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CENTRIFUGAL SEPARATION

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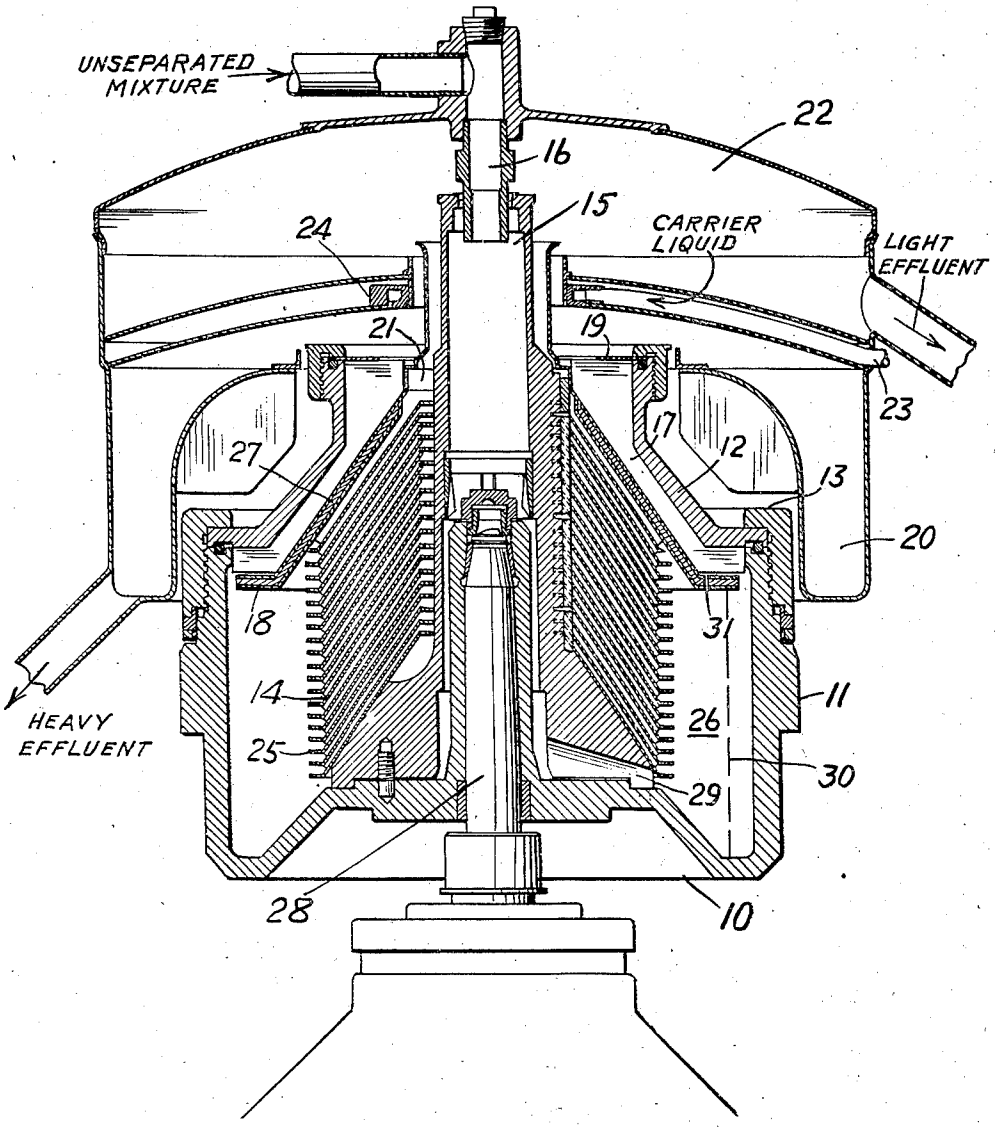

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CENTRIFUGAL SEPARATION

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4 Claims. (Cl. 196—19)

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The present invention pertains to the separation of mixtures which, when subjected to centrifugal force, separate into three liquid layers (hereinafter referred to as phases) of different specific gravities. In discussing liquid phases, we mean to include any phase having sufficient fluidity to enable it to flow under centrifugal force in a centrifugal rotor; e. g., we mean definitely to include hydrocarbon waxes such as are frequently subjected to centrifugation to effect separation from an oil phase.

This invention was conceived and perfected in connection with research involving centrifugation to separate wax from oil in a centrifugal rotor and effect separate discharge of the wax and the dewaxed oil, respectively. It will accordingly be described in reference to that problem, with the understanding that it is capable of broader application and is, indeed, applicable to the solution of any separating problem involving three phases of the type discussed above, in which the phase of intermediate specific gravity occurs in a minor proportion.

In attempting to separate the lightest liquid phase from the heaviest liquid phase, in attacking a problem of this kind, the operator may proceed by effecting sedimentation of the respective phases by centrifugation, with passage of the heaviest phase around the outer circumference of a dividing wall or cone and along the outer side of that wall or cone, while passing the lightest phase inwardly along the inner side of the wall or cone and conducting the respective phases to their respective zones of discharge from the centrifugal rotor in which the centrifugation occurs. The presence of the small amount of intermediate phase interposes serious difficulty to such an operation, however, in that this intermediate phase tends to accumulate gradually to form a thick layer along the inner side of the dividing wall or cone, and ultimately to be discharged with the lightest liquid phase, thereby defeating the primary object of the centrifugation.

In the practice of the present invention, the difficulties caused by the presence of the intermediate phase are avoided by establishing communication through the dividing wall or cone between the respective zones of discharge on opposite sides of said wall or cone. The detailed nature of the invention and the preferred means for practicing it will be more evident from a reading of the following detailed description in the light of the attached drawing, in which the single figure is a cross sectional view of a centrifugal

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separator in which the process of the invention may be practiced.

Since the invention was conceived in connection with solution of a problem of separating wax from oil, it will be described primarily in reference to that problem. The mixture of wax and oil under treatment at the time of conception of this invention, which is characteristic of the type of mixture which may be treated most effectively in practice of the invention, consisted of three phases. The lightest liquid phase consisted of a liquid hydrocarbon oil dissolved in a hydrocarbon diluent of sufficiently low specific gravity to insure a substantial specific gravity difference between this phase and the wax to be separated from the oil. The heaviest phase consisted of the bulk of the wax to be separated from the oil, this wax having been precipitated from the oil solution by a chilling operation such as is conventional in the art of dewaxing. This mixture was contaminated by a very small amount of a lighter wax which was immiscible with the heavy wax and which had a specific gravity intermediate between that of the oil solution and that of the heavy wax.

The above mixture was subjected to centrifugation in a machine of the type described in Jones Patent 2,266,553, which is illustrated, with a slight modification to permit practice of the process of the present invention, in the accompanying drawing. In this machine, the rotor 10 is driven by a shaft 28. The rotor includes a main body portion 11 and a top portion 12 clamped thereto by clamping ring 13. A disc-bloc 14 consisting of a plurality of nested frusto-conical discs, is secured in position within the rotor between the top portion 12 and the main body portion 11.

A tube 15, secured to the interior of the rotor, receives the mixture to be treated from the feed conduit 16. This mixture is passed to the main body of the rotor through a plurality of openings 29 adjacent the base of the rotor, and these openings direct the mixture into the space 26 surrounding the outer circumference 25 of the disc-bloc. The rotor is provided with a plurality of discharge outlets 17 communicating with the outer portion of the separating space 26 and adapted to receive the heavy effluent from the rotor after that effluent has passed around the outer circumference of the frusto-conical disc 18 which constitutes the dividing wall for separating and separately discharging the light and heavy effluents respectively, after sedimentation in the rotor. These outlets 17 provide a bal-

ancing zone of the heaviest liquid phase whereby this discharging phase is balanced against the liquid phases being subjected to centrifugal sedimentation. The material passing upwardly through outlet 17 passes along the outer side of the dividing wall or cone 18 and thence around ring-dam 19 into a cover 20. The light effluent from the rotor passes inwardly between the respective discs of the disc-bloc 14 and is discharged through space 21 into the light effluent receiving cover 22.

A conduit 23 may be provided between covers 20 and 22 to convey liquid to a nozzle 24 and thence into the rotor, to act as a carrier liquid for the heavy effluent in cases in which a carrier liquid may be necessary. The bottom of the upper cover 22 may be separated from the top of the lower cover 20 by an insulating air space. The dividing wall 18 may be laminated and provided with insulation 27 as illustrated.

In the use of the centrifugal separator described above in dewaxing mineral oils, a mixture containing oil diluted with naphtha, hexane, or other diluent of sufficiently low specific gravity and in sufficient quantity to render the oil substantially lighter than the precipitated wax, and containing precipitated wax, is fed through conduit 16 into the feed tube 15 of the rotor. This mixture passes outwardly through openings 29 into the sedimenting space 26. Since this space 26 is relatively large, the principal sedimenting action of the rotor occurs therein, and entirely outwardly of the disc-bloc. Oil passing inwardly into the disc-bloc has therefore been deprived of the major part of its wax, and the wax content of such oil consists entirely of small quantities of finely divided wax which have not been removed incident to the sedimenting action which takes place in the outer circumferential zone 26. By reason of this fact, the cloggage of discs by wax is avoided.

The wax which separates as an outer stratum in the outer part of the space 26 passes outwardly around the outer edge of the dividing wall 18 and is discharged through passages 17 and around the ring-dam 19 into the cover 20, this wax being balanced against the concentric strata of wax and oil in the main body of the rotor.

A carrier liquid, such as hot water or brine, may be introduced through the conduit 23 and nozzle 24 into the upper part of the passages 17 adjacent the ring-dam 19.

It will be seen that, in the operation of the above-described machine when properly adjusted, the circumference of the cylindrical surface dividing the strata of sedimented wax and oil in the main body of the rotor will be beyond the outer circumference 25 of the disc-bloc, and along some cylindrical surface such as that indicated by the line 30 illustrated in the drawing. In the use of the machine constructed as described above, satisfactory separation of wax from the oil solution can be attained so long as there is only one type of wax in the mixture under treatment. When a mixture containing, in small proportion, a second wax of lower specific gravity than the first, is treated, trouble is encountered. When centrifugation of such a mixture is attempted, an intermediate wax layer begins to be built inwardly and outwardly from the dividing line 30 as the operation of sedimentation proceeds, and the progressive increase in depth of this layer is objectionable because it affects the normal balance between the two principal strata to be formed and separately discharged, and more importantly because it ultimately develops all the way to the zone of discharge for the oil solution, thereby completely defeating any further continuation of the dewaxing operation until the situation is corrected.

The above difficulties are avoided, in the practice of the present invention, by establishing communication, through the dividing wall 18, between the portion of the main body of the rotor occupied by oil in normal operation, and the zone of discharge of wax through the outlet 17 lying outside of (above, as illustrated) this zone. This may be accomplished by providing small holes 31 through the wall 18 at an appropriate point. These holes are made so small as to prevent passage of any substantial proportion of oil therethrough and into the discharge passages 17, but they are sufficiently large to permit passage of any sedimented lighter wax therethrough under the impelling force caused by the pressure difference between the portion of the main body of the rotor adjacent the holes and the communicating portion of the discharge passages 17. By operating in this way, there may be a very slight loss of oil with the wax, but the accumulation of the undesired wax within the rotor is prevented.

While the invention has been described specifically with reference to treatment of mixtures of oils and waxes, it should be understood that this invention is not limited to treatment of these particular mixtures, as it may be applied in solution of any problem involving centrifugation of three liquid phases of the type discussed in the introductory portion of the present specification.

Various modifications are possible within the scope of the invention, and I do not therefore wish to be limited except by the scope of the following claims.

I claim:

1. In the treatment of a mixture of liquid phases comprising a lightest liquid phase, a heaviest liquid phase and a liquid phase of intermediate specific gravity which is present in a minor proportion, the process comprising subjecting said mixture to centrifugal sedimentation, continuously discharging said lightest liquid phase from the zone of centrifugal sedimentation, continuously discharging the heaviest liquid phase from the zone of centrifugal sedimentation through a space interconnecting said centrifugal sedimentation zone with a liquid balancing zone of said heaviest liquid phase and thence from the influence of centrifugal force under liquid balance against the liquid phases being subjected to centrifugal sedimentation, and establishing communication between the zone of sedimentation of liquid phase of intermediate specific gravity being subjected to centrifugal sedimentation and the liquid balancing zone of the discharging heaviest liquid phase at a zone spaced inwardly from said interconnecting space, said communication being sufficient to permit passage of the sedimented intermediate phase into confluence with the discharging heaviest liquid phase for discharge therewith, but insufficient to permit discharge of a substantial proportion of the lightest phase with said heaviest phase.

2. In the treatment of a mixture of wax and oil comprising a lightest liquid oil phase, a heaviest liquid wax phase and a liquid wax phase of intermediate specific gravity between said aforementioned phases which is present in a minor proportion, the process comprising subjecting said mixture to centrifugal sedimentation,

continuously discharging said lightest liquid phase from the zone of centrifugal sedimentation, continuously discharging the heaviest liquid phase from the zone of centrifugal sedimentation through a space interconnecting said centrifugal sedimentation zone with a liquid balancing zone of said heaviest liquid phase and thence from the influence of centrifugal force under liquid balance against the liquid phases being subjected to centrifugal sedimentation, and establishing communication between the zone of sedimentation of liquid phase of intermediate specific gravity being subjected to centrifugal sedimentation and the liquid balancing zone of the discharging heaviest liquid phase at a zone spaced inwardly from said interconnecting space, said communication being sufficient to permit passage of the sedimented intermediate phase into confluence with the discharging heaviest liquid phase for discharge therewith, but insufficient to permit discharge of a substantial proportion of the lightest phase with said heaviest phase.

3. In the treatment of a mixture of liquid phases comprising a lightest liquid phase, a heaviest liquid phase and a liquid phase of intermediate specific gravity which is present in a minor proportion, the process comprising subjecting said mixture to centrifugal sedimentation, continuously discharging said lightest liquid phase from the zone of centrifugal sedimentation, continuously discharging the heaviest liquid phase from the zone of centrifugal sedimentation through a space interconnecting said centrifugal sedimentation zone with a liquid balancing zone containing said heaviest liquid phase and thence from the influence of centrifugal force under liquid balance against the liquid phases being subjected to centrifugal sedimentation, and establishing communication between the zone of sedimentation of liquid phase of intermediate specific gravity being subjected to centrifugal sedimentation and the liquid balancing zone of the discharging heaviest liquid phase at a zone spaced inwardly from said interconnecting space, said communication being sufficient to permit passage of the sedimented intermediate phase into confluence with the discharging heaviest liquid phase for discharge therewith, but insufficient to permit discharge of a substantial proportion of the lightest phase with said heaviest phase.

4. In the treatment of a mixture of wax and oil comprising a lightest liquid oil phase, a heaviest liquid wax phase and a liquid wax phase of intermediate specific gravity between said aforementioned phases which is present in a minor proportion, the process comprising subjecting said mixture to centrifugal sedimentation, continuously discharging said lightest liquid phase from the zone of centrifugal sedimentation, continuously discharging the heaviest liquid phase from the zone of centrifugal sedimentation through a space interconnecting said centrifugal sedimentation zone with a liquid balancing zone containing said heaviest liquid phase and thence from the influence of centrifugal force under liquid balance against the liquid phases being subjected to centrifugal sedimentation, and establishing communication between the zone of sedimentation of liquid phase of intermediate specific gravity being subjected to centrifugal sedimentation and the liquid balancing zone of the discharging heaviest liquid phase at a zone spaced inwardly from said interconnecting space, said communication being sufficient to permit passage of the sedimented intermediate phase into confluence with the discharging heaviest liquid phase for discharge therewith, but insufficient to permit discharge of a substantial proportion of the lightest phase with said heaviest phase.

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