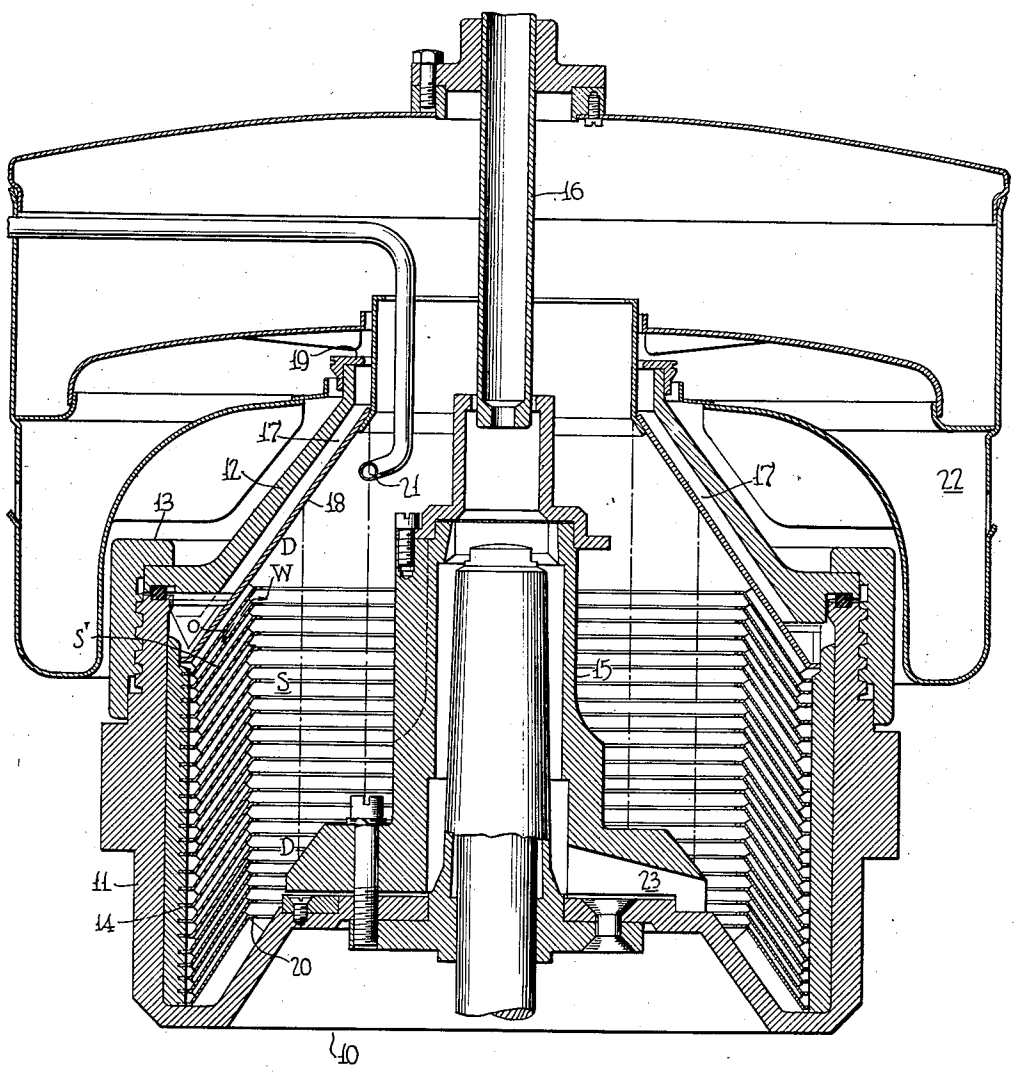
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APPARATUS FOR SEPARATING WAX FROM OIL

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APPARATUS FOR SEPARATING WAX FROM OIL

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The present invention relates to the art of centrifugally separating mixtures of liquids and solids by subjecting such mixtures to the influence of centrifugal force to effect subsidence thereof into concentric layers and discharging the materials of these layers separately from the influence of centrifugal force. It includes both machine and method features and was conceived as a solution of the problem of separating wax, of a type presenting peculiar difficulties of separation, from an oil solution of higher specific gravity than said wax. While both the machine and method probably have other applications than that of separation of wax from oil, the invention has been found to be particularly useful in connection with problems encountered in connection with separating operations of this character and will be described with particular reference thereto.

In the practice of the method or the use of the machine of the invention in the separation of wax from oil, the separating operation is performed upon a mixture containing precipitated wax particles suspended in a solution of oil in a diluent medium of sufficiently high specific gravity to produce an oil solution having a specific gravity substantially higher than that of the suspended wax. The diluent medium may comprise a heavy chlorinated hydrocarbon solvent such as described in my prior Patent No. 1,930,479. A mixture which has been found to be particularly useful as a diluent for oils containing various types of wax comprises ethylene dichloride and benzol. The proportion of benzol to be used in the diluent mixture has been found to be dependent upon the character of the oil to be dewaxed. The more paraffinic the oil, the greater the proportion of benzol that is required. For highly paraffinic oil up to 35% of benzol is required in the diluent mixture and for less paraffinic oils little or no benzol may be used. If proportions of benzol which are substantially higher than 35% are used, the solubility of the wax in the solvent mixture is increased so that lower temperatures are required in dewaxing and the specific gravity of the oil solution is reduced impeding the separation of wax from solution in the centrifuge. Such a solvent mixture has been found to be effective in affording a good yield of low pour point oil when used as a diluent in the practice of the invention.

In the use of such a solvent mixture the wax precipitated upon chilling, being lighter than the oil solution, will naturally flow toward the center of the rotor when subjected to centrifugal force and the oil will flow radially outwardly to the circumference of the rotor. If continuous operation is desired, it is necessary to discharge wax from the inner circumference of the body of material under treatment while discharging the oil from an outer zone thereof. Such discharge presents a difficult problem in connection with the treatment of certain types of wax due to the lack of fluidity of such wax, these difficulties being particularly great in connection with wax which is precipitated from the oil solution in crystalline form.

The difficulty of causing the wax to flow longitudinally of the rotor presents a serious problem in connection with attempts to discharge the wax continuously at high capacity from a conventional imperforate rotor of the high speed tubular type. Attempts to effect separation in a conventional imperforate rotor of the shorter type provided with closely spaced nested discs affording a plurality of overlying subsidence separating zones have likewise met with serious difficulty by reason of the fact that the large quantity of wax present in the oil causes rapid cloggage of the space between the discs and necessitates frequent shutdowns for the purpose of cleaning the rotor. By the use of the machine and the practice of the process of the present invention, I have obviated the difficulties presented by the use of the abovementioned conventional machines. The manner in which these difficulties have been solved will be better understood from a reading of the sub-joined specification in the light of the attached drawing, in which:

The single figure is a central longitudinal section through a centrifugal separator incorporating the machine features of the invention and illustrating the process of the invention.

The process of the invention can be most readily understood when considered in connection with the machine and the novel details of this machine will accordingly be described before the process is discussed in detail.

Referring to the drawing by reference characters, the numeral 10 designates the rotor of the machine, this rotor being driven by suitable means such as a shaft to which it is secured. The rotor comprises a main body portion 11 and a top portion 12 which may be secured to the main body portion by suitable means such as a clamping ring 13. A series of nested frustro-conical discs 14 is secured within the main body portion of the rotor, these discs being spaced apart from each other but a slight distance longitudinally of the rotor and serving to divide liquid passing therethrough into a plurality of relatively thin layers.

A feed tube 15 may be secured to the interior of the rotor and is adapted to receive the mixture to be treated from a conduit 16 communicating with the source of supply and to direct the mixture outwardly through channels 23 into the main body of the rotor. The heavier liquid discharged from the rotor passes through a discharge passage or passages 17 formed between the top por-

tion 12 of the rotor and an annular frustro-conical disc 18, liquid being discharged from the passage 17 over a suitable ring-dam 19 into a liquid receiving cover 22 from which it flows to a suitable storage receptacle.

The discs 14 are of relatively short radial extent, the inner circumferences of these discs lying radially without the principal zone of separation of the rotor. The lighter material of the mixture may be removed from the rotor at a zone well within the zone occupied by the discs, by suitable means such as a skimming nozzle or the like, as indicated at 21, this skimming nozzle communicating with a discharge conduit through which the lighter effluent, such as the wax of the oil-wax mixture referred to above, is discharged from the machine.

In the use of the machine described above in the separation of precipitated wax, the suspension of wax in the chilled heavy oil solution is fed to the rotor through the conduit 16 and is directed into the unobstructed zone S of the rotor through the feed tube 15 and passages 23. The relative locations of the ring-dam 19 and the skimming nozzle 21 are such as to afford an unobstructed subsidence separating zone S of substantial radial depth between the skimming nozzle 21 and the inner termini 20 of the discs. The subsidence of wax and oil in this zone affords a body of wax containing a certain small proportion of entrained oil in the portion of the rotor radially inward of the line D—D of separation of wax from oil and a body of oil outside of this zone from which the major portion of the wax has been removed. It will thus be seen that the principal zone of separation of wax from oil lies inwardly of the zone occupied by the discs 14 and that very little wax comes into contact with these discs. If the separating action of the rotor within the zone S were relied upon alone to effect separation of wax from oil, however, the rotor would be relatively inefficient, as a rotor having the large diameter necessary to obtain reasonably high capacity of through-put of this viscous wax cannot be safely rotated at a speed sufficient to afford the high centrifugal force necessary to effect the desired degree of wax removal. Residual wax which passes with the oil beyond the dividing zone S is, accordingly, subjected to the more thorough wax removing action of the discs 14, the oil passing between these discs being divided into a plurality of concentric parallel layers which are subjected to the action of centrifugal force to effect removal of the wax from the thin streams of oil passing through these discs. Wax removed within this space collects upon the upper faces of the respective discs and passes under the influence of centrifugal force inwardly beyond the disc separating zone, as indicated by the arrow W in the drawing, whereas the oil continues its movement outwardly, as indicated by the arrow O, and passes from the rotor after passing around the outer circumferences of the discs 14 and of the disc 18.

It will be evident from the above discussion that the centrifugal machine of the present invention possesses many of the combined advantages of the tubular and the disc types of centrifugal separator. The advantages of the disc type are attained by reason of the general shape of the rotor, in that the rotor is relatively short and that the lighter effluent, such as the wax, is not required to flow for a substantial longitudinal distance and that oil which has been subjected to preliminary wax removal is passed between a plurality of subsidence separating discs within which a fine degree of wax removal takes place. The advantages of the tubular type of rotor are attained by reason of the fact that the major portion of the wax or other lighter effluent is separated from the oil in a zone which is unobstructed by discs and which does not therefore involve the inconvenience of cloggage of disc passages by wax incident to the separating operation.

Modifications of both the machine and method will be obvious to those skilled in the arts to which these inventions pertain and I do not therefore wish to be limited except by the scope of the sub-joined claims.

I claim:

1. A centrifugal separator comprising an imperforate rotor in which subsidence of a mixture of liquid and solids of lower specific gravity than said liquid is adapted to take place under the influence of centrifugal force, and means for feeding a mixture of liquid and solids to the rotor, said rotor comprising a main body portion, means for directing a mixture fed to the rotor into a central unobstructed part of said main body portion and a series of closely spaced frustro-conical discs having their inner circumferential termini radially a substantial distance without said zone of feed, whereby to afford a substantially unobstructed subsidence zone within which the major portion of the solids of said mixture is adapted to be stratified from the liquid content of the mixture and a radially outer disc zone within which residual solids which flow outwardly with liquid from said unobstructed subsidence zone are adapted to be collected and returned to the unobstructed zone, and a skimming nozzle located in a position adapted to contact subsided solids within the rotor and effect continuous discharge of such solids therefrom under the influence of the inertia of said solids.

2. A centrifugal separator comprising an imperforate rotor in which subsidence of a mixture of liquid and solids of lower specific gravity than said liquid is adapted to take place under the influence of centrifugal force, and means for feeding a mixture of liquid and solids to the rotor, said rotor comprising a main body portion, means for directing a mixture fed to the rotor into a central unobstructed part of said main body portion and a series of closely spaced frustro-conical discs having their inner circumferential termini radially a substantial distance without said zone of feed, whereby to afford a substantially unobstructed subsidence zone within which the major portion of the solids of said mixture is adapted to be stratified from the liquid content of the mixture and a radially outer disc zone within which residual solids which flow outwardly with liquid from said unobstructed subsidence zone are adapted to be collected and returned to the unobstructed zone, and a stationary dislodging tool located in a position adapted to contact subsided solids within the rotor and effect continuous discharge of such solids therefrom under the influence of the inertia of said solids.

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