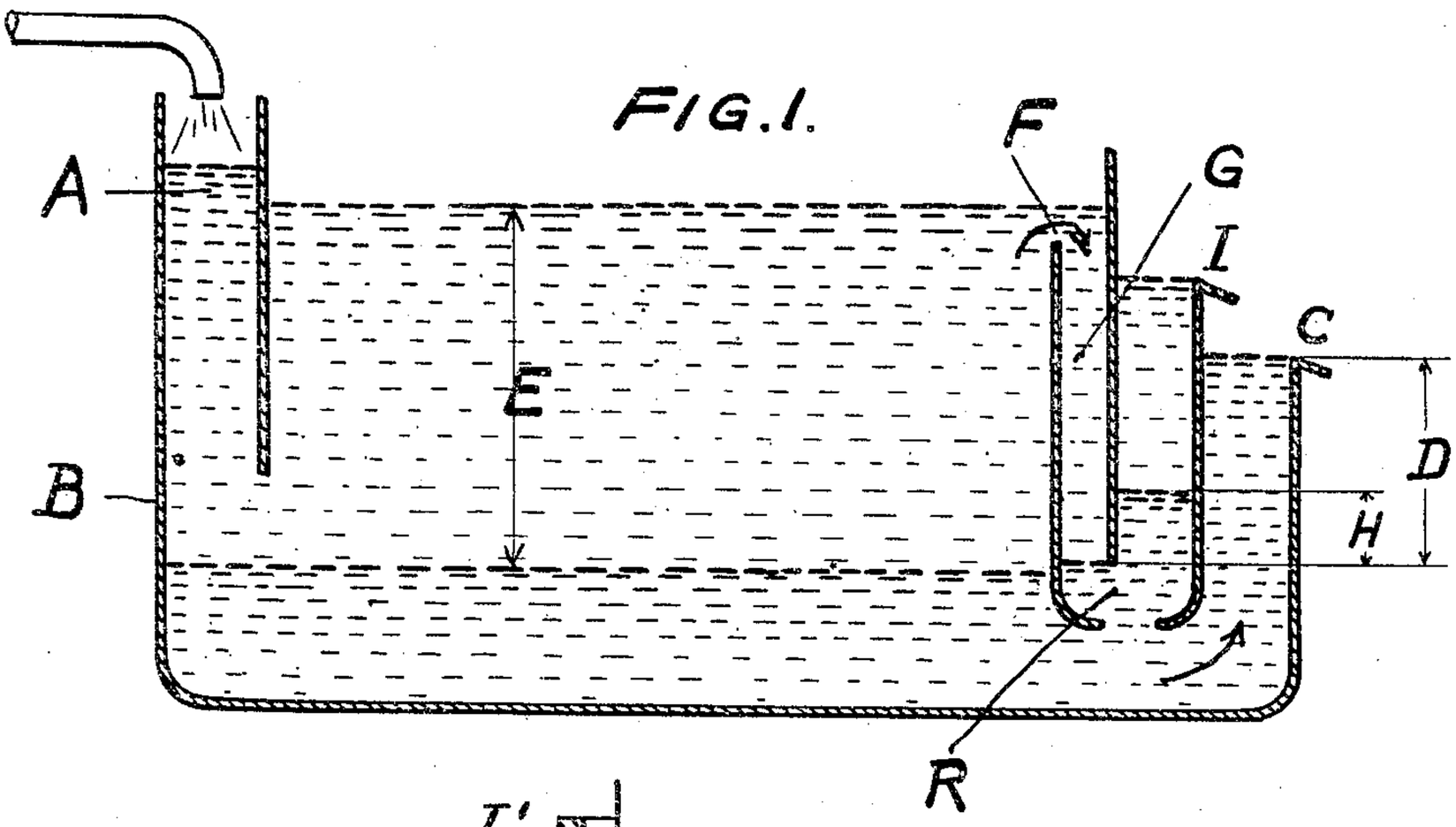
Feb. 14, 1933. S. A. B. DAHLGREN 1,897,240

PROCESS FOR SEPARATING LIQUIDS OF DIFFERENT SPECIFIC GRAVITIES

Original Filed June 21, 1930

FIG. 1.



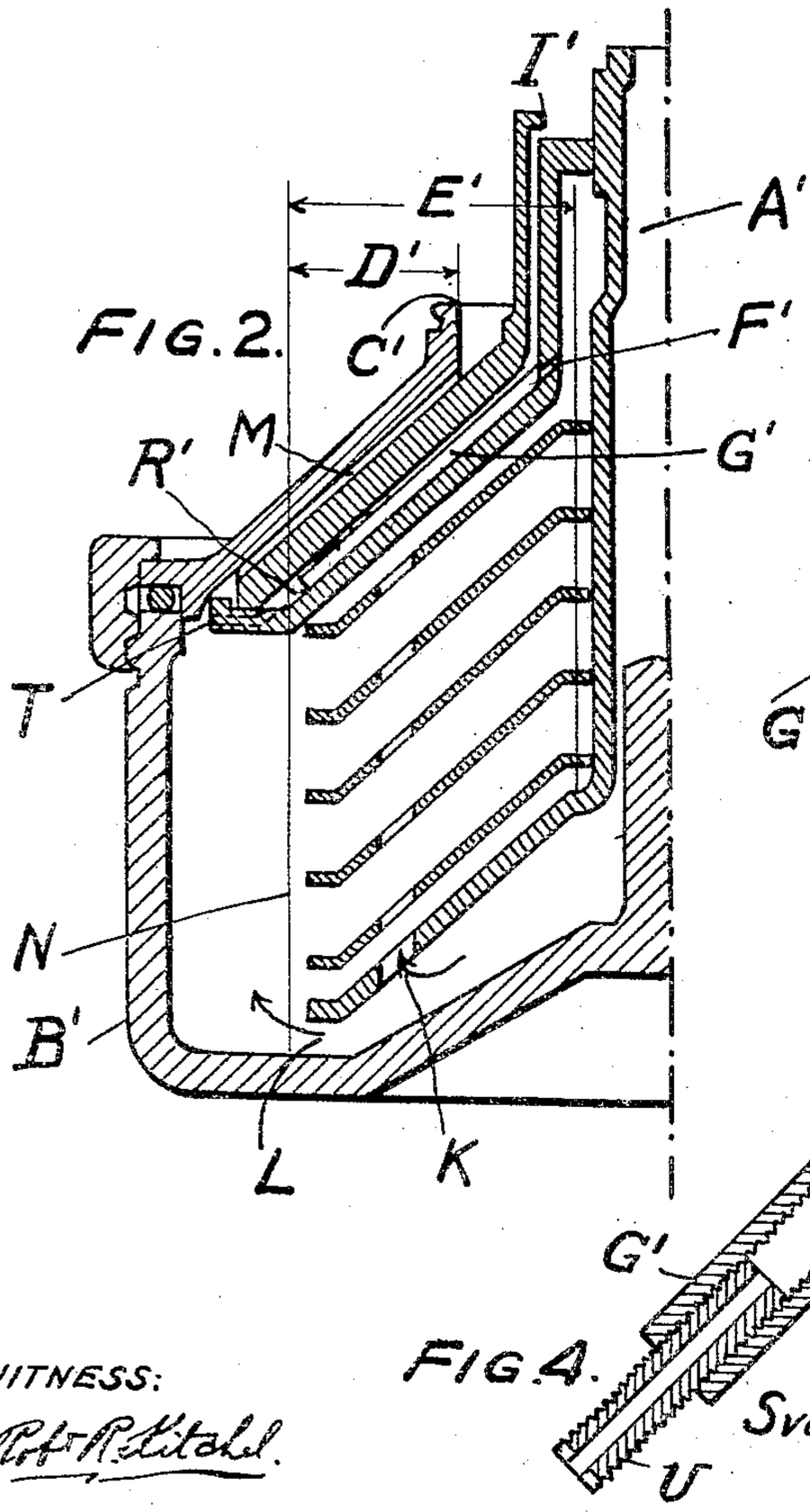


FIG. 2.

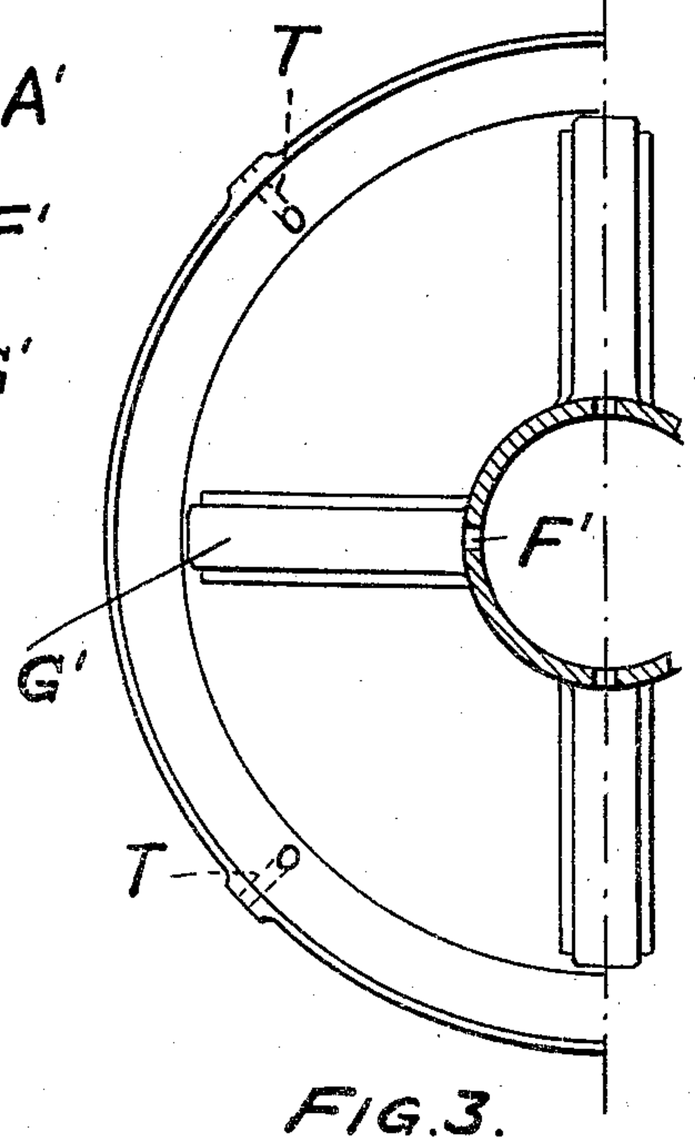


FIG. 3.

FIG. 4.

WITNESS:

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Patented Feb. 14, 1933 1,897,240

UNITED STATES PATENT OFFICE

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PROCESS FOR SEPARATING LIQUIDS OF DIFFERENT SPECIFIC GRAVITIES

Application filed June 21, 1930, Serial No. 462,773, and in Sweden July 3, 1929. Renewed July 13, 1932.

In separating two liquids of different specific gravities, for instance oil and water, it is generally possible to obtain continuous discharge of the liquids by arranging a liquid seal of the heavier liquid in the separating vessel. If the separation takes place in a centrifuge and if a mixture of the two liquids is fed into the bowl of the centrifuge, the heavier liquid will be separated out towards the periphery of the bowl, where it displaces a corresponding quantity of liquid via the liquid seal, said liquid leaving the bowl through an outlet at a certain distance from the axis of rotation of the bowl. The lighter liquid moves inwards towards the centre and is discharged from the bowl at a smaller distance from the axis of rotation of the bowl. To attain the highest separating efficiency, the outlet radius should be such that the level between the lighter and the heavier liquid in the centrifugal bowl is at the greatest possible diameter. If the liquids contain solid impurities, which must be separated out, the correct determination of said outlet radius is of the greatest importance for the result of the separation, as these impurities generally are more difficult to separate than the liquids and also interfere with the separation of the liquids.

To obtain in every case the most advantageous position of the level in the bowl according to the specific gravities of the liquids, the outlets for liquid have been arranged in such manner that their distance from the axis of rotation of the bowl can be varied. A common method is to take out one of the liquids through a ring that is concentric with the axis of rotation of the bowl, said ring being replaceable by a similar ring of any desired different inner diameter. Another method is to move the outlet radius of the heavier or the lighter liquid in a radial direction by means of a screw.

The regulation brought about by exchange of rings or by adjustment of screws involves great inconveniences, especially as the specific gravities of the liquids often vary. It may even happen that the specific gravities of the liquids vary during the separation. This is for instance the case when separating the press-liquid obtained from olives. Whereas the specific gravity of the olive oil is comparatively constant, the specific gravity of the fruit water may vary between 1.00 and 1.12. At the same time a very exact adjustment of the bowl is of the utmost importance for the result of the separation, making it necessary often to stop the separator so that the levels can be regulated. In unfavorable cases such a regulation of the levels may be necessary several times an hour, so that the centrifuge works in an uneconomical manner and is troublesome to operate.

The object of the present invention is to avoid the necessity of manual regulation of either of the liquid outlets or of stoppage of the centrifuge in order to maintain the conditions required for efficient separation. Specifically the object of the invention is attained by the maintenance of a constant level between the two liquids in the separating chamber independent of the relatives specific gravities of the liquids. The invention also comprises novel structural features in the centrifuge itself, although the process is not dependent for its execution on a centrifuge of any particular construction.

In the drawing:

Fig. 1 is a diagram illustrating the principle of the invention by means of a decanting apparatus wherein separation is effected by gravity.

Fig. 2 is a vertical section though a centrifuge embodying my structural improvements and adapted to carry out my improved process.

Fig. 3 is a plan view of the central feed tube, the initial lighter liquid outflow channel and the upper surface of the plate forming the bottom of the auxiliary separating chamber.

Fig. 4 is a detail sectional view of means for regulating the radius of the outlet from the outflow passage of once-separated lighter liquid.

In order to illustrate the principle of the invention in a simple manner, it will be assumed that the separation is taking place under the influence of gravity instead of under centrifugal force, and for this purpose reference will first be made to Fig. 1.

The mixture of liquids, consisting of, for instance, oil and water, is fed into the separating vessel through the inlet A. In the chamber B separation takes place, the water and the impurities sinking to the bottom of the vessel and the lighter oil rising to the surface. The water discharges through the fixed outlet C through a water seal. There is static equilibrium between the column of water D and the column of oil E. The purified oil discharges at F through the tube G, which extends down to about, but not necessarily exactly, the level at which one desires to keep the boundary level between the two liquids in the separating vessel. Through the tube G the oil is led into a chamber R in which the oil must pass through a layer of water H and finally discharges through the fixed oil outlet I. The oil is clean when it again meets the water in the chamber R and the water has also been liberated from solid impurities, so that the liquids easily effect a clean separation.

If now the specific gravity of the water suddenly increases, the weight of the column of water D also increases. In order that there shall be equilibrium between said column of water and the column of liquid under the fixed oil outlet I, the height of the column of water H must be such that the pressure of the same plus the pressure of the column of oil over it is equal to the pressure of the column of water D. In order that the oil shall be able to surmount the increased pressure of the water, it is necessary that the height of the column of oil E shall increase simultaneously. The level between water and oil in the separating vessel will still be at the same height, water and oil discharge at fixed levels, and the only result of the variation in the specific gravity of the water is that the height of the column of oil E automatically increases or decreases.

Figs. 2 and 3 show a centrifugal bowl embodying my improved construction and adapted to carry out my improved process in accordance with the principle shown in Fig. 1 and above described. The mixture of liquids is fed into the bowl through the central feed tube A′ and is introduced into the separating chamber B′ through the channels K and L. The heavier liquid as well as the solid impurities move towards the wall of the bowl under the influence of the centrifugal force. The former discharges continuously through the channels M to the fixed outlet C′, whereas the heavier solid impurities that are not carried out with the liquid deposit on the wall of the bowl. The lighter liquid moves inwards to the centre of the bowl and is gradually liberated from the heavier liquid and the impurities. The bowl shown in the figure is fitted with a pile of discs, the object of the same being to increase the separating efficiency of the bowl. The purified oil flows outwards through the holes F′ and the channels G′ and surmounts the pressure of the heavier liquid in the chamber R′, which is connected with the liquid seal by means of the channels T, and then returns inwards to the centre at the side of or over the channels G′, and finally discharges through the fixed oil outlet I′. The efficiency of the separation in the chamber R′ can be increased by letting the lighter liquid also pass through a pile of discs in this chamber. The level N in the bowl between the heavier and the lighter liquid keeps at a constant distance from the axis of rotation of the bowl if the specific gravity of either of the liquids should vary, analogous to what is the case with the static separating tank illustrated in Fig. 1.

By lengthening or shortening the tubes G′ at their outer ends, it is possible to move the level between the liquids from or towards the centre of the bowl respectively. The level for the discharge of the oil in the chamber R′ and thus also the level between the liquids can be made variable by means of special regulating devices, for instance, by means of screws U, provided with a central hole, at the outer ends of the tubes G′ as shown in Fig. 4.

In certain cases, as, for instance, when the specific gravities lie close to each other and undergo but small changes during the separation, it may be desirable to place the outlets for the liquids at as small a diameter as possible, one advantage of this being reduced power consumption for the separation. It is also suitable to provide regulating devices for the variation of the diameter of outlets for the liquids, said regulating devices having, however, no influence on the position of the level between the two liquids in the centrifugal bowl.

The separation of oil and water and of olive oil and fruit water are merely examples of mixed liquids capable of separation by my improved process and centrifuge. It should be clearly understood that the invention is applicable to all mixtures of liquids which are capable of being centrifugally separated.

No claim is made herein to the novel structural features of the centrifuge, the same forming the subject-matter of a separate application filed April 28, 1931, Serial No. 533,428.

Having now fully described my invention, what I claim and desire to protect by Letters Patent is:

1. In the separation of two liquids of different specific gravities in which the separated heavier liquid that has been separated in the main separating space is discharged through a liquid seal formed by the heavier liquid, the process which comprises flowing the lighter liquid that has been separated in the main separating space into an auxiliary body of the heavier liquid communicating

with said liquid seal and at a level approximating the level between the two liquids in the main separating space, and in said auxiliary body of the heavier liquid separating therefrom said lighter liquid and discharging it from an outlet at a level between the outlet for the heavier liquid and the level of the lighter liquid in the main separating space, whereby the level between the two liquids in the main separating space is maintained constant notwithstanding varations in the specific gravities of the two liquids.

2. In the centrifugal separation of two liquids of different specific gravities in which the heavier liquid that has been separated in the main separating space is discharged therefrom through a liquid seal formed by the heavier liquid and thence flows inward toward the axis of rotation and discharges through an outlet at a smaller distance from the axis of rotation than the level between the two liquids in the main separating space, the process which comprises flowing the lighter liquid that has been separated in the main separating space into an auxiliary body of the heavier liquid communicating with said liquid seal and at a level approximating the level between the two liquids in the main separating space, and in said auxiliary body of the heavier liquid again separating the lighter liquid from the heavier liquid and flowing it inward toward the axis of rotation and discharging it through an outlet between the outlet for the heavier liquid and the level of the lighter liquid in the main separating space, whereby the level between the two liquids in the main separating space is maintained constant notwithstanding variations in the specific gravities of the two liquids.

3. In the centrifugal separation of two liquids of different specific gravities in which the heavier liquid that has been separated in the main separating space is discharged therefrom through a liquid seal formed by the heavier liquid and thence flows inward toward the axis of rotation and discharges through an outlet at a smaller distance from the axis of rotation than the level between the two liquids in the main separating space, the process which comprises flowing the lighter liquid that has been separated in the main separating space through an auxiliary body of the heavier liquid communicating with said liquid seal and therein again separating the lighter liquid from the heavier liquid and discharging it.

4. In the centrifugal separation of two liquids of different specific gravities in which the heavier liquid that has been separated in the main separating space is discharged therefrom through a liquid seal formed by the heavier liquid and thence flows inward toward the axis of rotation and discharges through an outlet at a smaller distance from the axis of rotation than the level between the two liquids in the main separating space, the process which comprises flowing the lighter liquid that has been separated in the main separating space through an auxiliary body of the heavier liquid communicating with said liquid seal and therein again separating the lighter liquid from the heavier liquid and discharging it through a fixed outlet at a radial distance from the axis of rotation between the radial distances of the outlet for the heavier liquid and the level of the lighter liquid in the main separating space.

5. In the centrifugal separation of two liquids of different specific gravities, the process which comprises separating the two liquids in a main separating space, discharging therefrom all the separated heavier liquid through a liquid seal of such heavier liquid and discharging all the lighter liquid through another liquid seal of said heavier liquid.

6. In the centrifugal separation of two liquids of different specific gravities, the process which comprises separating the two liquids in a main separating space, discharging therefrom all the separated heavier liquid through a liquid seal of such heavier liquid communicating with the peripheral zone of separated heavier liquid and outflowing from the main separating space all the lighter liquid into another liquid seal of said heavier liquid at a level approximating the level between the two liquids in the main separating space, and reseparating the lighter liquid from the heavier liquid of the second liquid seal and discharging it.

7. In the centrifugal separation of two liquids of different specific gravities, the process which comprises separating the two liquids in a main separating space, discharging therefrom all the separated heavier liquid through a liquid seal of such heavier liquid communicating with the peripheral zone of separated heavier liquid and outflowing from the main separating space all the lighter liquid into another liquid seal of said heavier liquid at a level approximating the level between the two liquids in the main separating space, and reseparating the lighter liquid from the heavier liquid of the second liquid seal; and thence flowing the lighter liquid through a fixed outlet at a radial distance from the axis of rotation between the radial distances of the heavier liquid outlet and the level of the lighter liquid in the main separating space.

In testimony of which invention, I have hereunto set my hand, at Stockholm, Sweden, on this 2nd day of June, 1930.

SVEN ALFRED BERTIL DAHLGREN.