May 7, 1974 G. F. DUCHATEAU 3,809,538

ROTARY COUNTERCURRENT SOLID-LIQUID EXTRACTION APPARATUS

Filed June 28, 1971 4 Sheets-Sheet 1

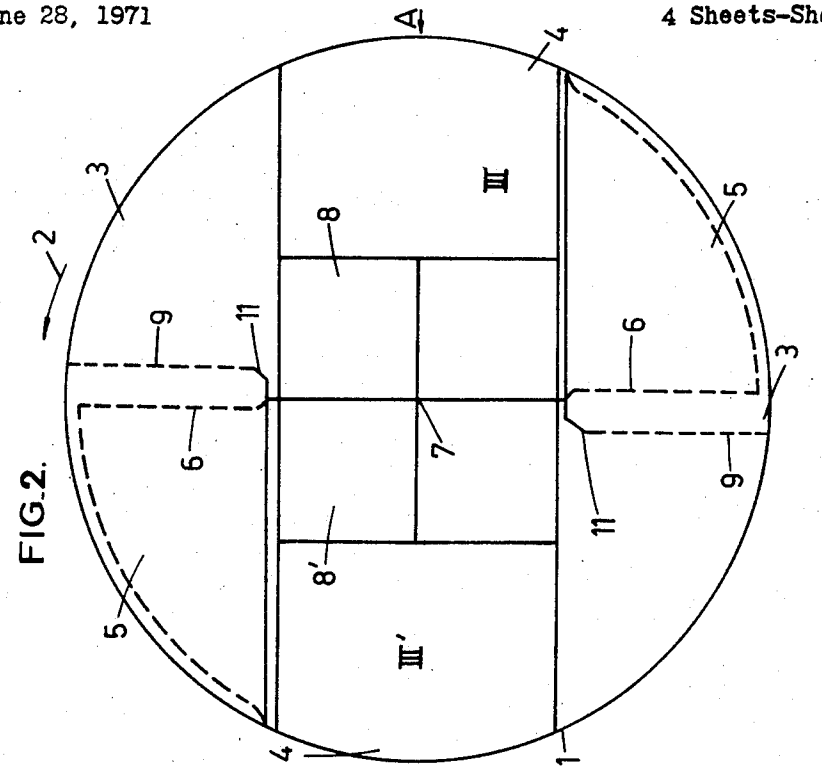

FIG.2.

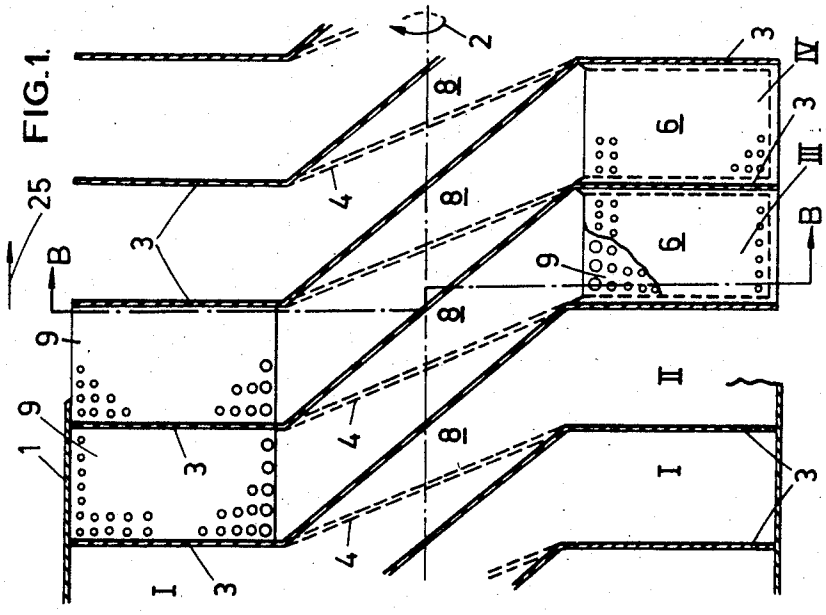

FIG.1.

ROTARY COUNTERCURRENT SOLID-LIQUID EXTRACTION APPARATUS

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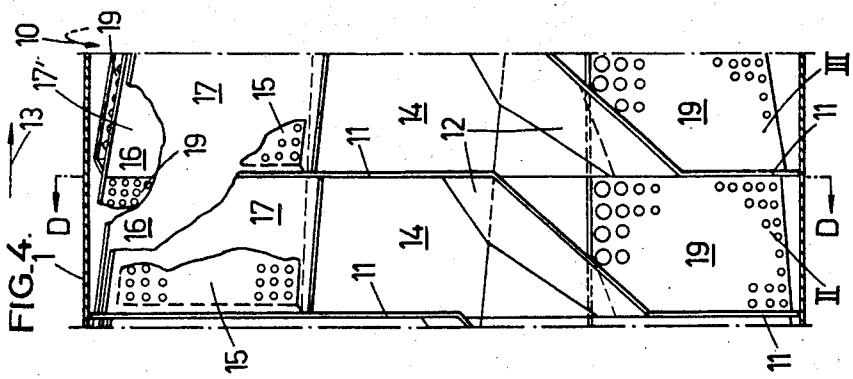

FIG.4.

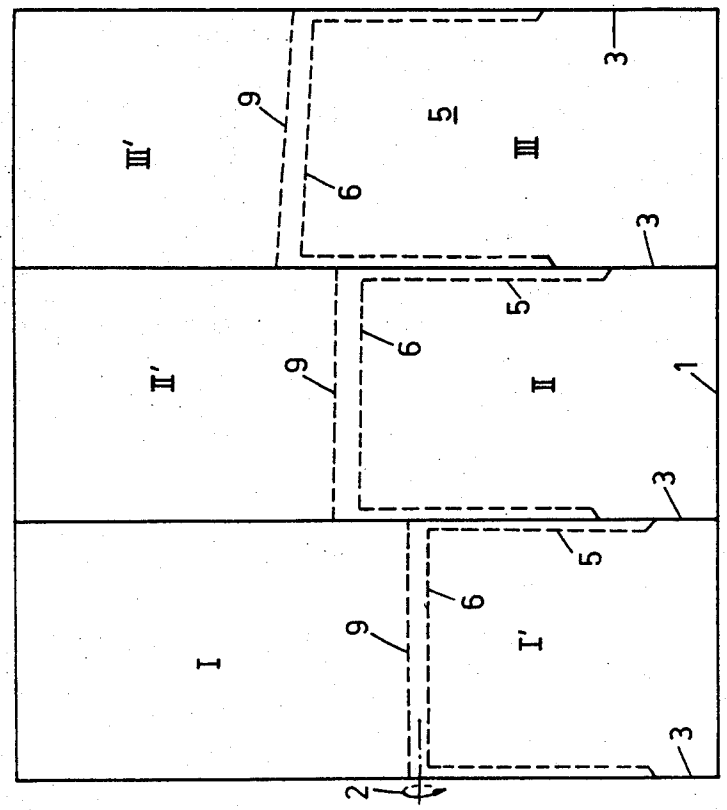

FIG.3.

ROTARY COUNTERCURRENT SOLID-LIQUID EXTRACTION APPARATUS

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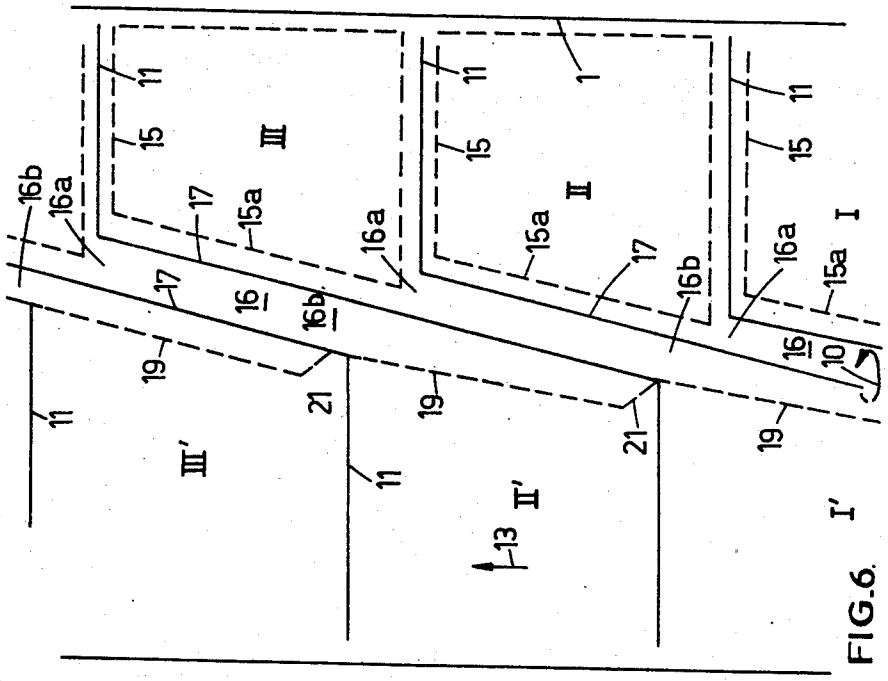

FIG.6.

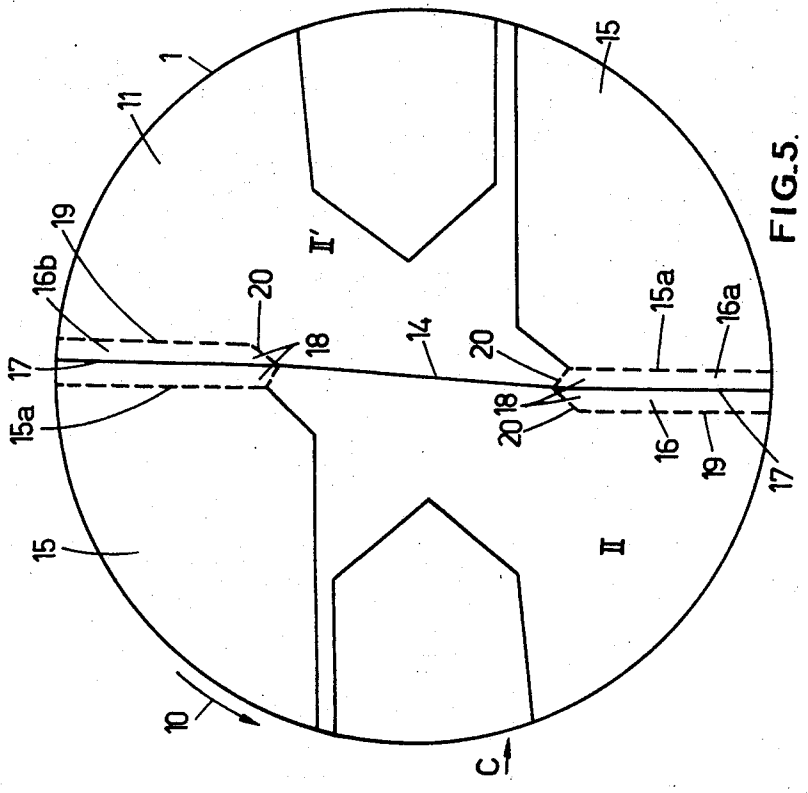

FIG.5.

ROTARY COUNTERCURRENT SOLID-LIQUID EXTRACTION APPARATUS

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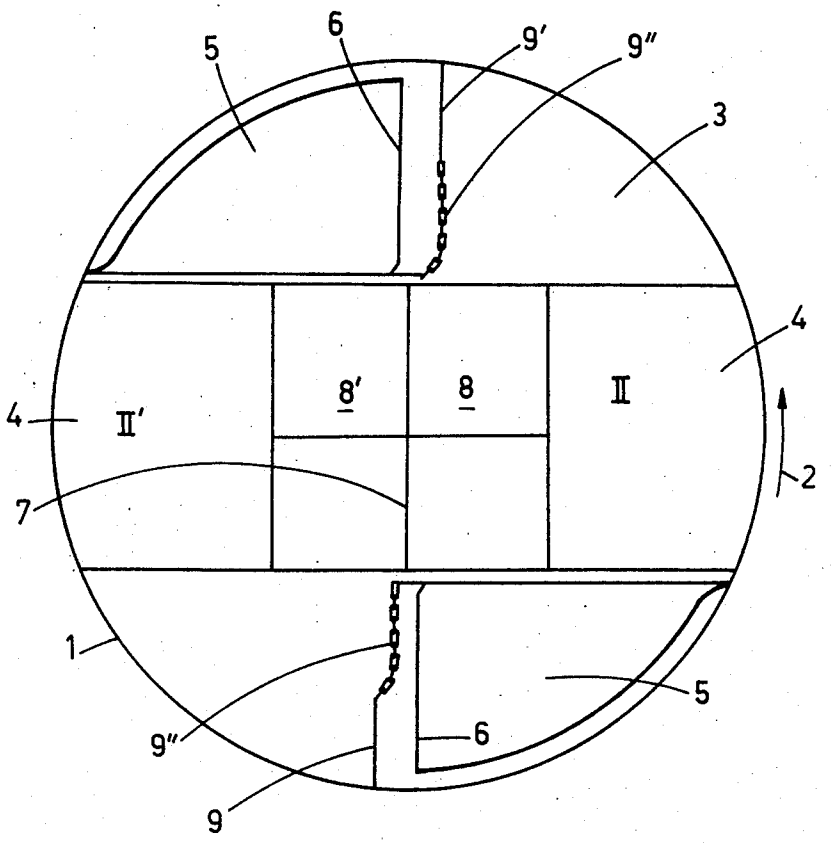

FIG.7

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3,809,538

ROTARY COUNTERCURRENT SOLID-LIQUID EXTRACTION APPARATUS

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Int. Cl. B01d *11/02*
U.S. Cl. 23—269 9 Claims

ABSTRACT OF THE DISCLOSURE

A method for extracting, by means of a liquid, products which are part of solids in a partitioned rotating extractor, with the flow of the liquid fraction separated from the solids fraction being slowed down by baffles and said liquid fraction being spread over the length and width relative to the new solids fraction.

This invention relates to improvements in methods for extracting, by means of a liquid, products which are part of solids in a partitioned rotating extractor in which the solids on the one hand and the liquid on the other hand are divided into fractions with relative resulting length-wide displacements along opposite directions, each liquid fraction being periodically separated from a solids fraction and said fraction then flowing toward another solids fraction.

Methods of this kind and devices for the working thereof are already known, notably from Belgian Pat. Nos. 367,630, 371,926, 475,626, 711,219 and 728,417. It has been noted that the mixture of the liquid fraction and the solids fraction was not homogeneous and that the common path in the extractor did not correct said lack of homogeneity, because the liquid or solids fraction was not from the start in proportion with solids or liquid fraction supply and was not suitably distributed over the length and width.

An object of this invention is to obviate these drawbacks. For this purpose according to the invention, the flow of the liquid fraction separated from the solids fraction is slowed down and said liquid fraction is spread over the length and width relative to the solids fraction.

A further object of this is to improve the extracting devices for the working of said improved method. Such devices comprise a rotating drum inside which is arranged a screw conveyor the solid windings of which define compartments for the solids fractions and the liquid fractions, said compartments being subdivided into cells which contain the solids fractions, said cells communicating for the liquid through generally axial raising elements for the solids, said elements being pervious to the liquid and extending between two succeeding windings. According to the invention, each cell comprises a baffle for slowing-down the inlet liquid flow in said cell, which baffle is arranged as considered along the liquid movement direction in the drum, downstream of the raising element of that cell the liquid fraction flows from.

In a preferred embodiment, said baffle extends generally axially between the windings which bound the cell on the liquid inlet side of the cell, from the drum circumference over a radial distance relative to the drum axis which ie at least equal to the distance occupied in the cell by the solids and liquid fractions.

Other detail and features of the invention will stand out from the description given below by way of non-limitative examples and with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic view, with parts broken away, of a length of extracting device as described in

Belgian Pat. No. 475,626, along arrow A in FIG. 2, which device is provided with the improvement according to the invention.

FIG. 2 is a diagrammatic section view along the line B—B in FIG. 1.

FIG. 3 is a diagrammatic plan view on a larger scale, of FIG. 2.

FIG. 4 is a diagrammatic view with parts broken away, of an extracting device of the type described in Belgian Pats. No. 711,219 and 728,417 along arrow C in FIG. 5, showing the improvement according to the invention.

FIG. 5 is a diagrammatic section view along line D—D in FIG. 4.

FIG. 6 is a diagrammatic plan view, on a larger scale, corresponding to FIG. 5.

FIG. 7 is a view similar to FIG. 2 showing another embodiment.

In the various figures, the same reference numerals pertain to similar elements.

FIGS. 1 and 4 each slow a length of a device for extracting with a liquid products which are part of solids, the liquid and solids having resulting relative displacements along opposite directions. Such extracting devices, which are notably well known in the sugar industry, comprise in the embodiment shown in FIGS. 1 to 3, an horizontal-axis drum **1** which is rotatable along the direction of arrow **2**, said drum being divided into compartments by a conveyor screw which is comprised of a series of portions of diametral solid walls **3** which are connected by portions of slanting solid walls **4**. The compartments are subdivided into two series of cells I', I'', II', II'' . . .; by solids-raising elements **5** which are previous to the liquid and comprised of perforated baskets the bottoms **6** of which are generally axial and are joined in pairs by a solid axial wall **7**. Two series of slants channels **8**, **8'** are provided in the central area of the drum **1** to direct the solids fractions raised by the baskets **5** as they pass through the lower part of the drum inside a cell of one and the same series, which is spaced along a direction opposite to the screw conveying direction, which opposite direction is shown by arrow **25**, by two cells relative to a particular cell; for instance the solids fraction raised by the basket in cell II will fall in cell IV.

The liquid fractions separated from the solids raised by the baskets **5** each flow in the cell of the other series which, when considering the drum rotating direction, lies directly upstream of the cell the fraction leaves so as to mix with a new solids fraction with which it is conveyed along the screw conveying direction (direction opposite to the arrow **25**) till the raising thereof by the basket of said other series cell; consequently the liquid fraction passing through the basket of cell II flows in cell II'.

To spread uniformly the liquid fraction which is each time separated from a solids fraction relative to the width and the height of the new solids fraction said liquid fraction will meet in the new cell and to slow down the liquid flow in the new cell, in each cell I, I', II, II'', . . . is provide a baffle **9** which extends when considering the drum rotating direction, upstream and when considering the liquid conveying direction in the drum, downstream of the bottom **6** of the basket **5** of that cell which the liquid fraction leaves each time to reach the cell under consideration.

By "width" and "height" of a solids fractions is meant the space which said fraction occupies when it lies in the drum lower part, on the one hand along the drum axial direction and on the other hand along the drum radial direction.

The baffles **9** are comprised of irregularly-perforated walls which extend axially between each two succeeding walls **3** substantially in parallel relationship with the bottom **6** of the baskets **5** and radially from the drum periph-

eral wall over a distance at least equal to the length of the basket bottoms **6**. Lengths of solid walls **11** join the baffles **9** to the axial walls **7**.

The ratio between the perforated area and the solid area of the walls **9** increases from the peripheral wall of the drum **1** towards the drum axis; preferably the perforation area increases with the distance from the drum peripheral wall.

In the embodiment shown in FIGS. 7, the irregularly-performated baffle **9** is placed by a baffle with solid portion **9'** adjacent to the drum peripheral wall and followed by a chain bed **9''**. According to this embodiment an actual delay is introduced between the time where liquid fraction flow from a cell starts and the time where this liquid collected behind the baffle solid portion flows in the new cell.

In the device shown in FIGS. 4 to 6 which is of the type disclosed in Belgian Pats. No. 711,219 and 728,417, the drum rotating direction is shown by arrow **10** and the screw conveyor windings comprised of a series of cut-out solid diametral walls **11** which are joined by slanting solid walls **12**, insure the conveying of the solids along the direction of arrow **13**. A solid axial wall **14** which extends between the succeeding walls as well as diametrically-opposed baskets **15** divide the compartments defined by the windings into two series of cells I, II, III, . . . and I', II', III', . . . for contacting each a solids fraction and a liquid fraction. For the advance of the liquid fractions along the direction opposite to the direction of arrow **13**, slanting liquid channels **16** are formed on the circumference of the drum **1** between the two solid walls **17** which extend the axial wall **14** and border notches **18** provided in the solid diametral walls **11**. Each liquid channel **16** opens (inlet) in **16***a* on the one hand behind (upstream) the bottom **15***a* of the basket **15** in each cell when considering the drum rotating direction and on the other hand in **16***b* in a cell of the other series which is part of the compartment removed by two units from that compartment the original cell is part of; for instance with reference to FIG. 6, the liquid fraction leaving cell III flows in cell I'.

According to the invention each cell is provided in such a case also with a baffle **19** for slowing down the flow of that liquid fraction which enters the cell in **16***b*. Said baffle **19** which is similar to the baffles **9** described with reference to FIGS. 1 to 3 and 7, is arranged in the extension of the solid wall **17** which ends at the outlet **16***b* of the considered cell liquid channel **16** over substantially all of the cell width; a length of perforated wall **21** joins the baffle to the connecting line between the solid wall **17** in said cell and the winding **11** bounding said cell on the side opposite inlet **16***a*, while another length of perforated wall **20** joins the high end of the baffle to the axial wall **14** at a level which corresponds substantially to the high end of the bottom **15***a* of that basket **15** pertaining to the opposite-series cell in the same compartment.

It must be understood that the invention is in no way limited to the above embodiments and that many changes may be brought therein without departing from the scope of the invention as defined by the appended claims.

What I claim is:

1. In an apparatus for extracting material from solids by contacting the solids with counterflowing liquid comprising:

a revolving drum housing means;

solid walls means defining at least one solid conveyor screw means mounted in said revolving drum housing means and integral with said drum housing means;

said walls determining compartments for fractions of solids and for fractions of liquid;

a liquid permeable solids raising means positioned in each compartment;

means for feeding the solids into said revolving drum housing means at a first end of said conveyor means and means for removing liquid from said revolving drum housing means also at said first end;

means for feeding liquid into said revolving drum housing means at a second end of said conveyor means opposite to said first and means for removing solids from said revolving drum housing means also at said second end;

means to convey the fractions of liquid separated by said liquid permeable solids raising means to successive compartments; and

means for conveying the fractions of solids raised by said liquid permeable solids raising means to successive compartments but in an opposite resulting direction of displacement in relation to the liquid fractions and without intermixing between the successive fractions of solids and between the fractions of liquid

the improvement comprising a baffle located in at least one of said compartments adjacent to the liquid permeable solids raising means positioned in the preceding compartment, downstream of said liquid permeable solids raising means when the direction of the liquid flow is considered, and parallel to said liquid permeable solids raising means, said baffle being adapted to delay the flow of the liquid fraction and to spread the liquid fraction in relation to a new fraction of solids falling in said compartment from a liquid permeable solids raising means, which baffle extends substantially axially between two succesive walls of the conveyor means and which baffle is provided with passages for the liquid, the area of said passages increasing from the drum circumference toward the drum axis.

2. In the improvement as claimed in claim **1**, the further feature that said baffle comprises a solid portion adjacent to the drum housing means, followed by a portion provided with passages for the flow of the liquid.

3. In the improvement as claimed **1**, the further feature that said baffle comprises a solid portion adjacent to the drum housing means followed by a portion comprising a chain bed.

4. In an apparatus for extracting material from solids by contacting the solids with a counterflowing liquid comprising:

a revolving drum housing means;

a pair of separate stepped helical solid conveyor means, each solid conveyor means carrying a portion of the solids in an axial direction through the drum housing in a continual forward motion without intermixing or regression;

a central partition extending axially through the drum separating the two solid conveyor means, the central partition preventing intermixing of the solids portions, each solid conveyor means further including a series of successive cells for moving its respective portion of solids;

means for feeding the solids into said revolving drum housing means at a first end of each solid conveyor means and means for removing liquid from said revolving drum housing means also at said first end;

means for feeding liquid into said revolving drum housing means at a second end of each solid conveyor means opposite to said first end and means for removing solids from said revolving drum housing means also at said second end;

a liquid-permeable solids raising means positioned in each successive cell; and

liquid conveyor means including channels through the central partition extending substantially inward from the drum housing means and in the axial direction for passing liquid in a counter axial direction to the solids direction, each channel connecting one cell of one solid conveyor means with a successive cell in the other conveyor means, each channel extending beneath an adjacent cell in the same successive series of cells as the one cell, whereby the liquid is transmitted in two separate portions and travels twice

as fast through the drum as the solid portions, the improvement according to which

in at least one of said cells a baffle is provided to delay the flow of the liquid fractions entering said cell and to spread the liquid fractions in width and height with reference to the fractions of solids that falls in said cell from the raised elements;

said baffle extends substantially axially between successive helixes with the helical conveyor means immediately behind, when the direction of rotation of the drum is considered, of the outlet for the liquid of the channel in said cell, said baffle being located adjacent to the liquid permeable solids raising means positioned in the preceding compartment, downstream of said liquid permeable solids raising means when the direction of the liquid flow is considered, and parallel to said liquid permeable solids raising means, and

said baffle is provided with passages for the liquid the area of which increases from the drum housing towards the drum axis.

5. In an improvement according to claim **4**, the further feature that said baffle comprises a solid portion adjacent to the drum housing means, followed by a portion provided with passages for the flow of the liquid.

6. In an improvement according to claim **4**, the further feature that said baffle comprises a solid portion adjacent to the drum housing means followed by a portion comprising a chain bed.

7. In an apparatus for extracting material from solids by contacting the solids with a counterflowing liquid comprising:

a revolving drum housing means;

a pair of separate stepped helical solid conveyor means, each solid conveyor means carrying a portion of liquid in an axial direction through the drum housing in a continual forward motion without intermixing or regression;

a central partition extending axially through the drum housing means and having a central liquid non-permeable portion and two liquid permeable portions situated adjacent the drum housing means for getting through the liquid, said central partition defining on each side thereof a series of successive cells for moving a respective portion of solids;

a liquid permeable solids raising means positioned in each successive cell;

inclined channels through the helixes of the helical conveyor means provided in the central zone of the drum housing means, on each side of said central portion of said central partition for passing solids in a counter-axial direction to the liquid direction, each channel connecting one cell of one series of cells with the successive but one cell of the same series of cells;

means for feeding liquid into said revolving drum housing means at a first end of said solid conveyor means and means for removing solids from said revolving drum housing means also at said first end; and

means for feeding the solids into said revolving drum housing means at a second end of said conveyor means opposite to said first end and means for removing liquid from said revolving drum housing means also at said second end;

whereby the liquid is transmitted in two separate portions and travels twice as fast through the drum as the solid portions without intermixing of the solids portions,

the improvement according to which, in at least one of said cells, a baffle is provided to delay the flow of the liquid fractions entering said cells and to spread the liquid fractions in width and in height with reference to the fractions of solids which fall from the raising elements into said cells, said baffle extending substantially axially between successive helixes of the helical conveyor means immediately behind, when the direction of rotation of the drum is considered, that liquid permeable portion of the central partition which is situated in the bottom of the drum housing means when entering of the liquid into the cell is considered, said baffle furthermore being located adjacent to the liquid permeable solids raising means positioned in the preceding compartment, downstream of said liquid permeable solids raising means when the direction of the liquid flow is considered, and parallel to said liquid permeable solids raising means, and said baffle being provided with passages for the liquid, the area of said passages increasing from the drum circumference to the drum axis.

8. In an improvement according to claim **7**, the further feature that said baffle comprises a solid portion adjacent to the drum housing means, followed by a portion provided with passages for the flow of the liquid.

9. In an improvement according to claim **7**, the further feature that said baffle comprises a solid portion adjacent to the drum housing means followed by a portion comprising a chain bed.

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U.S. Cl. X.R.

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