A recuperator piston 30 is moved by an eccentric shaft 28 so that the oil pressure influences the control piston 22 over line 35. The control piston 22 which is sealed against the suction valve 14 by a folded bellows 20 depresses, with its pushrod, the suction valve ball 18. During the time of this opening the pump chamber 17 is evacuated through the fitting 21 which is connected with the compensating line 15 whereby the fluid flows into the pump area 17 through the intake 19 and the piston 23 returns to its rear dead center.

Shortly before the recuperator piston 30 reaches its upper dead center, the bore 31 is cleared by the control edge of the spindle sleeve 25 with the result that due to this edge control the oil pressure collapses suddenly and the suction valve 14 closes rapidly due to the spring force acting upon the valve ball 18. The height level of the controlling edge can be adjusted by a lock nut 24 and the spindle sleeve 25 which runs within the cylinder 29 so that the closing action of the suction valve 14 can be timed accurately. In this manner the suction valve 14 can be closed before the piston 23 reaches its rear dead center position. This arrangement serves to avoid losses due to counter flow toward the vacuum suction side and it becomes possible to accomplish a delivery which is almost free of losses.

By an appropriate adjustment of the nuts 27 at the supporting bolt 36 it is possible to change the position of the housing 26 of the recuperator piston 30 in relation to the cam shaft 28. By this adjustable shift of the eccentric the positive control of the suction valve 14 is influenced so that the duration of its open position can also be timed precisely.

During the pressure build-up of the hydraulic system which is vented at the fitting 34 the spring 33 is compressed with the result that the recuperator piston 30 will return quickly, and without losing its contact with the eccentric, to its lower dead center position upon conclusion of the suction stroke. At the same time oil will flow back from the housing 26, which is designed as a storage tank, through the flowback valve 32 into the hydraulic-pressure area which becomes accessible above the recuperator piston and any losses within the hydraulic-pressure area due to leakage will be replenished automatically.

If multiple pumps are employed, multiple impulse-producing elements can be arranged at a central drive shaft which influence the diverse pump heads and can be adjusted independently.

The positively controlled suction valve being precisely adjustable as to its time and duration of operation prevents a counter flow of the product toward the suction side and ensures, due to its method of operation: locked by mechanical forces or by shape, the metering of products which are extremely difficult to process, for example highly viscous media which by their friction develop great flow resistances, or suspensions containing a great amount of solids and coarse-grained suspended solid particles, or

media which are very close to their boiling point at the suction side, even under very difficult conditions, for example a high vacuum. In particular, the positively controlled suction valve will ensure satisfactory venting and starting operation.

The newly developed apparatus is particularly advantageous for the venting and the delivery of gas-containing media such as synthetic plastic pastes. Due to the mechanical stresses of the medium caused by the piston movement and the interconnected generation of a low pressure during the suction cycle a complete and efficient de-gasification of the medium will be accomplished. The separated gases can be drawn off also at the suction valve.

We claim:

Apparatus for transferring a liquid having a tendency to vaporize under the intake suction of a reciprocating fluid displacement pump from an evacuated container into a storage tank which is normally under atmospheric pressure comprising, in combination with said container and said storage tank a pump casing disposed below the level of liquid in said container, a horizontal bore in said pump casing, a fluid displacing element in said bore, a head closing an end of said bore, an inlet port in the upper end of said head, a discharge port in the lower end of said head, a normally closed non-return valve in the lower end of said head controlling said discharge port, a conduit connecting said discharge port with said storage tank, a normally spring closed valve in the upper end of said head controlling said inlet port, a conduit connecting said inlet port with the lower end of said container, means for cooling said last named conduit, a push rod positioned to engage and open said inlet valve, an open space in said head above said inlet port and its control valve, a bellows surrounding said push rod and communicating with said open space, a conduit connecting said bellows with the space in said container above the normal liquid level therein, a first hydraulic cylinder at the upper end of said push rod, a first piston in said first hydraulic cylinder connected to said rod, a second hydraulic cylinder, a second piston in said second hydraulic cylinder, a conduit connecting said first hydraulic cylinder and said second hydraulic cylinder, a cam mounted to rotate in contact with said second piston, means for simultaneously operating said fluid displacement element and said cam, a casing supporting said second hydraulic cylinder, means for adjustably turning said casing and said second hydraulic cylinder around the rotation axis of said cam to vary the timing of said inlet valve cycle relative to the movement of said fluid displacement element, a cross-bore in said second piston, means for adjustably raising and lowering said second hydraulic cylinder relative to said cross-bore in said second piston to vary the closing of said inlet valve relative to the movement of said fluid displacement element and a non-return valve in said second piston permitting the flow of hydraulic fluid upwardly through said second piston.

References Cited by the Examiner

UNITED STATES PATENTS

2,018,144	10/1935	Mesinger	103—203 X
2,083,021	6/1937	High	103—203
2,246,515	6/1941	Heinrich	230—223

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