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CENTRIFUGE UNLOADER

Filed July 19, 1934

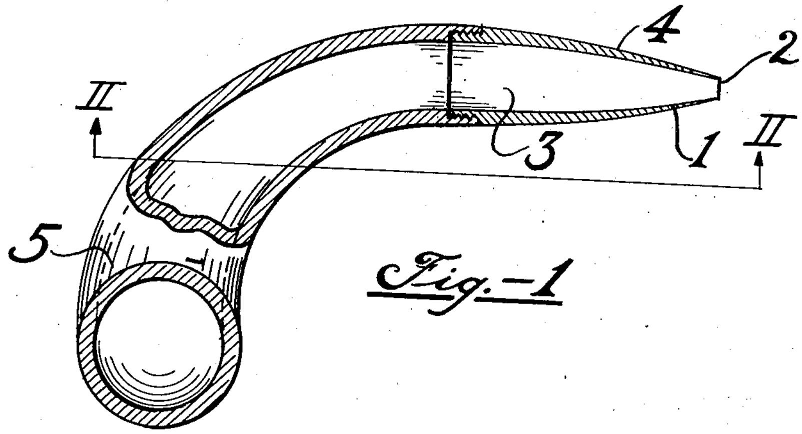


Fig.-1

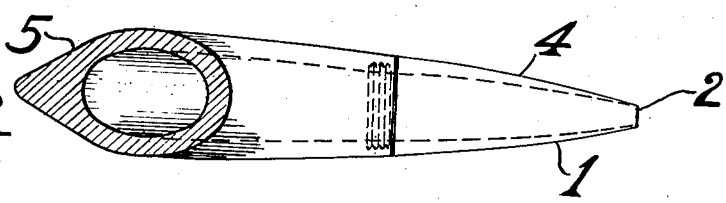
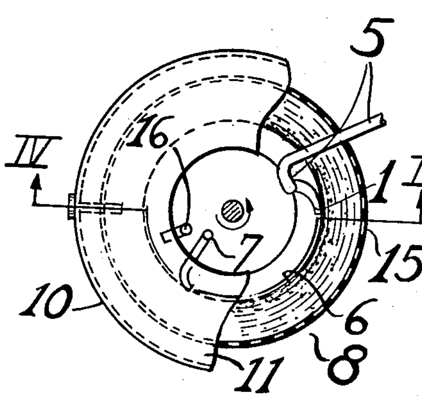


Fig.-2



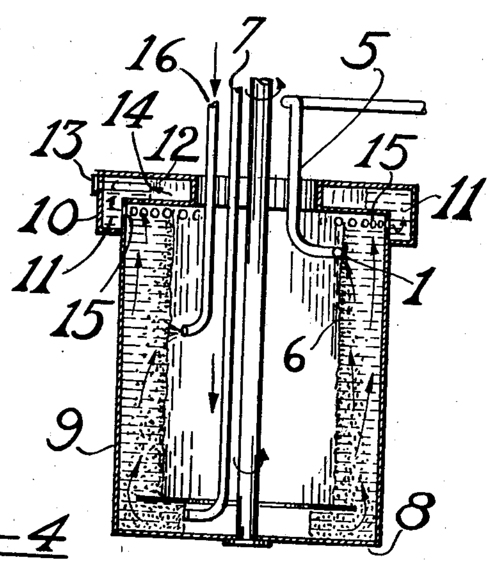


Fig.-3 Fig.-4

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CENTRIFUGE UNLOADER

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Application July 19, 1934, Serial No. 736,025

3 Claims. (Cl. 233—22)

This invention relates to improved means for removing material from a whirling centrifuge, and more particularly to an improved means by which the kinetic energy of the whirling material is used to cause it to pass out of the centrifugal zone, and to improvements in such devices for increasing the efficiency of centrifuges in which they are used. The device disclosed herein is of especial advantage in the removal of wax from centrifuges used in the dewaxing of oils such as petroleum lubricating oils.

The drawing shows a device representing a preferred embodiment of this invention and indicates a suitable method for using it in a centrifuge.

Fig. 1 represents a longitudinal view partly in section of a suitable modification of this device.

Fig. 2 represents a transverse sectional view taken along the lines II—II of Fig. 1.

Fig. 3 is a diagrammatic plan view of a centrifugal bowl and illustrates the use of the device of Fig. 1 in connection therewith.

Fig. 4 is a transverse sectional view taken along the line IV—IV of Fig. 3.

Referring in greater detail to the drawing, a cutting member 1 comprises a cutting edge 2 which is directed into the path of the material to be withdrawn and which severs a portion thereof from the remaining material, and a means 3 which may suitably be in the form of a tube for directing the severed material out of its original path and preferably inwardly toward the axis of rotation of a centrifuge in which the device is used. The outer surface 4 of the cutting member behind the cutting edge 2 is curved in a plane perpendicular to the axis of rotation of the centrifuge and preferably forms an arc therein of approximately the same radius of curvature as that of the inner surface of the whirling material to which the cutting edge is to be applied. The radius of curvature of this arc of the surface 4 should be within about 25% and is preferably within about 10% of the mean radius of curvature of the material to be removed by the device. This mean radius is that of a concentric arc half way between the inner and outer surfaces of the material. The entire outer surface of the cutting member may be symmetrical about the longitudinal axis, if desired, for convenience in manufacture. Or that portion of the outer surface not contacting with the rotating material in the centrifuge may be so designed as to offer as little resistance as possible to the rotating air blanket adjacent to the surface of the rotating material. Suitable means 5 which are also preferably tubular in form are attached to the rear end of the cutting member 1 and serve to direct the severed material out of the centrifugal zone, preferably in a curved path offering as little resistance as possible to the flow of this material. This means 5 also preferably has an outer surface of streamlined design adjacent to the rotating material so as to create as little turbulence as possible both in the whirling material and in the air adjacent thereto. One such design suitable for this purpose is indicated in Fig. 2.

The length of the cutting edge 2 should be as short as would conveniently remove material from the centrifuge at the desired rate. This edge may suitably be continuous about the entire end of the cutting device 1 in the event that a tubular device is used. The edge may be circular. It is preferably made razor sharp with the outer edge a smooth continuation of the arc of the surface 4 and with the inner edge ground. The opening preferably enlarges smoothly and gradually to the inside diameter of the tubular means 5 in order to avoid interference with the flow of material therethrough. It is preferable that the inner walls of the passageway 3 should diverge at so slight an angle that the loss of kinetic energy due to turbulence and internal friction in the material flowing therethrough is as small as possible. For example, the design of this passageway may be similar to that of the down stream side of a Venturi meter, the sides thereof converging at a total angle of about seven degrees. A sharper angle of convergence, up to about fifteen degrees or more, and a correspondingly shorter cutting member may be used if the initial kinetic energy of the severed material entering the cutting member is sufficiently high to offset frictional losses and to carry the material out of the centrifugal zone.

In using the device, the cutting member 1 is preferably forced into the surface of rotating liquid or viscous solid material in a centrifuge in such manner that the radius of the arc 4 lies substantially on a diameter of the centrifuge. In such case there is a practically continuous line of contact of the inner surface of the rotating material with the surface 4 of the cutting member. The cutting member is then moved outwardly on a diameter of the centrifuge until the cutting edge cuts the desired, preferably slight, distance into the surface of the whirling material. Or the cutting member may be pivoted on its rear end so that the cutting edge 2 is moved into the whirling material to this degree.

A continuous stream of the whirling material is thus severed from the surface 6 and passes because of its momentum through the tube 5 and out of the centrifuge. It is possible by this means to remove liquids of high viscosity and even suspensions of solids in liquids from a centrifuge rotated at sufficient speed to give the necessary linear velocity to the surface 6. For example, the use of this device will be described in connection with the centrifugal dewaxing of lubricating oils with a heavy solvent as described in copending application Serial No. 736,024, filed July 19, 1934, by the present inventors.

A waxy lubricating oil of 120° F. pour point is dissolved in three volumes of a heavy dewaxing solvent consisting of 25% carbon tetrachloride and 75% dichlorethane. The solution is cooled to −170° F. and precipitates crystalline wax as a relatively lighter phase. This mixture of wax crystals in the oil-solvent solution is passed by line 7 into centrifuge 8 which may suitably be about 24'' in diameter and rotating at about 1800 R. P. M. The end of line 7 may suitably be faced against the direction of rotation of the centrifuge, so as to serve as an automatic check on the supply of feed when the material in the centrifuge has reached any desired thickness. The position of the inlet tube may be made adjustable for the purpose of controlling the thickness of this material. This centrifuge has an inner wall 9 having an enlarged section 10 which forms an annular space 11 through which the separated liquid passes into section 12 and out of the centrifuge through one or more adjustable overflow tubes 13 positioned therein. These overflow tubes may be of any desired diameter. It is preferable, however, to place an orifice 14 of such diameter in the overflow tube that a slight head 0.1 or 0.5 inch or more is required to force the liquid therethrough at its normal rate. The liquid then passes out through this tube at a substantially constant rate, in spite of slight fluctuations in the rate of feed or the formation of any waves or surges in the centrifugal bowl. In fact, the use of the orifice tends to prevent the development of such surges and to increase the efficiency of the centrifuge. The passage of liquid into the annular space 11 may also be somewhat restricted, as by a number of distributing orifices 15 spaced evenly about the circumference of the drum. By making these orifices 15 of suitable size to provide a pressure drop therethrough equal to about $\frac{1}{10}$ of the head on the orifice 14, a substantially equal amount of liquid passes through each of the orifices 15 and channelling in the separation zone is effectively prevented.

Wax may also be removed with the improved device shown herein from a centrifuge having a perforated wall 9 and a filter blanket mounted thereon, as shown in copending application Ser. No. 669,084, filed May 3, 1933 by the present inventors.

This invention may also be applied to batch operation, if desired, thereby making it possible to remove the wax layer during or at the end of each separation period without change in the speed of the centrifuge. The position of the tube 5 may be made adjustable vertically or horizontally, as on a diameter of the bowl, or both if desired. The horizontal adjustable feature will be found of advantage in removing wax in batch operation of the centrifuge, as the cutting edge of the tube can be moved outwardly as the wax is removed. The vertical adjustable feature is ordinarily not required but may be of use in the case of very stiff wax cakes which do not flow sufficiently freely in the bowl to make wax removal from a single horizontal plane satisfactory. A particularly effective method of operation in batch operation in which the inner wall 9 of the centrifuge is perforated and covered with a filter blanket is to permit the wax cake to build up until the liquid phase has largely passed through the blanket and wax is resting against it, then remove the wax by means of the tube until only a thin layer of wax remains, preferably of less thickness than the radial distance between the overflow level of the tube 13 and the blanket, then add sufficient heavy wash liquid to the bowl to float the wax inwardly from the blanket, and removing the so floating layer of wax with the tube 5.

The wax being lighter than the oil-solvent solution is displaced inwardly in the centrifuge during the upward passage of the mixture therein and forms a wax cake on the inner surface of this mixture in the upper portion of the centrifugal bowl. This cake contains considerable occluded liquid which may be largely removed by long continued whirling, or may be washed out by admitting a suitable cold washing liquid, preferably a heavy dewaxing solvent such as that used initially, by line 16 and spraying it on the wax as it rises in the centrifuge. A wax removal tool of the type described herein is applied to the inner surface of the wax cake near the top of the centrifuge and removes the wax continuously. For the centrifuge described herein, the cutting element may suitably have a circular cutting edge with a hole of ⅛'' diameter therein. The outer surface of the cutting element contacting with the wax cake may have a 10'' radius of curvature. With this device 137.6 gallons per hour of total feed was dewaxed to obtain from the resulting liquid phase a 70.3% yield of a lubricating oil having a pour point of 10° F. When using an ordinary cutting element consisting merely of a knife edged open ended cylindrical tube which is directed against the rotation of the wax, a yield of only 66.4% of a 10° F. pour point oil could be obtained due to the increased turbulence and decreased efficiency of separation caused by this type of cutting element.

It is possible with the improved tube to remove substantially any wax from a centrifuge if the linear speed of the whirling wax cake is sufficiently high. It is preferable to operate the centrifuge so that the wax removed still contains a substantial amount of liquid distributed between the wax crystals. Due to the known interlacing characteristic of wax crystals, a solid wax cake may contain 25 or 50 to 75% or even more of a liquid or oil-solvent or solvent phase. It is generally preferable to remove the wax cake with a cutting element of the type described herein while its content of liquid is at least 10% and is preferably 25 to 50%. It is desired that the centrifuge be operated at sufficient velocity so that the inner surface of the wax cake has a linear speed of about 4,000 to 15,000 feet per minute, although higher speeds are not objectionable and even lower speeds may be used with sufficiently plastic waxes. Operation according to the herein disclosed invention may be used satisfactorily to dewax both paraffinic and mixed base oils and both residual and distillate fractions thereof, and of products and fractions thereof obtained by distillation, solvent extraction, hydrogenation, dehydrogenation, cracking and other treatments.

The waxes to be removed may be crystalline or amorphous or mixed, and of any melting point.

The improved cutting element disclosed herein may also be used for removing substantially any liquid or solid material, having sufficient fluidity to permit pumping, from a centrifuge.

This invention is not to be limited to any examples, applications or explanations, all of which have been presented herein solely for purpose of illustration, but is limited only by the following claims in which it is desired to claim all novelty insofar as the prior art permits.

We claim:

1. In a centrifuge of the type having a generally circular drum, stationary means for removing a separated component therefrom comprising a cutting member of elongated form having a longitudinal bore extending from one end to the other, said bore tapering from the discharge to the entrance end of the cutting member and terminating in a sharp cutting edge of relatively small diameter, the total angle of convergence of the taper of said bore being approximately between the limits of seven and fifteen degrees, the outer surface of said cutting member from the entrance to the discharge end adjacent the surface of the material being centrifuged lying on an arc in a plane normal to the axis of rotation, said arc being substantially concentric with and having substantially the same radius of curvature as the inner surface of the material in the drum being centrifuged during normal operation of the drum, tubular means secured to the discharge end of the cutting member having a bore gradually and smoothly tapering from a fixed diameter to the diameter of the bore of the cutting member of the discharge end, said tubular member establishing communication between the cutting member and exterior of the drum; whereby the cutting member may be forced into the lighter separated component with its cutting edge directed opposite to the direction of rotation of the drum to remove said component by means of its kinetic energy with minimum turbulence.

2. Stationary means in accordance with claim 1 in which said tubular means secured to the discharge end of the cutting member is turned inwardly toward the axis of rotation.

3. In a centrifuge of the type having a generally circular drum, stationary means for removing a lighter separated waxy component therefrom comprising a cutting member of elongated form having a longitudinal bore extending from one end to the other, said bore tapering from the discharge to the entrance end of the cutting member and terminating in a sharp cutting edge of relatively small diameter, the total angle of convergence of the taper of said bore being approximately between the limits of seven and fifteen degrees, the outer surface of said cutting member from the entrance to the discharge end adjacent the surface of the material being centrifuged lying on an arc in a plane normal to the axis of rotation, said arc being substantially concentric with and having substantially the same radius of curvature as the inner surface of the material in the drum being centrifuged during normal operation of the drum, tubular means secured to the discharge end of the cutting member having a bore gradually and smoothly tapering from a fixed diameter to the diameter of the bore of the cutting member at the discharge end, said tubular member establishing communication between the cutting member and exterior of the drum; whereby the cutting member may be forced into the lighter separated waxy component with its cutting edge directed opposite to the direction of rotation of the drum to remove said component by means of its kinetic energy with minimum turbulence.

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