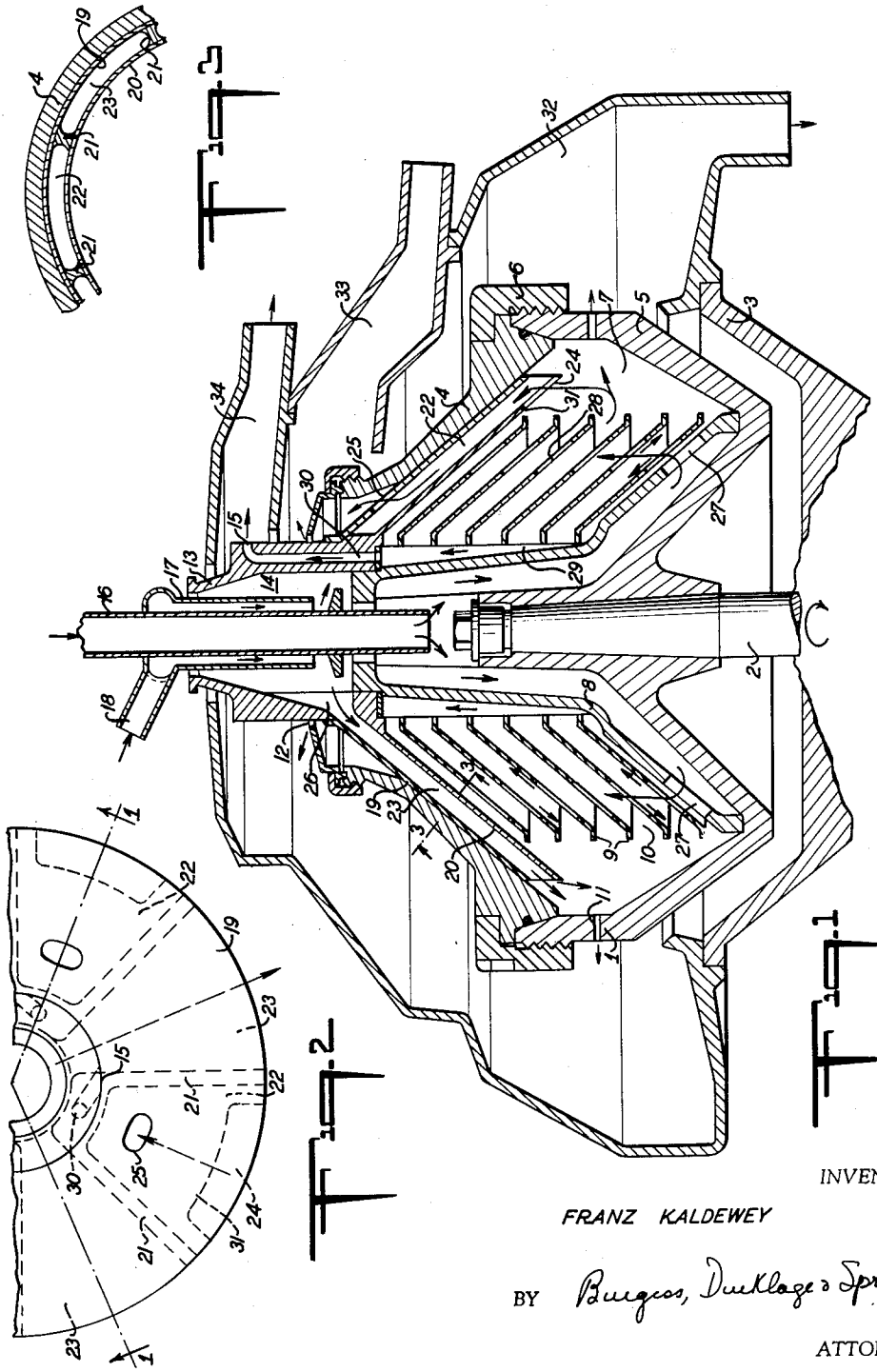
Dec. 15, 1959 F. KALDEWEY 2,917,230

CENTRIFUGAL SEPARATOR HAVING AN AUXILIARY LIQUID FEEDING DEVICE

Filed Jan. 24, 1956 3 Sheets-Sheet 1



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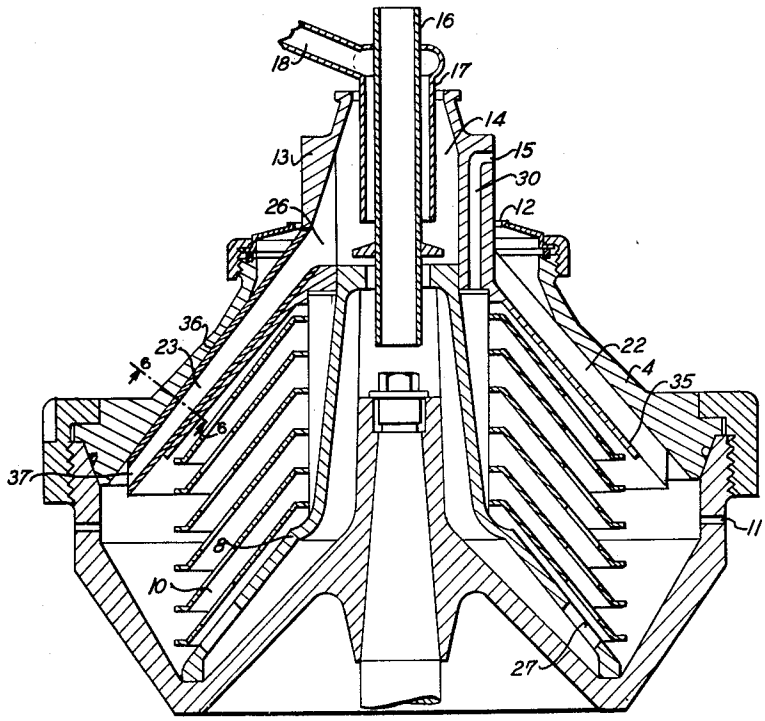

FIG. 4

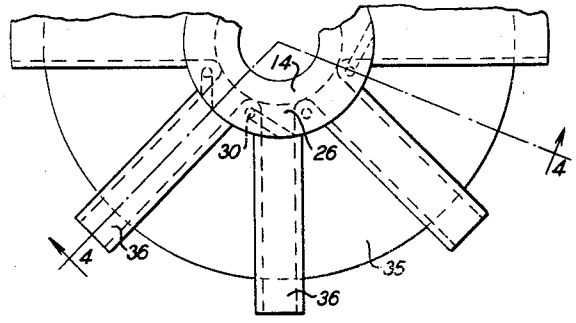

FIG. 5

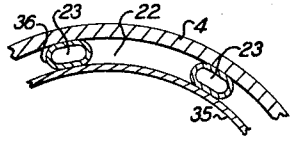

FIG. 6

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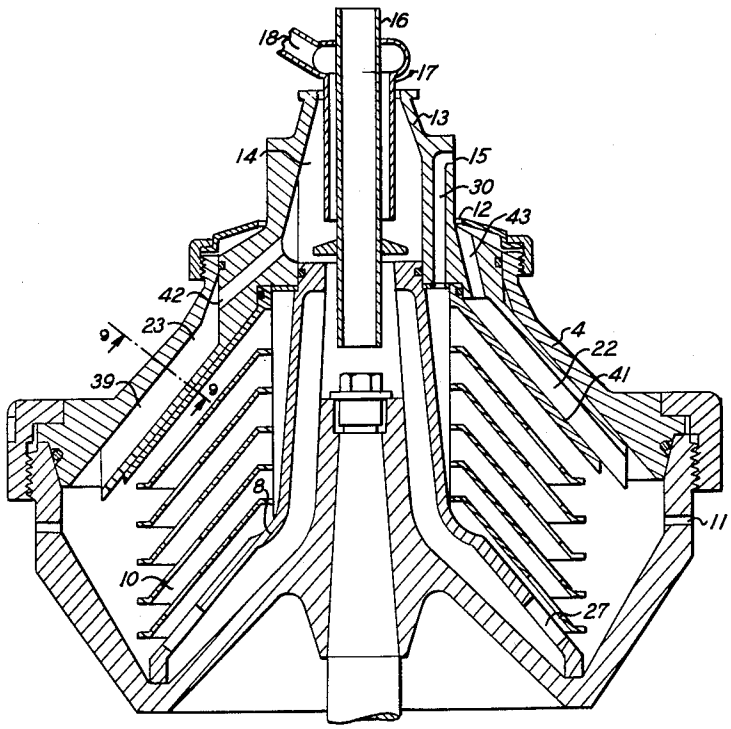

FIG. 7

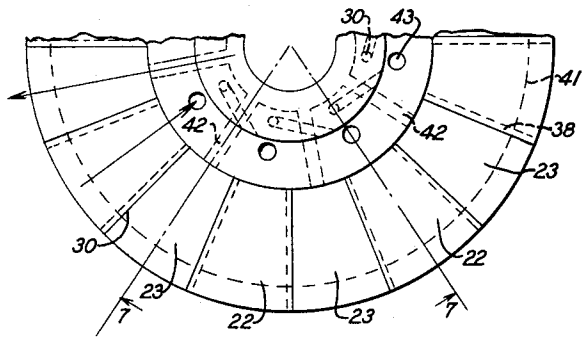

FIG. 9

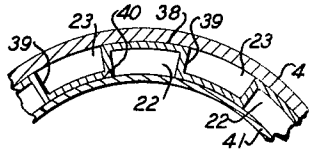

FIG. 8

FIG. 10

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CENTRIFUGAL SEPARATOR HAVING AN AUXILIARY LIQUID FEEDING DEVICE

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9 Claims. (Cl. 233—14)

This invention relates to an improved centrifugal separator having an auxiliary liquid feeding device.

Centrifugal separators are known, which have devices for feeding an auxiliary liquid into the outer peripheral part of the centrifuge bowl. This feed device is provided in addition to the main feed and is used when the liquid to be separated contains a solid which might clog the outlets at the periphery of the bowl. With the auxiliary liquid feed, the quantity of liquid which leaves the bowl through the outlets at the periphery is increased, so that it is possible to make these outlets relatively large, thus reducing the danger of their clogging.

The above-described type of centrifuges in addition to the outlet at the periphery which generally consists of a multiple number of radially positioned openings or bores extending through the peripheral portion of the bowl shell is provided with an outlet for the so-called medium-heavy component and an outlet for the specifically lighter component of the liquid. The outlet for the separated specifically lighter component is located at the portion of the bowl interior, which is closest to the axis of rotation of the bowl. This position will be referred to herein and in the claims as adjacent the axis of rotation of the bowl, though the same, depending on the particular bowl structure, need not be immediately adjacent this axis. The outlet for the medium-heavy component is located between the outlet defined through the peripheral portion of the bowl shell, which is for the specifically heavier component and the outlet for the specifically lighter component. If the quantity of the specifically heavier component is relatively small, as compared with the other separated components, and if the quantity of this component is subjected to large variations, it is possible, by the admission of the auxiliary liquid, to insure that a liquid ring or annulus of the heavy component, is continuously present, feeding liquid through the openings through the peripheral portion of the bowl shell, so that the emergence of the lighter components through these openings is dependably avoided.

The conventional centrifuges of the above-mentioned type have the disadvantage that the auxiliary liquid which is fed is first of all mixed in the separating chamber of the bowl with one or more of the other components prior to being centrifugally separated and migrates to the peripheral portion of the bowl in front of the peripheral outlet openings. In this manner the purity of the components is reduced and/or the capacity of the centrifuge is decreased.

One object of this invention is a centrifugal separator of the above-mentioned type which avoids the above-described disadvantages. This, and still further objects, will become apparent from the following description, read in conjunction with the drawings, in which:

Fig. 1 is a partial diagrammatic vertical section, showing an embodiment of a centrifuge in accordance with the invention;

Fig. 2 is a plan view diagrammatically illustrating a portion of the conical disc of the centrifuge of Fig. 1;

Fig. 3 is a partial cross-section in the section lines 3—3 of Fig. 1;

Fig. 4 is a vertical section showing another embodiment of a centrifuge bowl in accordance with the invention;

Fig. 5 is a plan view diagrammatically showing a portion of the conical disc shown in Fig. 4;

Fig. 6 is a cross-section of a portion of the conical disc along the line 6—6 of Fig. 4;

Fig. 7 is a vertical section of still another embodiment of a centrifugal bowl in accordance with the invention;

Fig. 8 is a plan view diagrammatically showing a portion of the conical disc of the embodiment shown in Fig. 7; and

Fig. 9 is a partial cross-section of the conical disc of the bowl shown in Fig. 7 along the section line 9—9.

The invention basically relates to an improved construction for a centrifugal separator of the type having a rotatably mounted centrifugal bowl defining a separating chamber with an inlet into the separating chamber for the material to be separated, an outlet through the peripheral portion of the bowl shell for the separated specifically heavier component, and an outlet from the internal portion of the bowl which is closest to the axis of rotation of the bowl, i.e., adjacetn the bowl's axis of rotation for the separated specifically lighter component.

In accordance with the improved construction of the centrifuge in accordance with the invention, means are provided defining a first channel attached to the interior of the centrifugal bowl for rotation therewith, extending from an inlet end at the peripheral portion of the bowl interior between the peripheral outlet for separated specifically heavier component and at the outlet for the specifically lighter component toward the axis of rotation of the bowl and terminating at an outlet for separated medium-heavy component. Additional means are provided defining a second channel attached to the interior of the centrifugal bowl for rotation therewith, extending from a discharge end in the peripheral portion of the bowl interior radially outward the inlet end of said first channel toward the axis of rotation of the bowl and terminating at a liquid inlet for auxiliary liquid. The channels are preferably positioned in a common conical plane, as, for example, adjacent the inner surface of a conically shaped top portion of the centrifugal bowl extending therealong. Preferably a multiple number of first and second channels are provided alternately positioned about the inner surface of the top portion of the bowl.

In accordance with a preferred embodiment of the invention, the outlet for the medium-heavy component is in the form of an overflow lip, extended within which near the axis of the bowl, a housing is provided which forms a chamber for the feeding of the auxiliary liquid. The auxiliary liquid is introduced into this chamber through stationary conduits, and the interior of the housing is in communication with the second channels.

With the construction in accordance with the invention the auxiliary liquid is conducted through the separating chamber into the peripheral portion of the bowl near the openings without the same mixing with the already separated light component or medium-heavy component, since the same emerges from its channel, i.e., the second channel at a point which lies outside of the separated medium-heavy component.

The invention will be explained in further detail with reference to the embodiments shown in the accompanying drawings.

Referring to the embodiments shown in Figs. 1, 2, and 3, the centrifuge has a centrifuge bowl 1 of conventional construction, which is mounted on the rotatable spindle 2. The spindle 2 is supported in a frame 3 and driven in the conventional manner, as, for example, by an electric motor. The centrifuge bowl has the upper

part 4 and the lower part 5, which are secured together by a threaded ring 6. The interior of the centrifuge bowl defines the separating chamber 7, in which the disc guide 8 is positioned. The latter has a plurality of discs 9 connected thereto, which, in the conventional manner form an intermediate space 10. A multiple number of outlets 11, circumferentially positioned about the periphery of the bowl, extend radially through the periphery of the lower part 5, providing outlets for the separated specifically heavy component, while outlet 12 for the medium heavy component is provided at the inner upper edge of the upper bowl part 4.

A housing 13, which is supported on the disc guide 8 forms a chamber 14 for the auxiliary liquid feed. Additional outlets 15 for the separated specifically light component are provided through the housing.

A central stationary feed pipe 16 extends into the inside of the disc guide 8 for the feeding of the liquid to be separated. The pipe 16 is surrounded by a somewhat larger stationary pipe 17, through which the auxiliary liquid is fed into the chamber 14 via the connection 18.

Extending from the housing 13 into the interior of the centrifuge bowl are two conical discs 19 and 20. The disc 19 rests against the inner conical surface of the upper bowl part 4, while the disc 20 is spaced therefrom toward the bowl interior. As may best be seen from Fig. 3, ribs 21 are positioned between and hold the two conical discs 19 and 20 spaced apart and divide the space between the two conical discs into a plurality of radially extending channels 22 and 23, which are alternately positioned about the circumference of the discs. The exact shape and positioning of these channels may be seen in Fig. 2.

Within the limits of the channels 22, the lower conical disc 20 is provided with the cut-outs 24 at its outer periphery. Within the limits of the same channels 22 the conical disc 19 has the holes or bores 25 defined therethrough, which form a passageway from the channels 22 to the outlet 12 for the separated medium-heavy component. The channels 23 are connected by openings 26 with the chamber 14 defined by the housing 13.

In operation, the main liquid mixture to be separated is passed through the inlet pipe 16 into the interior of the centrifuge, while the centrifuge bowl is rotated on the spindle 2 in the conventional manner. The liquid passes into the space enclosed by the disc guide 8, passes through the openings 27 of the disc guide, and the openings 28 of the discs 9 into the intermediate spaces 10 between these discs. During this passage, the liquid is caused to rotate with the rotating centrifuge bowl, causing a separation in accordance with the specific gravity with the heavy components moving toward the periphery of the bowl and the lighter components moving toward the interior of the bowl adjacent the axis of rotation. The separated specifically lighter component therefore flows inward and upward through the central opening 29 of the discs 9 to the channels 30 in the housing 13, and leaves the centrifuge drum through the outlets 15, discharging into the discharge conduit 34, from which the same may be recovered in the desired manner.

The separated medium-heavy and the specifically heavy components of the liquid flow out from the intermediate spaces 10 into the peripheral portion of the separating chamber 7 and are separated further, depending on their specific gravity, into the medium-heavy component and the heavy component. The heavy component discharges through the outlets 11 on the periphery of the bowl shell, while the medium-heavy component passes through the cut-out 24 into the channel 22, passing through the opening 25 and outlet 12 into the discharge 33 provided on the housing from which the same may be recovered in the desired manner.

The auxiliary liquid is introduced through the connection 18 and tube 17 into the chamber 14, and flows through the openings 26 and channels 23 into the peripheral part of the bowl. As a result of the cut-outs 24, the inlet end 31 of the channels 22 is located closer to the axis of rotation than the outlet end of the channels 23, which is formed by the outer edge of the disc 20. The stream of auxiliary liquid which discharges from the channels 23 and the separated medium-heavy component which enters the channels 22 for discharge therefore do not intersect and cannot mix with each other. The discharging heavy component emerging from the outlets 11 is collected in the annular vessel 32, which is placed on top of the frame 3. If the heavy or the medium-heavy component is to be used as the auxiliary liquid, the liquid is pumped out of the collecting vessel 32 or discharge 33, respectively, directly to the connection 18.

In the embodiment as shown in Figs. 4, 5, and 6, the channels for the admission of the auxiliary liquid and for the discharge of the separated medium-heavy component are provided by means of a single conical disc 35 and the pipes 36. The conical disc 35 is spaced from the corresponding conical inner surface of the upper bowl part 4 with the pipes 36 radially extending in this space, dividing the space into a multiple number of radial channels extending over the circumference of the disc. The outer, i.e., discharge end of the pipes extend past the edge of disc 35, and the upper ends of the pipes 36 adjoin the housing 13 and communicate with the chamber 14 formed thereby through the openings 26. The interiors of the pipes thus form channels which correspond to the channels 23, and the spaces between the pipes and between the disc 35 and the conical inner surface of the bowl top portion 4 form channels which correspond to the channels 22. Since the upper part of the bowl 4 forms the discharge openings 12, the channels 22 are in direct communication with these discharge or outlet openings 12.

In all other respects the construction and operation of the embodiments shown in Figs. 4, 5, and 6 are identical to the embodiment shown in Figs. 1, 2, and 3, and since the discharge end 37 of a pipe 36 extends radially outward from the edge of the disc 35, the auxiliary liquid being passed into the interior of the bowl will not mix with the separated medium-heavy component being discharged through the channels 22 around the edge of the disc 35. The shape and positioning of the pipe 36 and disc 35 and the channels formed thereby can best be seen from Figs. 5 and 6.

In the embodiment shown in Figs. 7, 8, and 9, a conical disc 41 is positioned in spaced relationship to the correspondingly conically-shaped inner surface of the upper bowl part 4. Between the conical disc 41 and the inner conical surface of this upper bowl part a heavy conical disc (38, 39, 40) 38 is positioned, which has radially-extending grooves alternately cut in its upper and lower surfaces forming the channels 22 provided with the upper surface 38 and the channels 23, provided with the lower surface 40, and separated from the channels 22 by the partitions 39. The lower surface 40 remaining from the cut groove and the inner conical surface of the bowl top portion 4 form the upper and lower limits of the channels 23, while the upper surface 38 left by the cutting of the groove and the conical disc 41 form the upper and lower surfaces of the channels 22. The heavy conical disc is somewhat larger, so that the same extends radially outward the edge of the disc 41, so that the outlet end of the channels 23 extend radially outward the inlet end for the medium-heavy component in the channels 22. The channels 23 are communicated by the holes 42 with the chamber 14, and the channels 22 are communicated by the holes 43 with the outlet 12 for the medium-heavy component. In all other respects the construction and operation of this embodiment are identical and are described in connection with the previous embodiments.

The centrifuge in accordance with the invention may be used in the same manner and for any purpose for which centrifugal separators provided with a peripheral

discharge for a separated specifically heavy component, a discharge for a medium-heavy component, and a discharge for a separated specifically light component, and a feed for auxiliary liquid may be used. The centrifugal separator in accordance with the invention may be used with particular advantage for the separation of vegetable oils. These oils, in addition to water and pulp, frequently contain large quantities of sand or other soil components. In the separation of these liquids, therefore, the outlets on the periphery of the bowl must be made relatively large in order to prevent the clogging thereof with the solid components. Since, in the separation of such liquids, fresh water is frequently not available, or at least not available in sufficient quantity, the medium-heavy component discharging from the separator is advantageously used as the auxiliary liquid.

The centrifuge in accordance with the invention may also be advantageously employed for the removal of oil and slime from glue water. When used in this connection, the concentrate, which is the concentrate of low glue-water content, may be used as the auxiliary liquid, while the glue water itself is obtained free of solids. In this way the further treatment of the glue water is simplified.

While the invention has been described in detail with respect to the various embodiments shown, various changes and modifications will become apparent to the skilled artisan which fall within the spirit of the invention and scope of the appended claims.

I claim:

1. In a centrifugal separator having a rotatably mounted centrifugal bowl defining a separating chamber, an inlet into the separating chamber for material to be separated, an outlet through the periphery of the bowl shell for separated specifically heavy components, and an outlet from the interior portion of the bowl adjacent the bowl's axis of rotation for the separation of separated specifically light components, the improvement which comprises: means defining a first channel attached to the interior of the centrifugal bowl for rotation therewith extending from an inlet end at the peripheral portion of the bowl interior between said outlet for separated specifically heavy components and said outlet for separated specifically light components toward the axis of rotation of the bowl and terminating at an outlet for separated medium-heavy components, and means defining a second channel connected to the interior of the centrifugal bowl extending substantially adjacent to and in the same direction as said first channel for rotation therewith extending from a discharge end in the peripheral portion of the bowl interior radially outward the inlet end of said first channel toward the axis of rotation of the bowl and terminating at a liquid inlet for an auxiliary liquid, said first and said second channels being positioned in a common conical plane.

2. Improvement according to claim 1, in which said centrifugal bowl has a conically-shaped top portion and in which said first and second channels are positioned adjacent said top portion extending therealong.

3. Improvement according to claim 2, including a multiple number of said first and second channels alternately positioned about the inner surface of said top portion.

4. Improvement according to claim 3, including a housing positioned adjacent the inner end portion of said channels, said housing defining a chamber within the interior thereof in liquid flow communication with said second channel and defining an outlet passage therethrough in liquid flow communication with said first channel, and including means for passing an auxiliary liquid into said chamber.

5. In a centrifugal separator having a rotatably mounted centrifugal bowl defining a separating chamber, an inlet into the separating chamber for material to be separated, an outlet through the periphery of the bowl shell for separated specifically heavy components, and an outlet from the interior portion of the bowl adjacent the bowl's axis of rotation for the separation of separated specifically light components, the improvement which comprises providing the upper portion of said centrifugal bowl with a conically-shaped inner surface, and including for rotation therewith a conical disc positioned adjacent in spaced relationship to said conically-shaped inner surface, and a multiple number of pipes defining a multiple number of inlet channels positioned radially in the space between said conical disc and said inner surface, said pipes dividing said space into a multiple number of discharge channels, said pipes extending past the outer edge of said disc, said discharge channels extending from corresponding outlet ends at the peripheral portion of the bowl interior between said outlet for separated specifically heavy components and said outlet for separated specifically light components toward the axis of rotation of the bowl and terminating at liquid outlets for separated medium-heavy components and said inlet channels extending from inlet ends in the peripheral portion of the bowl interior radially outward the outlet ends of said discharge channels toward the axis of rotation of the bowl and terminating at liquid inlets for an auxiliary liquid.

6. Improvement according to claim 5, including a housing positioned adjacent the axially inner end portions of said channels, said housing defining a chamber within the interior thereof in liquid flow communication with said pipes and defining an outlet passage therethrough in liquid flow communication with said discharge channels, and including means for passing an auxiliary liquid into said chamber.

7. In a centrifugal separator having a rotatably mounted centrifugal bowl defining a separating chamber, an inlet into the separating chamber for material to be separated, an outlet through the periphery of the bowl shell for separated specifically heavy components, and an outlet from the interior portion of the bowl adjacent the bowl's axis of rotation for the separation of separated specifically light components, the improvement which comprises providing the upper portion of said centrifugal bowl with a conically-shaped inner surface, and including for rotation therewith a first conical disc positioned in contact with said inner surface and a second conical disc positioned adjacent in spaced relationship to said first disc, a multiple number of radially-positioned ribs sub-dividing the space between said discs into a multiple number of inlet and discharge channels, the outer edge of said second disc having cut-outs between said ribs defining said discharge channels, and said first discs having openings defined through the inner portion thereof between said ribs defining said discharge channels flow communicating said discharge channels with an outlet for a separated medium-heavy component.

8. Improvement according to claim 7, including a housing positioned adjacent the axially inner end portions of said channels, said housing defining a chamber within the interior thereof in liquid flow communication with said inlet channels, and defining an outlet passage therethrough in liquid flow communication with said discharge channels, and including means for passing an auxiliary liquid into said chamber.

9. In a centrifugal separator having a rotatably mounted centrifugal bowl defining a separating chamber, an inlet into the separating chamber for material to be separated, an outlet through the periphery of the bowl shell for separated specifically heavy components, and an outlet from the interior portion of the bowl adjacent the bowl's axis of rotation for the separation of separated specifically light components, the improvement which comprises providing the upper portion of said centrifugal bowl with a conically-shaped inner surface, and including for rotation therewith a first conical disc positioned in contact with said inner surface and a second conical disc of smaller diameter positioned in contact with said

first disc, said first disc having a multiple number of radial grooves in its surface adjacent said inner surface defining a multiple number of inlet channels and a multiple number of radial grooves in its surface adjacent said second disc defining a multiple number of discharge channels, said inlet and discharge channels being in flow communication with an auxiliary liquid inlet and an outlet for a separated medium-heavy component, respectively,

positioned adjacent the axially inner end portions of said channels.

References Cited in the file of this patent

UNITED STATES PATENTS

2,179,941	Lindgren	Nov. 14, 1939
2,500,100	Strezynski	Mar. 7, 1950
2,628,021	Staaff	Feb. 10, 1953