

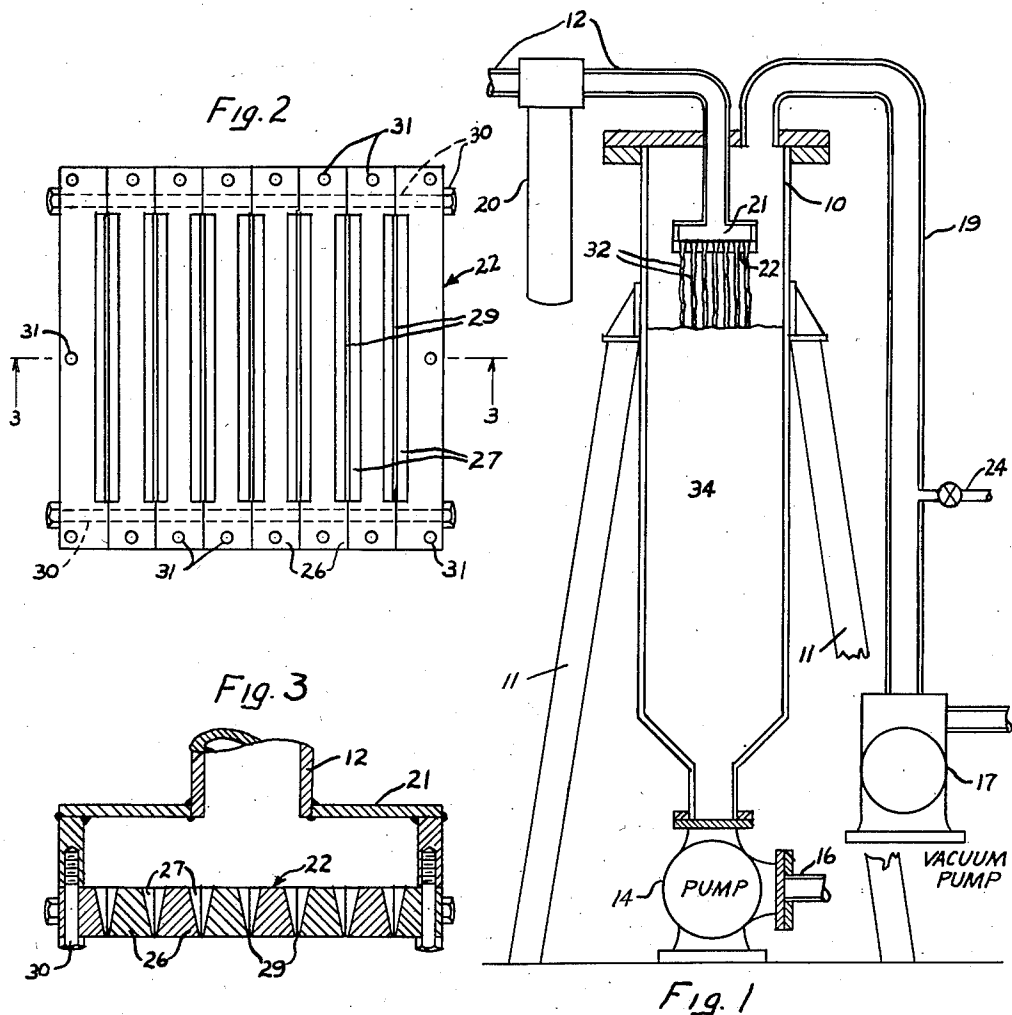
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METHOD AND APPARATUS FOR TREATING LUBRICANTS

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METHOD AND APPARATUS FOR TREATING LUBRICANTS

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This invention relates to an improved method and apparatus for deaerating and dehydrating fluid lubricants.

The term "fluid lubricants," and variations thereof, is used herein to include lubricants having viscosities or consistencies ranging from those of light- to medium-weight oils to those of highly viscous, stiff, fibrous greases.

It has been recognized heretofore that treatment of fluid or fluidized masses for deaeration and dehydration requires exposure of a large surface area of the mass in relation to its volume to sub-atmospheric pressure. This procedure promotes physical removal of trapped air and evaporation and removal of entrained water.

Methods and apparatus heretofore proposed to operate on this principle have, however, left much to be desired. For the most part, such efforts have involved intruding the mass to be deaerated or dehydrated into a vacuum chamber in the form of a plurality of fine streams. These streams are usually formed by extruding the mass through a spreader plate having a plurality of holes. The primary difficulty that has been encountered in methods and apparatus of this type is that with relatively small holes having diameters as small as $\frac{1}{32}$ inch, the rate of throughput is extremely slow and the pump requirements for forcing the materials through the holes are very high. On the other hand, with larger holes, say one inch or more in diameter, the throughput and pump requirements are satisfactory but the exposed surface area to volume ratio of the material processed is too low to provide satisfactory deaeration or dehydration. As a consequence, at least one method based on this principle involves storage of the intruded material in a vacuum chamber for a considerable period of time to augment the otherwise insufficient deaeration obtained as the material is first intruded into the chamber. As a result, the process is necessarily a batch rather than a continuous operation that involves tying up a considerable amount of equipment during unproductive periods.

We have now made the surprising discovery that fluid lubricants, including the heaviest greases, can be deaerated and dehydrated expeditiously and economically by forcing the lubricant into a zone of sub-atmospheric pressure through a spreader plate having elongated, tapered slots narrowing to widths of the order of 0.006 to 0.02 inch. By means of these slots it is possible to obtain area to volume ratios of 100:1 and higher, and therefore substantially complete deaeration, without requiring excessive pump capacity on the pressure side of the spreader plate or reducing the throughput to an impracticable level. In the method of the invention, the lubricant is subdivided into thin films on entering the zone of subatmospheric pressure or so-called vacuum. Both sides of the films are subjected to the sub-atmospheric pressure and therefore capable of liberating any air within the lubricant. Further in accordance with the invention, the thin films of lubricant are caused to coalesce and form a homogeneous mass while under sub-atmospheric pressure within the chamber. The treated lubricant is, in the preferred con-

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tinuous method, withdrawn from the bottom of the mass at a rate consistent with the maintenance of a level of treated lubricant within the chamber that is below the level of the spreader plate, yet sufficiently high to provide an adequate head for a discharge pump or equivalent device.

The apparatus of the invention comprises a vessel or chamber equipped with an air evacuating means, a discharge pump, and an inlet pipe and spreader for the lubricant in which the spreader plate is provided with a plurality of elongated and tapered slots. In one preferred embodiment, the spreader plate is made up of a number of bar members that are machined in such a manner as to form, when the bar members are properly assembled, a plurality of parallel slots having a V-shaped cross section in which the width of the slots at the narrowest portion is of the order of 0.006 to 0.02 inch.

The range of width of the slots is critical in the sense that departures therefrom will impair the success of the operation. Slots wider than 0.02 inch reduce the area to volume ratio below approximately 100:1 and cause deaeration to be incomplete. Slots that are narrower than 0.006 inch reduce throughput and increase pump requirements without achieving any compensating improvement in results. Generally it is feasible, but not necessary, to utilize slot widths in the lower portion of the range for the less viscous lubricants and slot widths in the upper portion of the range for the more viscous greases.

The distance between the spreader plate and the level of treated lubricant below in the chamber, i. e., the height of "free fall" of films of lubricant while exposed to sub-atmospheric pressure, is not critical. It is important, however, in order to insure a high rate of throughput of lubricant, to make the distance between the spreader plate and the intake of the discharge pump or equivalent device sufficiently great to permit an adequate head of lubricant to be maintained so that the capacity of the discharge pump, and therefore of the apparatus as a whole, will not be reduced.

The method and apparatus of the invention have a number of important advantages. Perhaps the most important of these are that the process is continuous and rapid. Another important advantage is that deaeration is substantially complete, even with the heaviest greases. Complete dehydration is somewhat more difficult but feasible with effective air and water vapor evacuating equipment. Another extremely important advantage that can be appreciated most readily by those skilled in the art upon comparison with heretofore proposed methods and equipment is that the method and apparatus of the invention are remarkably trouble-free and require very little maintenance.

These and other advantages, as well as the utility of the invention, will become more apparent from the following detailed description made with reference to the accompanying drawing and from the following example illustrating the best mode now contemplated for carrying out the invention.

In the drawing:

Figure 1 is a schematic view, in cross section and elevation, of a typical apparatus;

Figure 2 is a detailed plan view of a spreader plate constructed in accordance with one preferred embodiment of the invention; and

Figure 3 is a cross-sectional view of the spreader plate taken on section line 3—3 of Figure 2.

Referring now to Figure 1, there is shown a vacuum chamber 10 supported in upright position by any suitable means such as stanchions 11 and provided with an inlet line 12, a discharge pump 14, discharge line 16 and vacuum pump 17 connected to the vacuum chamber 10

by means of line 19. The inlet line 12 may, and preferably is, provided with a filter zone at 20 and terminates in a discharge head 21 having a spreader plate 22. The vacuum line 19 may be and preferably is also provided with a valve-operated air vent 24.

Referring now to Figures 2 and 3, the spreader plate 22 for the discharge head 21 is shown as made up of a number of blocks 26 machined so that when assembled as shown they form between them a plurality of V-shaped slots 27 with the narrowest portions 29 at the bottom. The spreader plate 22 is conveniently assembled by means of transverse bolts 30 and mounted on the discharge head 21 by any suitable means such as bolts 31. The discharge head itself may be secured to the inlet pipe 12 by any suitable means such as a screw connection or a welding.

In operation, grease or other fluid lubricant is forced through line 12, and if desired filter 20, into the discharge head 21 and through the slots 27 of the spreader plate 22 into the zone of sub-atmospheric pressure within the vacuum chamber 10. In passing through the spreader plate 22, the lubricant is subdivided into a plurality of thin films 32 having thicknesses approximately equal to the width of the narrowest portions 29 of the slots 27. These are exposed on both sides for deaeration and, if desired, dehydration. The films coalesce to form a homogeneous mass 34 of deaerated lubricant in the lower portion of the chamber 10, the deaerated mass being discharged from the chamber 10 by means of pump 14 and discharge line 16 at a rate consistent with the rate of introduction through inlet line 12 and the maintenance of a preselected level below the spreader plate 22.

If for any reason it is desired to suspend operation, the flow of material through the inlet line 12 is stopped and the sub-atmospheric pressure within the vacuum chamber 10 is released by opening the vent line 24. The increased pressure in the chamber 10 due to opening of vent line 24 will assist in providing a sufficient head on the discharge pump 14 to remove substantially all of the lubricant 34 within the chamber 10. If there should be any blockages in the slots of the spreader plate 22, they can readily be cleared by the introduction of compressed air through air vent 24. The width of the slots at 29 can be adjusted, if desired, by loosening the transverse bolts 30, inserting or removing spacers, not shown, between adjacent end portions of the blocks 26, and re-tightening the bolts 30.

Experience has shown that it is generally desirable to maintain a vacuum of about 23 to 28 inches of mercury under conditions of standard atmospheric pressure. At this high a vacuum, and particularly at the higher end of the preferred range, it will be understood that the intake for the discharge pump 14 is dependent almost entirely on the weight or head of lubricant 34 within the chamber 10. For this reason it is desirable, in order to keep the discharge pump 14 operating at optimum capacity, to maintain the level of the lubricant 31 within the chamber 10 as high as possible without of course reaching the spreader plate 22 or the vacuum line 19.

Example

14,000 pounds per hour of grease having an A. S. T. M. unworked-worked penetration of 330-340 were pumped through apparatus similar to that illustrated in the drawing wherein the spreader plate 22 was eight inches square with seven parallel, V-shaped slots, each six inches long and having a width, at the narrow portion, of 0.020 inch. This spreader plate was made up of eight bar members 26 having dimensions of 8" x 1" x 1" milled so that the widest portion of the slots was 1/2 inch. The distance from the spreader plate 22 to the entrance of the discharge pump 14 was 5 1/2 feet, the level of the deaerated grease within the chamber 10 during operation was four feet above the pump entrance, leaving a free fall from the spreader plate to the surface of approximately 1 1/2 feet. The chamber 10 was made from a fourteen inch

diameter pipe and was maintained under a vacuum of 25 to 28 inches mercury.

It was found that a rate of throughput of 14,000 pounds per hour could be maintained with no difficulty and that at this rate deaeration was substantially complete, resulting in a decrease in volume of the grease of up to about 10%. The same apparatus was utilized successfully for complete deaeration with all types of greases, including a stiff, fibrous grease having an A. S. T. M. unworked-worked penetration of 240-280 at a rate of 8000 pounds per hour.

It is believed to be significant that in these tests no appreciable increase was observed in the temperature of the grease being processed. This indicates that the tapered design of the slots reduces friction and may be responsible, in part at least, for the high throughput with low grease pumping requirements.

Changes in initial temperature of the greases, varying from 120-200° F., were found to produce no significant changes in rate of throughput or completeness of deaeration. However, increases in temperature will increase the efficiency of dehydration and the removal of any volatile components.

It is to be understood that various modifications will readily become apparent to those skilled in the art upon reading this description. All such modifications are intended to be included within the scope of the invention as defined in the appended claims.

We claim:

1. Method which comprises forcing an air-containing fluid lubricant through elongated and tapered slots narrowing to widths of the order of 0.006 to 0.02 inch into a zone of sub-atmospheric pressure.

2. Method which comprises forcing an air-containing fluid lubricant through a spreader plate having elongated and tapered slots narrowing to widths of the order of 0.006 to 0.02 inch into a vacuum chamber.

3. Method which comprises continuously forcing an air-containing fluid lubricant through elongated and tapered slots narrowing to widths of the order of 0.006 to 0.02 inch into a zone of sub-atmospheric pressure over a mass of treated lubricant and continuously withdrawing treated lubricant from the bottom of the mass.

4. Method which comprises continuously forcing an air-containing fluid lubricant through a spreader plate having elongated and tapered slots narrowing to widths of the order of 0.006 to 0.02 inch into a vacuum chamber containing a mass of treated and coalesced lubricant having an upper level below the spreader plate, and continuously withdrawing the treated lubricant from the bottom of the mass at a rate consistent with the maintenance of a preselected head of coalesced lubricant within the chamber.

5. Method which comprises continuously forcing air-containing grease through a spreader plate having V-shaped slots narrowing to widths of the order of 0.006 to 0.02 inch at a preselected rate into a vacuum chamber having a vacuum of the order of about 23 to 28 inches mercury and containing, entirely below the spreader plate, a mass of treated and coalesced grease having a head sufficient to permit continuous withdrawal thereof at a rate corresponding approximately to said preselected rate.

6. Apparatus comprising a vacuum chamber; means for maintaining a substantial vacuum therein; inlet means including a spreader plate in the upper portion of the vacuum chamber for intruding downwardly into the chamber a plurality of streams of air-containing fluid lubricant, said spreader plate having a plurality of elongated and tapering slots having at the bottoms thereof a width of the order of 0.006 to 0.02 inch; and means at the bottom of the chamber for removing treated lubricant.

7. In apparatus for deaerating a lubricant, said apparatus having a spreader plate in the upper portion of a vacuum chamber for intruding downwardly into the chamber a plurality of streams of air-containing fluid lubricant,

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the improvement which comprises a spreader plate forming a plurality of elongated and tapering slots having at the bottoms thereof a width of the order of 0.006 to 0.02 inch.

8. In combination, a spreader plate for a lubricant de-aerator having tapered slots, the narrow portions of the slots having at the bottoms thereof a width of the order of 0.006 to 0.02 inch and means for forcing an air-containing lubricant through said slots into a vacuum chamber.

9. In combination, a spreader plate for a lubricant de-aerator having a plurality of parallel, V-shaped slots, the narrow portion of each slot having a width of the order of 0.006 to 0.02 inch and means for forcing an air-containing lubricant through said slots into a vacuum chamber.

10. Apparatus comprising a vacuum chamber; means

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for maintaining a substantial vacuum therein; inlet means including a spreader plate in the upper portion of the vacuum chamber for intruding downwardly into the chamber a plurality of streams of air-containing grease, said spreader plate comprising a plurality of parallel bar members of generally rectangular cross section cut away to form between them elongated and V-shaped slots having at the bottoms thereof a width of the order of 0.006 to 0.02 inch; and means at the bottom of the chamber for removing treated grease.

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