Nov. 6, 1962 F. D. BECK 3,062,626

SOLVENT EXTRACTION APPARATUS

Filed May 19, 1958 4 Sheets-Sheet 1

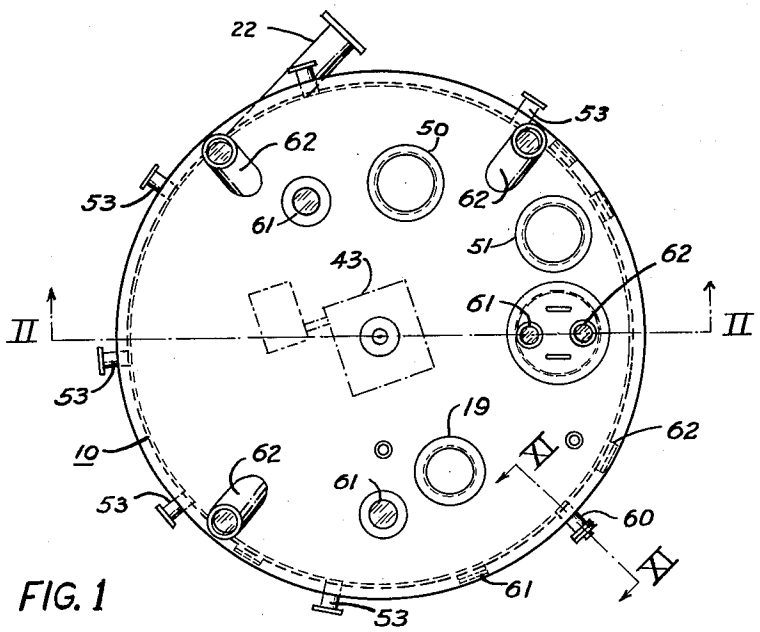


FIG. 1

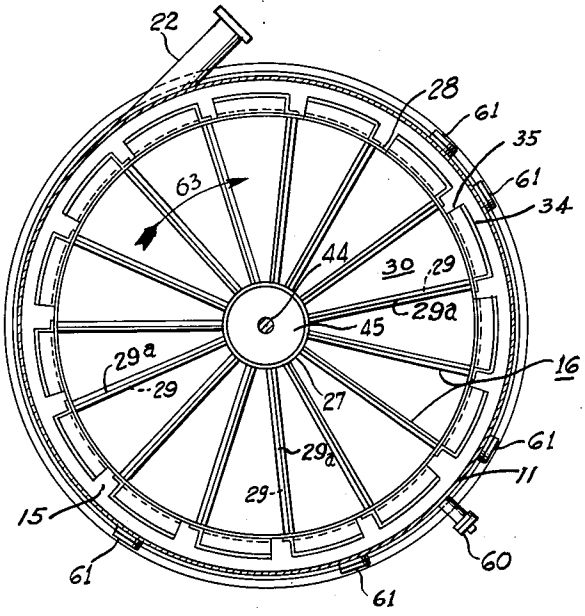


FIG. 3.

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SOLVENT EXTRACTION APPARATUS

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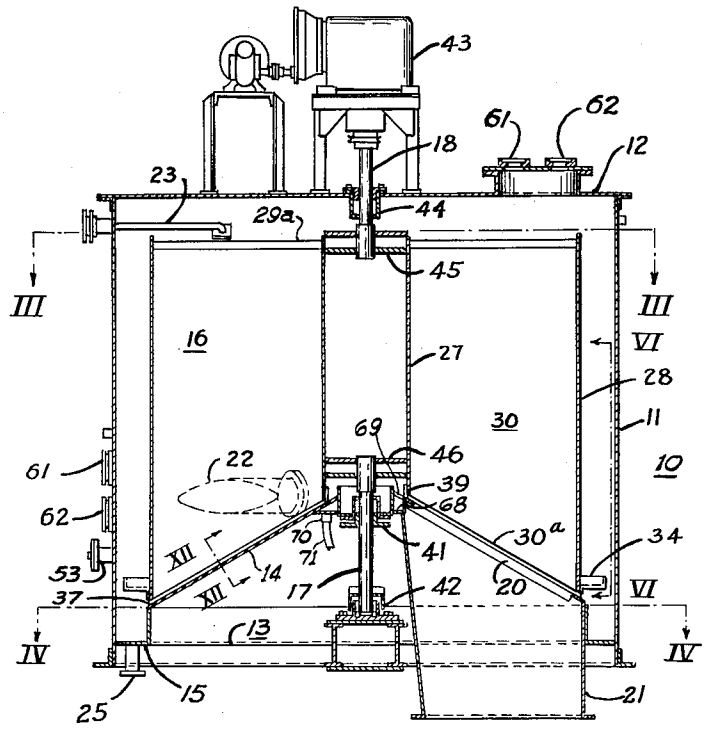


FIG. 2.

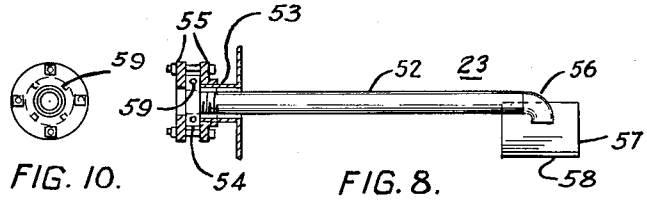


FIG. 10. FIG. 8.



FIG. 9.

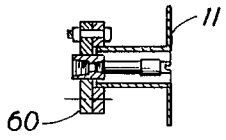


FIG. 11.

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SOLVENT EXTRACTION APPARATUS

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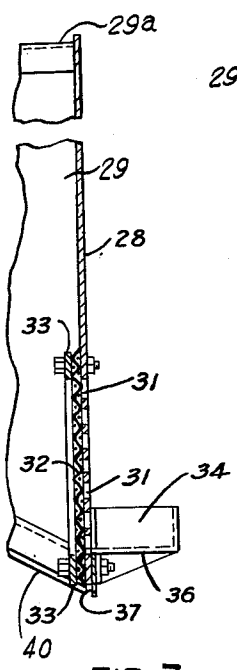


FIG. 7.

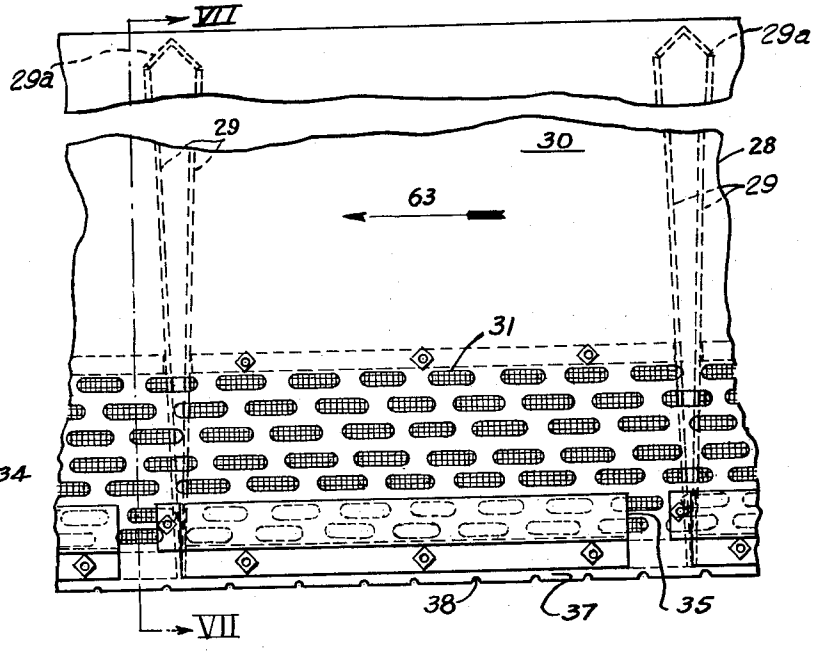


FIG. 6.

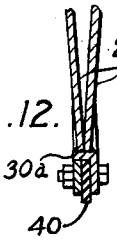


FIG. 12.

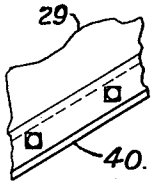


FIG. 12A.

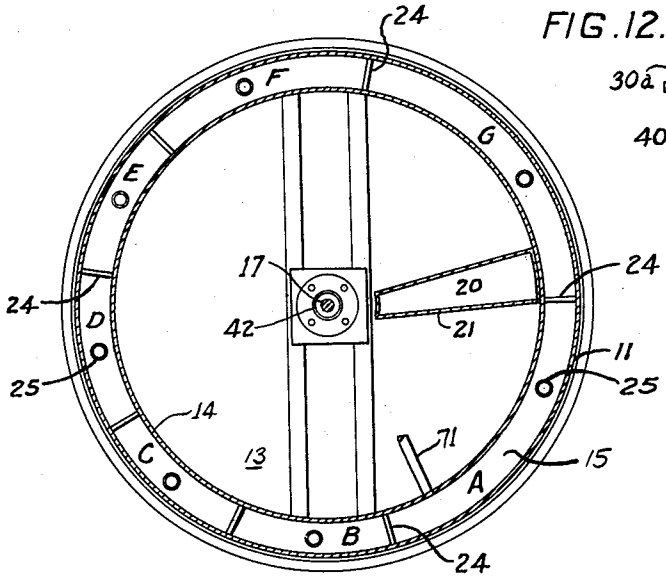


FIG. 4.

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SOLVENT EXTRACTION APPARATUS

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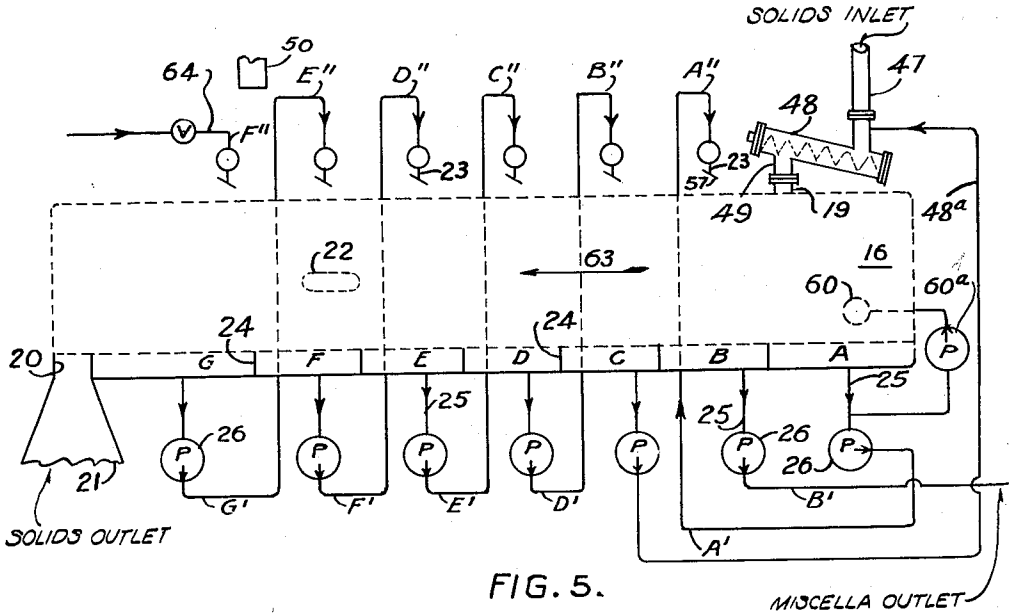


FIG. 5.

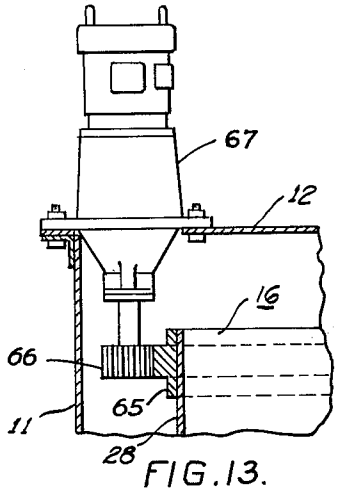


FIG. 13.

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United States Patent Office 3,062,626 Patented Nov. 6, 1962

3,062,626
SOLVENT EXTRACTION APPARATUS

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Filed May 19, 1958, Ser. No. 736,216
10 Claims. (Cl. 23—269)

This invention relates to solvent extraction apparatus. More particularly, it pertains to a solvent extractor of a continuous type which preferably is movable in endless fashion in a generally horizontal plane.

The advent of the "Rotocel" solvent extractor disclosed in application for United States patent Serial No. 91,372, filed May 4, 1949, now Patent No. 2,840,459, was a remarkable departure from the prior art and paternoster types of solvent extraction operation. In the illustrative extractor embodiment disclosed in that application, hinged doors are provided for the bottoms of the respective cells with associated equipment for the opening and closure thereof in appropriate fashion and with drainage compartments which generally underlie the cells. Such equipment is highly satisfactory, especially for larger solvent extraction operations. However, in the case of plants desiring apparatus of relatively smaller capacity, or lower cost, or both, or in which greater headroom limitations are present, alternative solvent extraction apparatus made in accordance with this invention provides marked attractiveness and advantage. Thus, such advantages of my invention include the following:

(1) Simplicity of design of this invention resulting in fewer moving parts, less costly fabrication and reduction in maintenance costs.

(2) Minimum internal surfaces and cavities that may require cleaning and ready access to screens and other parts for any such cleaning.

(3) Cost savings resulting from this invention make it possible to construct extractors for small plants at a competitively favorable price.

Other objects, features and advantages of this invention will be apparent from the following description and the accompanying drawings, which are illustrative only, in which

FIGURE 1 is a plan view of one embodiment of this invention with the motor-speed reducer drive equipment removed;

FIGURE 2 is a view in vertical section of the embodiment shown in FIGURE 1 taken along line II—II of FIGURE 1;

FIGURE 3 is a plan view taken along line III—III of FIGURE 2;

FIGURE 4 is a further view taken along line IV—IV of FIGURE 2;

FIGURE 5 is a schematic flow diagram of one hookup feasible operation of the foregoing solvent extractor embodiment;

FIGURE 6 is a detail view, somewhat enlarged, of an outer wall portion of a rotor in the aforesaid embodiment taken generally along line VI—VI of FIGURE 2;

FIGURE 7 is a view in section taken along line VII—VII of FIGURE 6;

FIGURE 8 is a detail view in elevation of a liquid-supplying nozzle;

FIGURE 9 is a view looking at the inner end of the nozzle shown in FIGURE 8;

FIGURE 10 is a view looking at the outer end of the nozzle shown in FIGURE 8;

FIGURE 11 is a view in section, somewhat enlarged, taken along line XI—XI of FIGURE 1;

FIGURE 12 is a detail view, somewhat enlarged, taken along line XII—XII of FIGURE 2;

FIGURE 12A is a view in side elevation of details set forth in FIGURE 12; and

FIGURE 13 illustrates a modified form of rotor drive utilizable on the embodiment illustrated in FIGURE 1.

FIGURES 1 to 12 of the drawings illustrate one embodiment **10** of a new solvent extraction apparatus of this invention. As shown, the apparatus is generally enclosed within a vapor-tight casing **11** having a removable top **12** suitably supported and a bottom **13**. Bottom **13** may be in the shape of a right circular cone **14**, or of a conoid or other downwardly and outwardly sloped surface of revolution, terminating around its lower edge in an annular trough **15**, the outer edge of which trough extends to the inside vertical wall of casing **11**. Trough **15** preferably is constructed with a relatively small cross section to make liquid draining into the trough, or arcuate portions thereof, flow comparatively fast thereby flushing the surfaces of the trough to keep them clear of any entrained solids which might otherwise tend to settle out or adhere to such surfaces. A rotor **16** is positioned centrally within casing **11** and is supported independently of bottom portion **14** by a lower rotor shaft **17**, the rotor being driven through an upper rotor shaft **18** at a preselected speed in a preselected direction.

Solid particles to be extracted, such as soybean flakes, are preferably fed in a saturated or slurried condition through a solids charging inlet **19** and discharged in drained condition upon completion of a predetermined angular path of movement. Such discharge takes place through a discharge gap **20** in bottom portion **14** and a discharge chute **21** leading from opening **20**. Fresh solvent in vapor form and "lean" condition is supplied tangentially to the illustrated embodiment through a solvent vapor inlet **22** to the space between the outside of rotor **16** and the inside of casing **11**. Liquid comprising solvent and extracted fats and oils drains into compartmented portions of trough **15** and is advanced usually in a countercurrent direction relative to the direction of rotation of rotor **16**. One schematic flow diagram for such a countercurrent liquid circulation arrangement is illustrated in FIGURE 5. On the other hand, if desired, the circulation of liquid may be arranged to proceed in a concurrent direction.

Such liquid is supplied to the respective beds of flakes in cells in rotor **16** through liquid-supplying nozzles **23** at preselected stations around the path of movement of rotor **16**, such nozzles being adjustable to vary the trajectory of the liquid stream so supplied and control the quantity reaching a selected spot along the rotor path. Liquid solvent with oils and fats dissolved therein is commonly called "miscella." Miscella in "rich" condition may be called full miscella and withdrawn from the apparatus illustrated at a suitable point preferably after being passed through a bed of flakes in rotor **16** to clarify such full miscella by the removal, for example, of solid fines therefrom by the filtration effect of such liquid percolation through said bed of flakes in the course of operation.

More particularly, the construction of the illustrated embodiment provides a series of compartment collectors in trough **15** by the provision of radial compartment separators or stage dividers **24**. A drain outlet **25** is provided from each such compartment, such outlets leading to a pump **26** of a suitable type which is preferably self-priming and of a sufficient capacity to empty the compartments as liquid drains into them for automatic flooding and draining of the respective cells in rotor **16**. Each of such compartments is fully accesisble to liquid and relatively free from sharp angles or sheltered areas in which solids might otherwise tend to settle or collect. Some small amount of liquid miscella may leak past the

inner upper end of the cells and pass through arcuate openings 69 which drain into an annular inner trough 68. An outlet 70 is provided to empty trough 68 and is connected by a pipe 71 to an appropriate compartment of trough 15. The rotor 16 as shown embodies a cylindrical inner wall 27 and a cylindrical outer wall 28 fashioned into a series of circumferentially contiguous cells 30 by double radial divider walls 29 extending between the walls 27 and 28 and overhanging the bottom radial corners respectively of the cells. A radial gable cap 29*a* covers the wedge-shaped space between such overhanging walls of each such double-walled divider 29. Alternately, the radial walls may be vertical and of a single thickness, or the inner and outer walls 27 and 28 may be constructed to slope so as to have the respective tops thereof overhanging the bottoms, or all four walls of each such cell may be sloped to provide such overhang to facilitate the discharge of solid particles therefrom.

The cells 30 are open at the top and bottom of each thereof. The lower portion of each of the cells 30 has a drainage opening in the form of a multiplicity of vertically and circumferentially spaced slots 31 passing through outer wall 28. A cylindrical screen 32 covers the inside of such drainage openings 31 and is fastened to wall 28 by fastening strips 33. Said screen 32 may be mounted instead on the outside of cell wall 28. Alternately, the screen 32 can be provided as framed unit sections separately mountable and removable relative to wall 28. Hence, liquid miscella in the cells 30 will drain through the openings 31 while the solids are retained in the cells. Preferably, an arcuate drain pan 34 is fastened to the outside of each cell 30 above trough 15, the rear end 35 of each such trough being open to the level of its bottom 36 with the result that liquid draining from a particular cell will flow off the rear end 35 in a more or less sheeted manner and drain into a compartment below through the space between that drain pan 34 and the adjoining one in a following direction relative to the direction of rotation of rotor 16. In certain types of operations of the new extractor, the pans 34 may be omitted.

The bottom edge 30*a* of each cell 30 is formed by the respective bottom edges of the radial dividers and inner and outer walls defining each such cell and is close to the smooth upper surface of the conical portion 14 of the bottom 13 of the extractor 10. A cylindrical "Teflon" strip 37 is fastened to the lower edge of outer wall 28 and extends below it so as to be in continuous engagement with the upper surface of cone 14. Drainage holes 38 are provided along the bottom edge of strip 37 for liquid to drain down over such surface into the respective compartments. A like strip 39, but without drainage holes, is provided between the bottom of inner wall 27 and the surface of cone 14. Further, the bottom edges of the radial dividers 29 are preferably provided with rubber wipers 40 fastened thereto to extend downwardly and engage the surface of cone 14. Thus, as each cell 30 revolves with rotor 16, it is effectively sealed against the loss of solid particles while permitting the repeated flooding and drainage of each cell in the course of movement of such cells around extractor 10 from solids inlet 19 to discharge opening 20.

The upper part of lower rotor shaft 17 is bushed in a packing gland 41 which prevents the escape of solvent vapors or liquids from the interior of casing 11 and a thrust bearing 42 at the lower end of shaft 17 provides the bearing support for rotor 16 in the course of its rotation. Such rotation is effected by a motor-speed reducer set 43 mounted on cover 12 with the output shaft of the speed reduced keyed to upper rotor shaft 18. Rotor shaft 18 passes through a packing gland 44 and has its lower end welded to crossbraces 45 to rotate rotor 16 in accordance with the selected speed. Similar crossbraces 46 connect rotor 16 as by welding to the upper end of shaft 17. However, shafts 17 and 18 may be made from one continuous piece of shafting material. If desired, particularly with coarser particles of solids, the nearness without engagement of the bottom edges 30*a* of the rotor cells to cone 14 may be such that strips corresponding to strips 37, 39 and 40 may be omitted even though the weight of rotor 16 does not rest upon cone 14.

Solid particles to be extracted are fed to the successive cells 30 in the course of preferably continuous rotation of rotor 16. Such rotation may, if desired, be intermittent. Solids to undergo such extraction may be passed through pipe 47 into an inclined seal conveyor 48 which discharges such flakes from the upper end thereof into a pipe 49 connected to inlet 19. A liquid level of solvent preferably is maintained in the lower portion of conveyor 48, such level being below the connection to pipe 49 so that solids discharged into pipe 49 will have been thoroughly immersed in solvent liquid and thus will fall into the cells 30 through inlet 19 in a solvent-saturated or somewhat slurried condition. The saturated condition of the solids being supplied to extractor 10 also aids in the distribution and stabilizing of the beds of solids charged into each cell 30 as it passes beneath inlet 19. If no such solvent liquid is used in conveyor 48, the escape of vapor from within casing 11 through the solids feed inlet may be otherwise provided for as by having a rotary barrel valve in pipe 47 for such purpose.

Such solids are supported on the upper surface of cone 14 as they move from the feeding station directly below inlet 19 in a clockwise direction as viewed in FIGURE 3, the walls of the cells 30 serving to push the solids along such surface until they are discharged through discharge opening 20. Opening 20 is preferably wedge-shaped in plan with the sides thereof generally parallel to the nearest radial divider at the time of discharging the contents of the cell and with such sides of discharge opening 20 between the inner and outer ends thereof being tangential to circles circumscribed about the vertical axis of rotor 16 as indicated on FIGURES 3 and 4. In that way, prompt effective discharge of the drained and extracted solids is obtained.

Solvent preferably is supplied to the interior of extractor 10 in lean, that is, in de-fatted and de-oiled condition as vapor through pipe 22. Such vapor assists in keeping extractor 10 at optimum operating temperature and in providing for preferential condensation of solvent therein. Solvent vapors not condensed within extractor 10 pass upwardly and out through a fitting 50 communicating with a condenser such as a reflux condenser so regulated as to condense and return such solvent vapor as liquid solvent to the cells 30 passing below the passage 50 (e.g., see United States Patent No. 2,790,708). A vent connection 51 may also be provided to maintain the pressure within casing 11 at atmospheric pressure or a trace below in cases where a solvent like hexane is used with a solids material like soybean flakes. The vent connection 51 may be provided with a suitable ventilator opening for that purpose at an appropriate height above grade. In practices of my invention in which the solvent used is non-toxic and non-volatile, the extractor casing will not have to be made vapor-tight. Indeed, where the solvent is non-volatile and supplied substantially wholly in liquid form, the casing for the extractor may be dispensed with entirely.

The liquid solvent is circulated in the illustrated embodiment in countercurrent fashion (counterclockwise as viewed in FIGURE 3) through respective liquid-supplying nozzles 23 at circumferentially spaced stations between discharge opening 20 and feed inlet 19. Each nozzle 23 has an axial body portion 52 extending inwardly through a sleeve 53 in casing 11. The axial portion 52 terminates at its outer end in a capstan head 54 which is revolvably held between flanges 55 bolted together with a predetermined tightness to hold nozzle 23 in place. The inner end of portion 52 terminates in a generally

downwardly directed L-shaped end **56** to the leading edge of which, considering the direction of rotor rotation, a spreader plate **57** is welded. Hence, solvent liquid issuing from a nozzle **23** will be spread as it flows over the upper surface of plate **57** and the discharge thereof over the following edge **58** of spreader plate **57** will be transverse line discharge giving relatively abrupt cutoff of flow as the trailing or following radial divider **29** of each cell passes through the sheeted flow from that particular nozzle.

The nozzles **23** are rotatable by a spanner wrench engaging the openings **59** in capstan head **54** so that the angle made by plate **57** with the horizontal can be varied significantly about the axis of portion **52**, thereby changing the trajectory and engagement locale between liquid so supplied and the solids receiving such liquid. Liquid from the solvent circulating system is also supplied to a washing nozzle **60** to clean the screen **32** where the empty cells pass from the solids discharge station to the solids inlet station. In addition, suitable light glasses **61** and sight glasses **62** may be placed at appropriate positions around the sides and top of extractor **10** to enable optimum operation therein to be provided by adjustment for selected solid material, solvent, wetting and draining, temperature, pressure and extraction conditions. Further, if desired, appropriate automatic and semi-automatic flow, level and other indicators and controllers may be applied to the new apparatus. Appropriate handways and manways and other fittings such as purge fittings may also be provided in the extractor for use, for example, when the apparatus is to be shut down as when a scheduled cleanout is to occur.

While the operation of the embodiment described above will be apparent from the foregoing description, one schematic flow diagram for one form of piping connection to provide countercurrent operation thereof is illustrated in FIGURE 5. As shown therein in developed form, rotor **16** may be considered to move in the direction of arrow **63**. Solid material is fed continuously through inlet **19** and any drainage therebelow plus liquid from washing nozzle **60** drains into compartment A and is pumped from thence by a pump **26** through a pipe A′ to nozzle station A″. Another pump **60***a* may take liquid from compartment A and recycle it to wash nozzle **60**. A cell **30** passing out from beneath inlet **19** will have a relatively compact and stabilized bed of solid material therein, which bed will act as a filter for solid fines and general clarification of full miscella issuing from the liquid-supplying nozzle **23** at station A″. Full miscella draining through such a stabilized bed passes into compartment B and from thence may be pumped out through line B′ to a miscella tank or liquids desolventizer for the separation of solvent and the end liquid product or products.

As each cell continues to the left as viewed in FIGURE 5, it will be flooded by solvent liquid issuing from the nozzle **23** at station B″ and will drain into compartment C or compartments C and D in accordance with the rotary angle at which spreader plate **57** at station B″ is set. In addition, the nozzle at station C″ may be set to "overlap" the separator between compartments C and D, if desired, to have some portion of liquid from station C″ pass into a cell while it is still draining into compartment C. Thus, adjoining liquid issuing nozzles with their spreader plates may be selectively set and coordinated to control the quantity of liquid supplied at a particular location and the quantity of liquid discharged into a particular compartment or compartments. Consequently, cells in passage between liquid-supplying stations will drain into the preselected compartment or compartments and the pumps **26** will empty those compartments so that they will not overflow in the course of a normal operation.

To continue with the described operation, liquid in compartment C will be pumped through a pipe **48***a* to conveyor **48** in which a liquid level is maintained through which the solid material passes as described above. Further, liquid-supplying stations D″, E″ and F″ are appropriately arranged and cooperate normally with compartments E, F and G, or more than one such compartment, as hereinabove pointed out, dependent upon the speed of the rotor, the spatial relation of the liquid-supplying stations, of the separators in the compartments and of the angular position of the spreader plates **57**. As shown, liquid draining into compartment D is pumped out through a pipe D′ to station B″, that in compartment E through a pipe E′ to station C″, that in compartment F through a pipe F′ to station D″, and that in compartment G through a pipe G′ to station E″.

Compartment G is larger than the others and acts as a final drainage compartment before solids in the cells reach opening **20** and pass out therethrough and through chute **21** in relatively completely drained condition. From chute **21**, the drained solids are taken normally to a solids desolventizer where residual solvent therein may be removed and returned to extractor **10** as a liquid, or as a vapor, possibly through pipe **22** along with solvent vapor from the liquid desolventizer. Condensed "lean" liquid solvent is supplied through fitting **50**. A valved pipe connection **64** may be connected to the liquid supply manifold at station F″ to supply any make-up or additional solvent that may be needed until the unit is fully on-stream with all of the inputs and take-offs of solid, liquid and vapor flows in optimum operation balance.

In the modification shown in FIGURE 13, a different drive for a rotor **16** is provided in the form of a bull ring gear **65** fixed to the upper portion of the outside wall of the rotor to be engaged by a pinion **66** driven by a motor gear reduction set **67** at a selected speed in a selected direction.

Various other changes in the illustrated embodiment and in the modification may be made in details thereof and other forms of this invention may be provided without departing from the spirit of my invention or the scope of the appended claims.

I claim:

1. In a solvent extractor, apparatus comprising, in combination, a circular vapor-tight casing, a right circular solid conical bottom within said casing having a smooth upper surface, an annular trough extending around the lower edge of said bottom in contiguous relation thereto, said trough having circumferentially variously spaced separators to provide successive compartments, drains for said compartments, a vertical axis rotor having a plurality of cells in contiguous arrangement around the axis thereof, said rotor further having a cylindrical outer wall and a cylindrical inner wall, said cells having radially extending dividers between said inner and outer walls, said cells being open at the top and bottom thereof with the bottom edge of said dividers extending closely along said upper surface, downwardly projecting circumferential flexible strips extending between the respective lower edges of said inner and outer walls and said upper surface, a flexible wiper strip fixed to the bottom edge of said cell dividers and extending downwardly to engage said upper surface, the lower portion of the outer wall of said rotor having perforated openings therein, a screen covering said openings, arcuate pans fixed exteriorly along said outer wall below said openings and above said trough, the following end of said pans extending radially and being open substantially to the level of the bottom thereof, a plurality of radially extending liquid-supplying nozzles projecting inwardly through said casing to a position intermediate the inner and outer walls of said rotor, said liquid-supplying nozzles being rotatably adjustable about the radially extending axis thereof, said liquid-supplying nozzles having a spreader line discharge flow plate at the discharge ends thereof respectively, a pressure nozzle extending through said casing adjacent said discharge open-

ing to jet liquid against each said screen to wash it, means for rotating said rotor about its axis, pump connections extending respectively between said drains and said liquid-supplying nozzles to advance liquid around the axis of said extractor in a direction counter to the direction of rotation of said rotor, vapor-tight means for feeding a slurry of flakes successively into said cells through the top thereof during the rotation of said rotor, a generally radially extending downwardly flaring discharge chute connected to said conical bottom spaced at an angle of not less than about 270° from said means for feeding flakes taken in the direction of rotation of said rotor, said conical bottom having a generally radial flush discharge opening above and communicating with said discharge chute, said discharge opening having its sides generally parallel respectively to relatively close lines tangent to circles of small but different diameters described about said axis, and a lean solvent vapor inlet pipe means tangentially connected to said casing and communicating with the space between the inside of said casing and the outer wall of said rotor.

2. In a solvent extractor, apparatus comprising, in combination, a casing, a solid conical bottom within said casing having a smooth upper surface, a trough extending around the lower edge of said bottom, said trough having a plurality of separators to provide successive compartments, drains for said compartments, a rotor having a plurality of cells around the axis thereof, said rotor further having an outer wall and an inner wall, said cells having radially extending overhanging double-wall dividers between said inner and outer walls, said cells being open at the top and bottom thereof with the bottom edge of said dividers extending closely along said upper surface, flexible strips extending between the respective lower edges of said inner and outer walls and said upper surface, the lower portion of the outer wall of said rotor having screened openings therein, pans fixed exteriorly along said outer wall below said openings and above said trough, the following end of said pans being open, a plurality of liquid-supplying nozzles projecting inwardly through said casing to a position above the tops of said cells, said liquid-supplying nozzles being adjustable and having a spreader plate at the discharge ends thereof respectively, means to clean said screened openings in the course of operation, means for rotating said rotor, pump connections extending respectively between said drains and said liquid-supplying nozzles to advance liquid around the axis of said extractor, means for feeding a slurry of flakes successively into said cells through the top thereof during the rotation of said rotor, a discharge chute connected to said conical bottom, said conical bottom having a generally radial flush discharge opening above and communicating with said discharge chute, and solvent vapor inlet means communicating with the inside of said casing.

3. In a solvent extractor, appartus comprising, in combination, a smooth solid bottom in the form of a surface of revolution to support solids and having a higher inner and lower outer periphery to drain liquid downwardly and outwardly, a plurality of arcuate compartments positioned adjacent and outwardly of said outer periphery to receive said liquid, a plurality of cells relatively movable over said bottom, each of said cells having four walls generally quadrilateral in plan, the bottom edges of said walls defining a lower cell opening and being in proximate relation to and coacting with said bottom as a closure therefor, means for moving said cells over said bottom, means for supplying solids to said cells for extraction, said bottom further having an opening therein spaced angularly relative to said last-mentioned means to discharge extracted solids from said cells, means for supplying solvent-containing liquid to solids in said cells prior to said discharge, and perforate means in said cells above said lower cell openings to drain liquid from said cells toward said compartments.

4. In a solvent extractor, apparatus comprising, in combination, an inclined immovable bottom member having a relatively smooth substantially impervious upper surface, a drainage trough positioned adjacent the lower edge of said bottom, a plurality of movable cells in successive connected arrangement, said trough being offset from a position directly beneath said cells, said cells having transversely extending front and back walls between the inner and outer walls thereof, said cells further being open at the top and bottom thereof with the bottom edge of said cells being close to and coacting with said surface as a closure therefor, the lower portion of at least one wall of each cell having a screen opening therein for liquid to drain to said trough, a plurality of spaced liquid-supplying nozzles for said cells, means for feeding flakes successively into said cells during movement thereof, said member having a discharge opening below said cells to discharge flakes from said cells in the course of movement thereof, and means for removing liquid from said trough.

5. In a solvent extractor, apparatus comprising, in combination, a bottom therein having a substantially impervious inclined portion extending downwardly from the central portion of said extractor toward the outside of said extractor, a drainage collector positioned along the outside of the inclined portion of said bottom, a plurality of cells in successive rigidly connected arrangement for relative movement along said inclined portion, said cells being open at the top and the bottom thereof and having a bottom edge conforming to the slope of said inclined portion to remain close thereto and to cooperate therewith as a closure during relative movement of said cells, means for supporting said cells independently of said inclined portion along which said cells relatively move, means for supplying liquid to solids in said cells, perforate means in said cells above said bottom edges respectively to drain liquid from said cells toward said collector, said inclined portion having a gap therein over which said cells pass in the course of relative movement along said inclined portion, whereby solids charged into said cells will be supported by said inclined portion and relatively moved along it by said cells before discharge of said solids through said gap while liquid will drain from said cells into said collector.

6. In a solvent extractor, apparatus comprising, in combination, a casing, a bottom therein having a substantilly impervious inclined portion extending downwardly from the central portion of said extractor toward the inside of said casing, said inclined portion being substantially endless along a horizontal path thereon, a compartmented drainage collector positioned along the outside of the inclined portion of said bottom, a plurality of cells in successive endless rigidly connected arrangement for movement along said inclined portion, said cells being open at the top and the bottom thereof and having a bottom edge conforming to the slope of said inclined portion to remain close thereto and to cooperate therewith as a closure during movement of said cells, said cells having a wall opening for drainage of liquid only therethrough, drain pans connected to said cells and overlying said collector to concentrate the drainage zone from said cells, means for supporting said cells independently of said inclined portion along which said cells move, flexible means extending between the bottom edge of said cells and said inclined portion, said inclined portion having a solids discharge opening therein generally along the direction of the inclination of said inclined portion and over which said cells pass in the course of movement along said inclined portion, whereby solids charged into said cells will be supported by said inclined portion and moved along it by said cells before discharge of said solids through said discharge opening while liquid will drain from said cells into said collector.

7. In an apparatus for treating solid material with liquid, apparatus comprising, in combination, a bottom

member having a solid loop-arranged generally smooth substantially impervious upper surface, a plurality of successive open-bottomed cells relatively movable along said surface in the course of movement of said cells along an endless loop path, said member forming a solid material supporting bottom for each said cell as it moves relatively along said surface, the lower edge of said cells being proximate to said surface during such movement to keep said solid material in said cells, means for charging said cells with solid material to be treated, means for supplying liquid to said cells during such movement, means for draining liquid from said cells during such movement above said member, means to one side of said lower edge and below said last-named means to receive draining liquid, and means for successively discharging said solid material from the respective open bottoms of said cells at a predetermined location along said endless path.

8. In a solvent extractor, apparatus comprising, in combination, a solid bottom member having a smooth upper surface, a plurality of open-bottomed cells in successively connected arrangement relatively movable along said surface in the course of movement of said cells along an endless loop path, the bottom edge of said cells being in juxtaposition to said member, said member forming the bottom of each said cell in the course of such movement, said cells further being open-topped, means for discharging solid material successively into said cells through the respective tops thereof in the course of such movement, means for flooding said cells with liquid solvent at selected spaced stations in the course of such movement, perforate means in said cell above said bottom edge for draining said cells between respective ones of said stations in the course of such movement, draining liquid receiving means to one side of said cells and below said perforate means, and means in the form of a discharge opening in said member for successively discharging said solid material in drained condition respectively through the bottoms of said cells in the course of their relative passage across said discharge opening.

9. In a solvent extractor, apparatus comprising, in combination, an inclined bottom member having a generally smooth substantially impervious upper surface, a plurality of open-bottomed cells in successively connected rotatable arrangement movable along said surface, the bottom edge of said cells being inclined in conformance with the inclination of said member, flexible strips fixed along said bottom edge to engage said surface, said member forming the bottom of each said cell in the course of such movement, said cells further being open-topped, means for discharging solid material immersed in liquid successively into said cells through the respective tops thereof in the course of such movement, means for introducing lean solvent vapor into said extractor, means for flooding said cells with liquid solvent at selected spaced stations in the course of such movement, perforate means in said cells above said bottom edge for draining said cells between respective ones of said stations in the course of such movement, draining liquid receiving means substantially to one side of said cells and below said perforate means, means in the form of a flush discharge opening in said member for successively discharging said solid material in drained condition from the respective opened bottoms of said cells passing across said discharge opening, and means for filtering and withdrawing miscella from said extractor through said solid material.

10. In a solvent extractor or the like, comprising, in combination, a rotor revolvable about a generally vertical axis radially divided by partitions into particle-containing cells open top and bottom, means for flooding and draining said cells with a liquid solvent, an impervious stationary material-supporting bottom below and in adjacent relation to said rotor to act as closures for said cells, the said partitions in the rotor extending substantially to surface-sweeping relation with said bottom, a trough around the lower edge of said bottom to one side of said cells, the said bottom sloping downwardly toward said trough to drain percolating liquid towards said trough, liquid-pervious wall sections in a wall of each cell proximate to said trough and above said lower edge, and a generally radially-extending outlet through said bottom for the discharge of drained extracted particles swept into said outlet by said partitions as the rotor revolves.

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