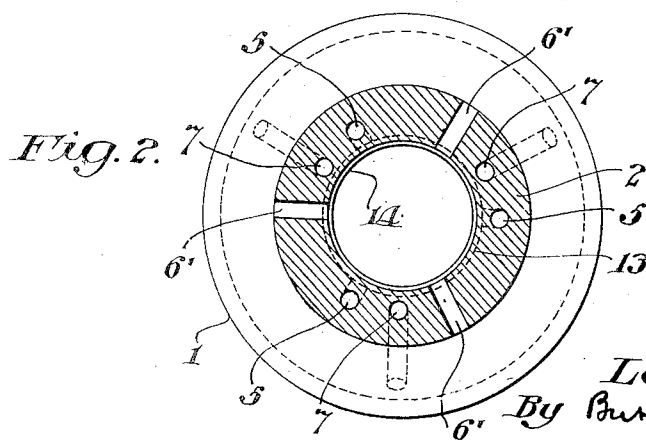


1,373,743.

3 SHEETS—SHEET 1.



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L. D. JONES.
METHOD AND MECHANISM FOR CENTRIFUGALLY SEPARATING SUBSTANCES.
APPLICATION FILED SEPT. 4, 1920.

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Patented Apr. 5, 1921.
3 SHEETS—SHEET 2.

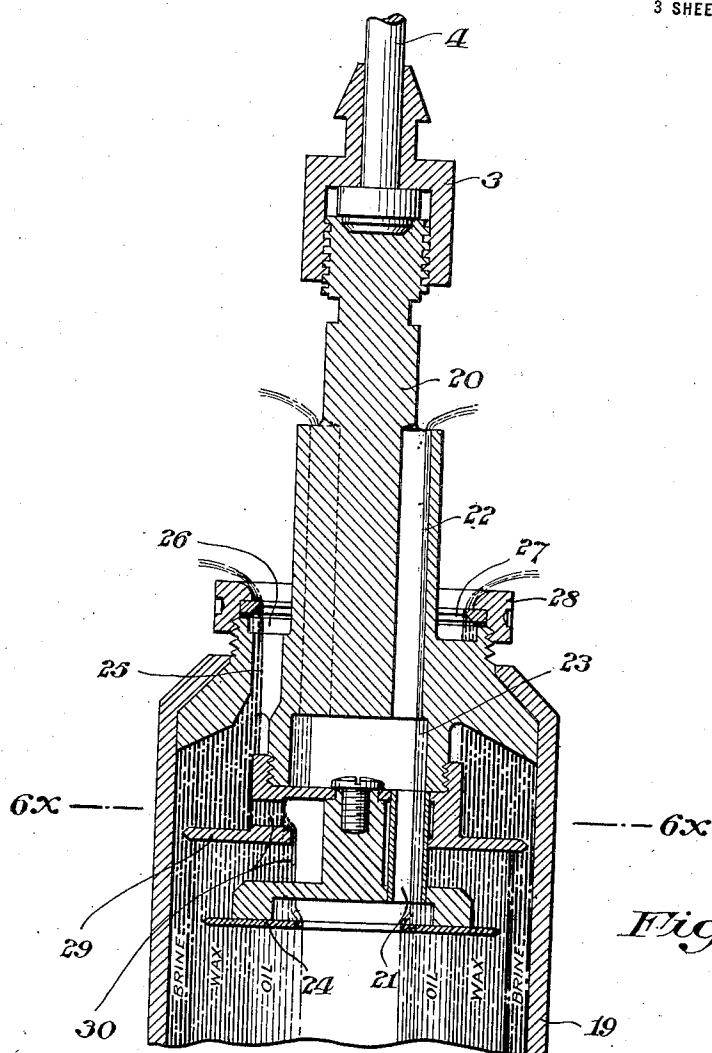


Fig. 5.

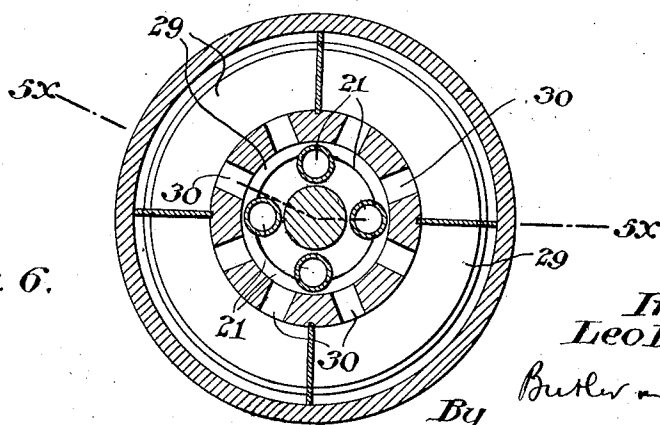
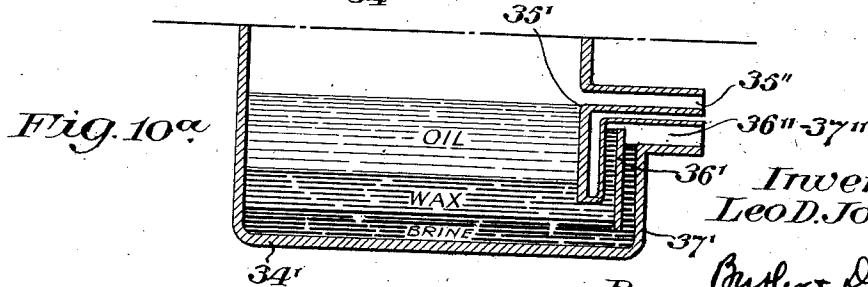
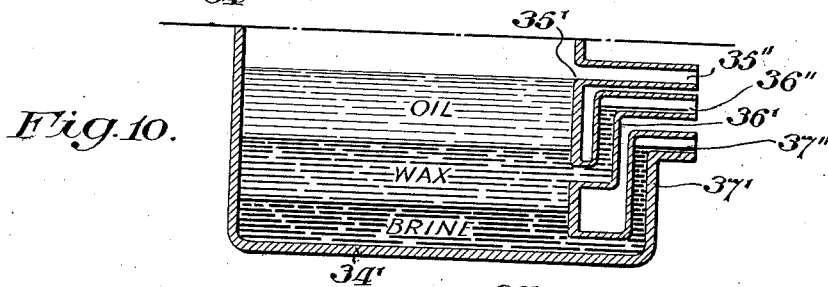
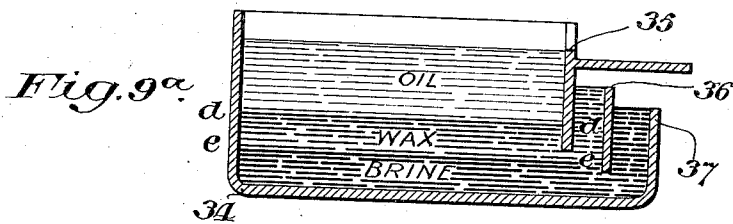
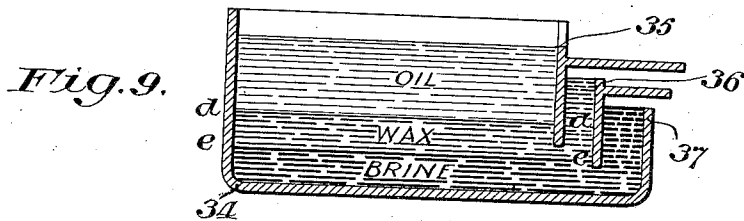
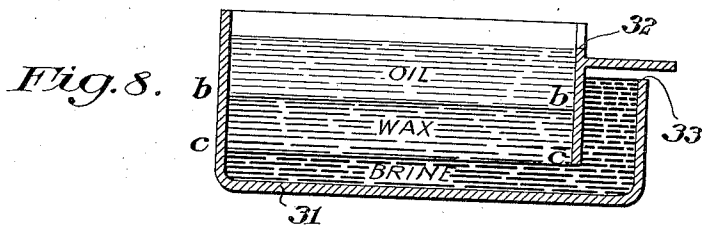
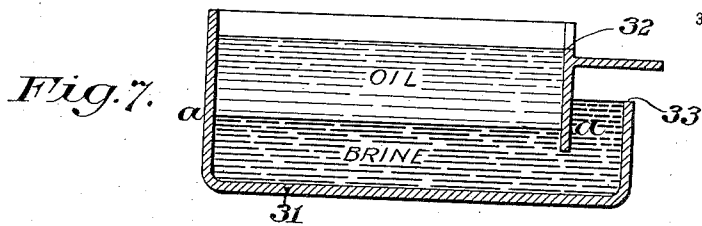


Fig. 6.

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UNITED STATES PATENT OFFICE.

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METHOD AND MECHANISM FOR CENTRIFUGALLY SEPARATING SUBSTANCES.

1,373,743.

Specification of Letters Patent.

Patented Apr. 5, 1921.

Application filed September 4, 1920. Serial No. 408,336.

To all whom it may concern:

Be it known that I, LEO D. JONES, a citizen of the United States, residing in the city of Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented an Improved Method and Mechanism for Centrifugally Separating Substances, of which the following is a specification.

This invention contemplates the separation of three substances, two or more of which are liquid, and it is designed especially for effecting separations where three constituents are involved, with a view to minimizing the objectionable effects on the separation of the two lighter constituents due to changes in the density of the heaviest constituents and nice adjustments of the dams therefor, as, more specifically in the treatment of dilute cylinder stock or petroleum oils containing wax, by subjecting the same together with a heavier carrier liquid, such as brine, to centrifugal force in a bowl having a plurality of outlets through which the separated substances are discharged respectively. It will be understood, however, that while the improvements have a highly important use in the separation of wax from oil, the principles involved are not to be considered as limited to this use but are of more general application as, for instance, to the separation of oil from soap water in which the soap has been precipitated by salt.

Specific advantageous functions of the invention are found in its capacity for segregating more than two substances by a machine having two or more discharge passages and improved means for controlling the discharge of the separated substances with avoidance of the necessity for the refinement in construction and adjustment and the elimination of the sensitiveness of operation involved in the separation of more than two constituents by known centrifugal means and methods, and also in the comparative independence of the separation of the two lighter constituents upon the adjustment of the dams and the specific gravity of the heaviest constituent, and vice versa, and the comparative independence of the separation of the two heavier constituents upon the adjustment of the dams and the specific gravity of the lightest constituent.

As an example of the sensitiveness of the customary practice, consider the operation

of a centrifugal machine designed to effect the discharge of wax with the carrier liquid through one passage and oil through another. Here an increase of $\frac{1}{8}$ inch in the axial distance of the weir over which the wax and carrier liquid flows over that required for normal operation has effected a change of relations which cause the discharge of oil with the wax, and a decrease of $\frac{1}{8}$ inch from that required for normal operation has been found to cause the discharge of wax with the oil, whereas in the present method a variation of $\frac{1}{8}$ inch in either direction in the position of the weir for the carrier liquid has been found to have no effect upon the efficiency of the separation of the wax from the oil.

Variations in the density of the carrier liquid may likewise take place without substantially effecting the efficiency of the separation of the oil and wax by the present improvements, whereas a slight variation in the density of the carrier liquid has heretofore interfered with and prevented the desired separations.

In separating a mixture of three substances each substance may be discharged separately but it frequently happens that it is desirable or more convenient to discharge one separately on the one hand, and discharge a mixture of the other two constituents (usually the heavier two) on the other. This is most efficiently accomplished by stratifying the three constituents and controlling the separation according to my invention, followed by reuniting the two to be discharged together while still under the influence of centrifugal force and discharging the two products through separate discharge passages.

The invention is practised by means of the structures set out in the following description and the accompanying drawings in illustration thereof.

In the drawings, Figure 1 is a broken vertical sectional view of the top of a centrifugal separator bowl constructed in accordance with the invention; Fig. 2 is a sectional view taken on the line 2^x—2^x of Fig. 1; Fig. 3 is a sectional view taken on the line 3^x—3^x of Fig. 1; Fig. 4 is a sectional view taken on the line 4^x—4^x of Fig. 1; Fig. 5 is a broken vertical sectional view of the top of a centrifugal bowl of modified construction taken

on the line 5*-5* of Fig. 6, by which three substances are separated in the bowl under control of respective dams therefor followed by discharging two of them together; Fig. 5 6 is a sectional view taken on the line 6*-6* of Fig. 5; and Figs. 7, 8, 9, 9^a, 10 and 10^a are vertical sectional views of vessels designed to illustrate diagrammatically conditions involved in the separation of three substances, 10 as in the case of petroleum oil containing wax with the use of brine as a carrier liquid.

The construction illustrated in Figs. 1 to 4 inclusive comprises a bowl 1 having a neck 2 connected by a coupling 3 with a spindle 15 4, by which the bowl is suspended and revolved.

The bowl 1 is provided at its top with three passages or sets of passages 5, 6-6' and 7 for discharging substances of different densities, as oil, wax and brine, which 20 have been stratified in the bowl by its revolution.

The discharge passages 5 communicate at their inlets with the bowl body through the concentric cylindrical chamber 8, into which 25 the oil, or otherwise the lightest of the separated substances, flows over the ring 9, and through passages 5, the passages discharging into the channel 10 concentric with the axis of rotation and having the concentric annular dam or ring 11 over which the liquid flows. The ring or dam 11 is made 30 exchangeable for dams or rings of different sizes and characteristics, for accommodation to different conditions, by means of the collar 12 detachably connected with the neck 2 for engaging such dams thereto.

The discharge passages 6 and 6' are connected through the cylindrical chamber 13, 40 which is disposed concentrically with the bowl in the neck thereof and has near its top the concentric ring or annular dam 14, the chambers 8 and 13 being separated by the diaphragm 15.

The discharge passages 7 lead from the interior of the bowl body 1, from inlets exterior to the passages 6, through the neck 2, to the annular channel 16, which discharges over a ring or annular dam 17 concentric with the axis of revolution, the ring 50 being retained so that substitutions of different rings can be effected for different conditions by means of the collar 18 connected detachably with the bowl neck.

As illustrated in the modified construction 55 of Figs. 5 and 6, the bowl 19, having the neck 20, is provided with the passages 21 and 22 connected by the concentric chamber 23 for discharging the lightest substance, as oil, which flows thereto over the inner edge of the dam or ring 24, and the passages 25 for discharging together the two heavier substances, as wax and brine, which 60 are delivered therefrom to the channel 26 and thence over the dam or ring 27, the

latter being held in place by the sleeve 28 screwed on the top of the bowl. A ring or dam 29 is fixed in the bowl between the dam 24 and the passages 25: the heaviest substance, as brine, flowing to these passages 70 around the outer edge of this dam 29 and the substance of intermediate density, as wax, flowing around the outer edge of the dam 24 and through the by-passes 30 extending around the inner limit or edge of 75 the dam 29.

In considering comparatively the conditions involved in the separation of three mingled constituents of different densities by the present invention, assume that the 80 vessel 31 is provided with the dams 32 and 33 adjusted so that the contact surface *a-a* of a resolved mixture (for instance of brine and wax free oil assumed for the purpose to separate by gravity) will, upon gravity 85 separation, be between the upper and lower edges of the dam 32 when the upper surface of oil is level with or overflows this dam and the upper surface of the column of brine between the dams 32 and 33 is level 90 with or overflows the dam 33, as illustrated in Fig. 7. If, now, oil containing precipitated wax is poured into the oil in the vessel 31, the wax may be assumed to gravitate to the surface of the brine and collect in a 95 layer between the oil and brine, having a top surface *b-b* above the surface *a-a* and a bottom surface *c-c* below the surface *a-a*, as illustrated in Fig. 8. With the desired adjustments and conditions (as the 100 mingled constituents are continuously poured into the vessel), the wax would break the brine seal and leak under the dam 32 and escape over the dam 33 the lighter wax free oil flowing off over the dam 105 32. It will be understood that a change in the height of the dam 33 varies the height of the adjacent column of brine and thus the plane of contact between the layers of oil and wax. A slight elevation of 110 this dam will elevate this contact surface so that the wax will occupy all the separating space for the oil and the oil will flow over the dam 32 without its wax having been separated, and a slight lowering of the 115 dam 33 will lower this contact surface and permit the oil to escape with the wax under dam 32 and over the dam 33, thus defeating the desired purpose of their separation. Likewise, if with dams properly adjusted, 120 there should be a variation in the density of the brine, the oil would escape with the wax in case of decreased brine density and the wax would discharge with the oil in case of increased brine density. It follows 125 then that, with this former type of separator or mode of operation, the efficiency of the separation of the two lighter substances varies with the density of the heaviest substance and the adjustment of the dams. 130

Considering now (diagrammatically and analogously in illustration of the present invention as embodied in Figs. 1 and 5) the vessel 34, it is provided with the dams 35, 36 and 37 having successively lower corresponding parts. The vessel 34 as shown in Fig. 9, is designed for the discharge separately of oil, wax and brine respectively, while this vessel, as shown in Fig. 9^a, is designed for the discharge of separated oil on the one hand and wax and brine together on the other. The plane of contact $d-d$ of the layers of oil and wax is between the top and bottom of the dam 35, and the plane of contact $e-e$ of the wax and brine between the bottoms of the dams 35 and 36; the dams 35, 36 and 37 being adjusted to the positions for effecting the desired operations. The contact surface between the oil and wax is controlled by the dams 35 and 36, and the contact surface between the wax and the brine is controlled by the dams 36 and 37. The contact surface between the wax and the oil is independent of the height of the dam 37 and the density of the brine within certain limits to be specified, until this dam becomes so high that the contact surface between the wax and brine lies between the top and bottom of the dam 35, with the result that the wax is sealed from its dam 36 and will discharge with the oil, or, on the other hand, until the dam 37 becomes so low that the contact surface between the wax and brine falls below the dam 36 when the wax escapes through the brine column adjacent to the dam 37. For similar reasons the contact surface between the oil and wax is also independent of the density of the brine within certain limits.

It follows from this that the efficiency of the separation of the two lighter substances is independent, within certain limits, of the adjustment of the brine dam and of the density of the brine.

Regard the construction shown in Figs. 10 and 10^a (which is analogous to that shown in Figs. 9 and 9^a) as a vertical section through a bowl 34' divided on an axial plane and having dams 35', 36' and 37' for controlling the flow through the respective discharge passages, 35'', 36'' and 37'', or 35''' and 36'''—37'''. In practice, it has been found that comparatively wide variations can be made in the distance of the weir or overflow edge of the dam 37', analogous to the parts 17 and 27 shown in Figs. 1 and 5, without changing the contact surface between the oil and wax or at all interfering with their separation and separate discharge.

In the bowls of Figs. 1 and 5, by reason of these characteristic features, the separation of wax from oil is independent of variations in the density of the brine and the

oil mixture within certain limits, and also of the adjustment of the brine dam within certain limits, for the contact surface between them is within wide limits independent of the density of the brine and the adjustment of the brine dam, whereas in the former practice it was directly dependent thereon and varied therewith.

The present invention is of distinct advantage in separating oil and wax with a carrier liquid, for the position of the contact surface between the oil and wax and therefore the separation varies with the relative specific gravities of the oil and wax, which is approximately constant in lots of oil obtained from the same source, whereas in the former practice the contact surfaces were dependent upon the specific gravities of the oil and brine which were liable to wide variations due to making up the brine and oil solutions.

These advantages of the new method, while well illustrated by the specific case of the separation of wax from oil, are equally true for separation of any three substances.

Having described my invention, I claim:

1. The method of separating three substances having different densities which consists in subjecting them to centrifugal force and controlling the distance of the contact surfaces of the centrifugally stratified substances from the center of revolution so that either of the contact surfaces of the intermediate substance may vary substantially without substantially varying its other contact surface.

2. The method of separating three substances of different densities which consists in centrifugally stratifying and controlling the place of separation of two of the contacting substances so that such place is substantially independent of variations in the density of the third substance, and separately delivering the respective substances so that the density of the third substance can be varied without substantially varying the distance from the center of rotation to the place of separation of the other substances.

3. The method of treating three substances of different densities which consists in centrifugally stratifying and controlling the place of separation of two of the substances so that such place is substantially independent of variations in the density of the third substance, separately delivering the respective substances so that the density of the third substance can be varied without substantially varying the distance from the center of rotation of this place of separation of the other substances, and reuniting and discharging together two of the separated substances.

4. The method of separating wax from petroleum oil which consists in chilling the

oil to precipitate the wax, and subjecting the chilled oil together with an immiscible carrier liquid to centrifugal force in a revoluble bowl having discharge passages with
5 controlling means at respective distances from the axis of rotation adjusted in functional relation to the respective densities of the oil, wax and carrier liquid.

5. A revoluble separator bowl provided
10 with three passages having independent communications therewith, a common outlet

for two of said passages and respective controlling means disposed at different distances from the axis of the bowl, said bowl and controlling means adapted for stratifying three mixed substances and delivering
15 said substances through the respective passages.

In testimony whereof I have hereunto set my name this 31st day of August, 1920.

LEO D. JONES.