

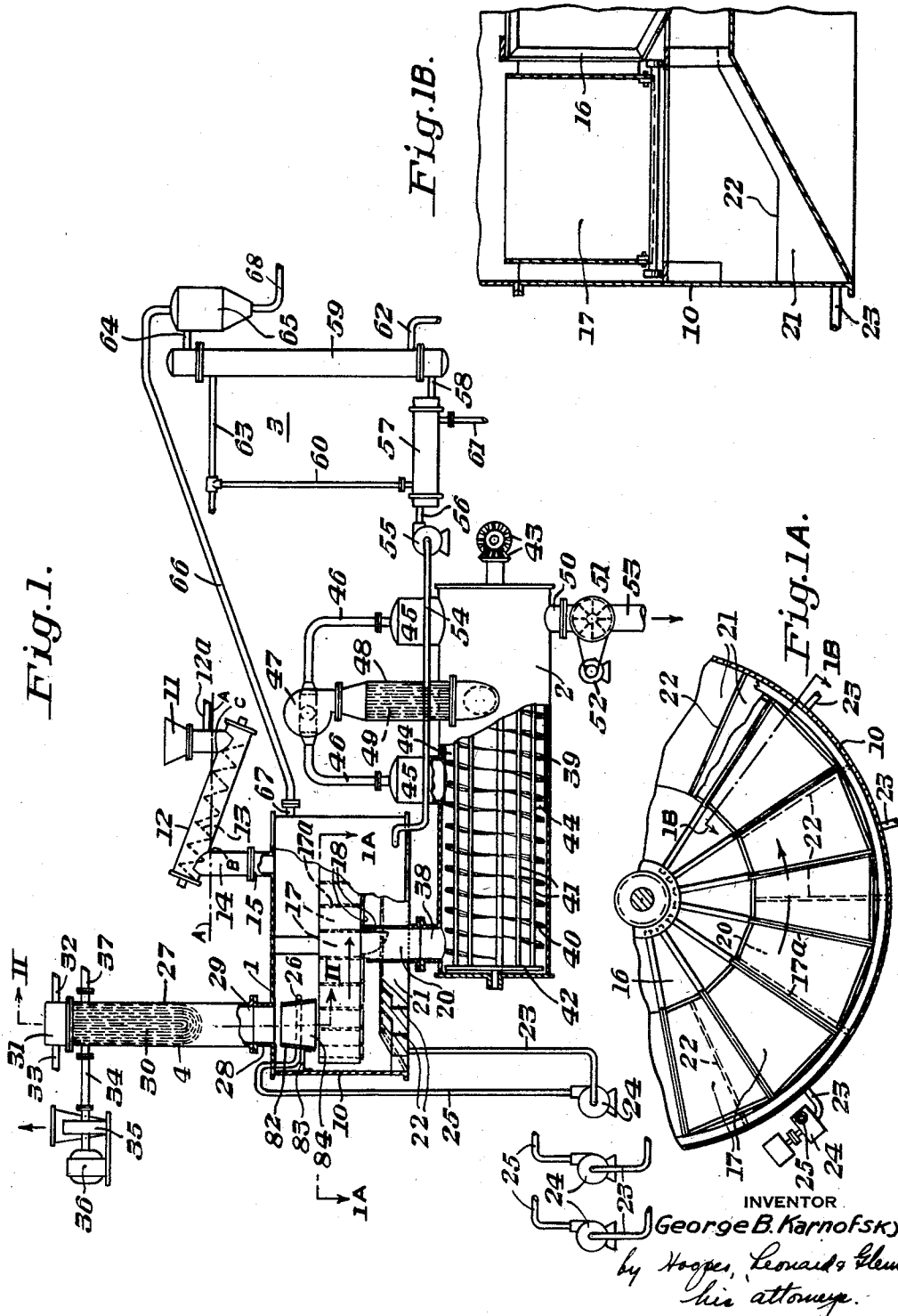
April 30, 1957

G. B. KARNOFSKY
SYSTEM FOR SOLVENT EXTRACTION OF OIL OR THE
LIKE FROM SOLID ORGANIC PARTICLES

2,790,708

Filed June 25, 1949

2 Sheets-Sheet 1



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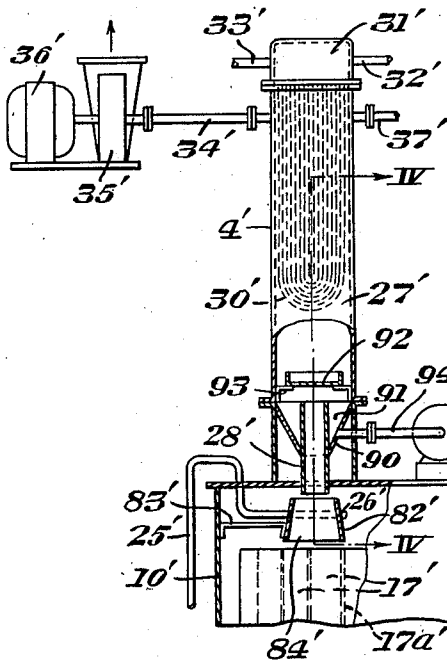


Fig. 2.

Fig. 3.

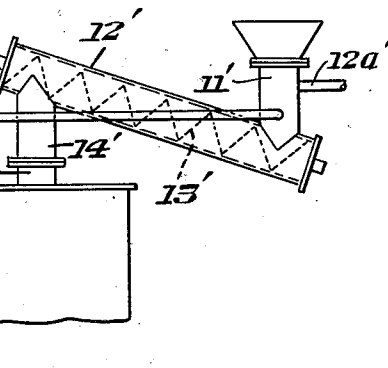
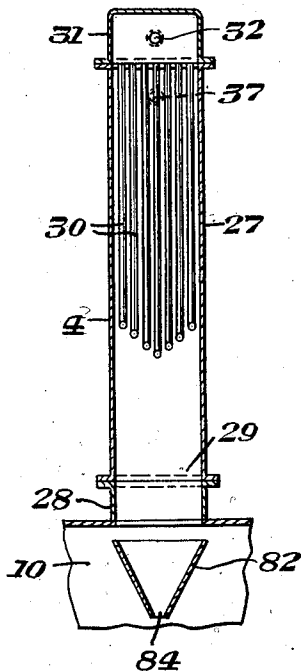
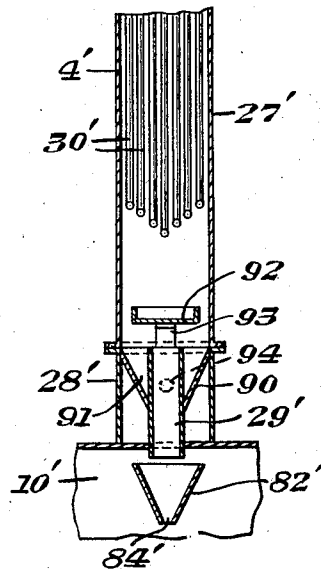


Fig. 4.



INVENTOR
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2,790,708

SYSTEM FOR SOLVENT EXTRACTION OF OIL OR THE LIKE FROM SOLID ORGANIC PARTICLES

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Application June 25, 1949, Serial No. 101,457

13 Claims. (Cl. 23—310)

The present invention relates to the solvent extraction of extract from organic substances such as cotton seeds, soybeans, other vegetable seeds and nuts and other substances. More particularly, it relates to an unobvious and unique organization of existing basic processing elements into a new combination, so operatively related that certain difficulties, heretofore found most troublesome, are overcome and certain additional advantages in the way of recovery of materials and economies in operation are obtained.

The usual solvent extraction system includes apparatus for extraction, for desolventizing the final solution of an extract such as oil (designated as "miscella") and for desolventizing the residual solids, and in all such systems solvent is recycled to the extractor, in closed paths, from the miscella desolventizer and from the solids desolventizer respectively. Customarily in this art the extractor is physically separated from the two desolventizer systems and functions as an extractor discretely, the parts, however, being interconnected for continuity of flow by conveyors, pumps, pipes, condensers, surge tanks and the like. The solids desolventizing apparatus has been a source of troublesome fine solid particles in the vapors and additional dust separating or vapor scrubbing apparatus has been found necessary to prevent fouling of condensers and vapor conduits. Moreover, the recovery of such fines has not been satisfactory, and their disposal has presented a problem. By the unique combination of this invention an integral and simpler system is obtained in which substantially all solid materials are recovered, the problem of handling fines-laden vapor is overcome, and many, if not most, of the above-mentioned auxiliary specialized devices ordinarily required are eliminated with greatly reduced cost of equipment, with reduced size of structures to house the equipment, and with increased thermal efficiency.

The system of this invention also provides for automatic maintenance of the optimum temperature for extraction, which usually is substantially at the boiling point of the solvent. It is, of course, common practice to conduct extraction at elevated temperature but heretofore specialized heating means have been required to provide it, and in conventionally organized systems using a vented extractor, operation is limited to some temperature below the solvent boiling point. In my system the maintenance of the desired higher temperature substantially at the solvent boiling point is inherent in the organization of the parts, and the increased temperature noticeably increases the efficiency of extraction.

These and other objects and advantages of this extraction system will be apparent from the following description of a specific embodiment, schematically shown in the following drawings, in which,

Figure 1 is a diagrammatic illustration of a plant embodying the system of this invention with a portion of the internal structure of the extractor and desolventizer used therein more fully shown;

Figure 1A is a horizontal sectional partial plan view

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on a somewhat enlarged scale taken along line 1A—1A of Figure 1;

Figure 1B is a vertical sectional view taken along line 1B—1B of Figure 1A;

Figure 2 is a view in vertical cross section taken along line II—II of Figure 1 and shows a condenser suitable for use with the plant system illustrated in Figure 1;

Figure 3 is a partial diagrammatic illustration of a modified form of the plant system of Figure 1; and

Figure 4 is a view in vertical cross section taken along line IV—IV of Figure 3.

The plant system of this invention consists of four essential elements, an extractor 1, a solids desolventizer 2, a miscella desolventizer 3, and a vapor condenser 4, a preferred example of each of which will be presently described in detail. It will be observed that the condenser 4, is connected directly to an extractor casing 10, and that vapors are conducted from the solids and miscella desolventizers to the condenser through this casing, which thus constitutes a vapor collecting manifold. The condenser is mounted above the extractor and discharges condensed solvent directly into the extractor where it is used. Condensed water and any fine solids present in the condensed liquids are also returned to the extractor and absorbed in the solid material in process. The vapor atmosphere passing through the extractor casing, in equilibrium with condensed liquid returned, automatically maintains the desired optimum extraction temperature of substantially the boiling point of the solvent.

The extractor 1 is preferably of the type more fully described in my copending United States patent application Serial No. 91,372, filed May 4, 1949. In the embodiment shown in Figures 1, 1A and 2, it consists of a casing 10, through the top of which duly prepared solid particles, such as soybean flakes, are fed from a feed hopper 11, by means of an inclined screw-conveyor tube 12, a screw 13, a spout 14, and inlet flange 15, connecting the casing 10, to the conveyor. The overflow point B, at the intersection of the tube 12 and spout 14, determines a liquid level A—A in the conveyor casing; and the conveyor is of such length and inclination that the underflow point C at the intersection of tube 12 and hopper 11 is below the level A—A, forming a liquid trap. Solvent solution from extractor 1 or fresh solvent is also introduced into tube 12, which is liquid tight, through a pipe 12a. Hence, a slurry of such solvent and flakes is maintained in the casing 12 of the screw conveyor and provides a vapor seal for the extractor. This slurry flows through outlet 14 and inlet flange 15 which is disposed appropriately for extraction purposes, as more specifically disclosed in the above mentioned application Serial No. 91,372.

Within extractor casing 10, a rotor 16 turns about its vertical axis moving successive cells 17 in a horizontal circular path. Each cell is open at the top and is substantially closed during the major portion of its rotation by a draining door 18 hinged along advancing edge 19 thereof which allows each cell to drain continuously. Means (not illustrated) cause the respective doors 18 to open above a solids outlet 20 in the bottom of extractor casing 10 after such drainage is completed.

This drainage of solvent and dissolved extract takes place into a series of compartments 21 radially divided from each other by partitions 22 in the bottom of casing 10 underlying the path of travel of the cells 17. In a preferred operation of extractor the contents of the respective compartments are pumped out respectively through suction lines 23 by pumps 24 and delivered through outlet lines 25 to the appropriate locations to obtain countercurrent flow of liquid relative the movement of particles in the respective cells 17. Nozzles 26 extend radially relative the axis of rotor 16 and are con-

connected respectively to the outlet ends of lines 25 and preferably are constructed to produce a sharp transfer of liquid flowing through each nozzle 26 as it passes over each partition 17a during the rotation of the cells 17 beneath that nozzle.

Condenser 4 has a casing 27 mounted in vertical position directly above a vapor outlet 28 in the top of extractor 10. Condenser 4 is connected to this vapor outlet by a conduit 29 which, in the embodiment shown, constitutes the lower portion of the shell 27 of the condenser. As shown in Figure 2 a plurality of U-shaped tubes 30 have their respective ends opening into the sealed compartments of a header 31 connected to the upper end of shell 27. A cooling medium such as liquid water enters the tubes through a line 32 connected to one of these compartments in heater 31 and flows out through a line 33 connected to the other compartment. Dependent upon the temperature and flow of water through the tubes 30, temperature of the vapors including entrained material rising through vapor outlet 28, it is possible to condense all of the condensable portions of these vapors in condenser 4 returning them directly through conduit 29 and vapor outlet 28 to the cells 17 in extractor 2. A funnel distributor 82 is positioned within extractor casing 10 beneath the lower end of vapor outlet 28 and is fastened to the shell of extractor 10 by a suitable bracket 83. The lower open end of funnel distributor 82 is formed in the shape of a slot 84 which extends radially relative to the vertical axis of rotor 16. In this way, there is a sharp transfer of the condensed liquids returning from condenser 4 between cells 17 as the respective partitions 17a thereof pass beneath slotted opening 84. Vapors rising in vapor outlet 28 first pass between the top of distributor 82 and the lower end of the vapor outlet.

Liquids condensed by condenser 4 fall in a direction counter to the movement of the vapors entering through outlet 28. This condensate effectively scrubs the rising vapors and washes the vertical heat transfer surfaces within casing 27, so that entrained fine solid materials are returned to extractor 1 with the condensed liquids. The non-condensable gases in the vapors pass out of condenser 4 through a vent 34. A fan 35 operated by a motor 36 may be connected to vent 34 to place the entire plant under a slight subatmospheric pressure. Operation under such a partial vacuum insures that if there should be any leakage in the system, there will be leakage of air into the system rather than any escape of solvent vapor from the system. Substantially no air enters extractor 1 because of the slurry vapor seal in conveyor tube 12.

Make-up solvent may be added to the system through a line 37 where it will assist the condensable portions of the vapors passing into condenser 4 to wash down and maintain the condensing surfaces therein clean as the condensed liquids run back toward extractor 1. Inlet connection 37 may preferably be so applied to casing 27 as to impart a tangential and downwardly spiraling motion around the inside thereof to the make-up solvent. The amount of make-up solvent is usually very small and may be added continually or periodically either through condenser 4 as indicated or elsewhere as may be desired.

As the doors 18 of the respective cells 17 are successively opened over the solids outlet 20, the solid residue in the cells including absorbed and adherent liquids in the form principally of solvent and water pass through outlet 20 and into a conduit 38 connected to one end of a desolventizer 2. In the solids desolventizer, the extracted particles are heated until the solvent is substantially all evaporated, the vapors thus generated passing upwardly through the outlet 20, and the extractor casing 10, to the condenser 4, where they are recovered as liquid solvent, as above described. Any convenient mode of heating the solids may be provided, but it is

preferred for processing soybean flakes or the like to use superheated solvent vapors for this purpose; and the solids desolventizer 2, illustrated in Figure 1, is constructed to operate on that principle. This desolventizer is of the type more fully described in United States application Serial No. 737,915, filed March 28, 1947, now Patent No. 2,571,143, in the name of Eugene H. Leslie. It is evident that other types of desolventizer may also be used.

In this desolventizer, which removes the vaporizable material from the solids, in order that the solids may be made into finished meal or other finished form, the material passing through conduit 38 is fed and cascaded toward the other end of desolventizer casing 39 principally by a helically wound blade 40. The various turns of helical blade 40 are connected by longitudinal bars 41 which terminate in plates 42 at the ends of the desolventizer. Plates 42 in turn are rotated by means of appropriate shafting and bevel gearing 43 driven by a motor which is not shown. Longitudinal scraper bars 44 extend between two vapor domes 45 and assist in cascading the solids being progressively fed through so that such solids fall through the vapor in the desolventizer used to vaporize residual liquids in those solids.

This vaporization is produced by the heating of the vapors rising in vapor domes 45. These vapors pass through ducts 46 under the influence of a fan 47 which blows such vapors through a heater 48 the lower end of which opens into desolventizer 2 intermediate the two domes 45. Heater 48 is a shell and tube type of heat exchanger, the tubes 49 of which are heated by steam which surrounds them, said steam flowing through the casing of heater 48 through appropriate connections (not shown). The vapors passing through fan 47 flow through the tubes 49 and into desolventizer 2 in a superheated condition where they divide and flow toward both ends thereof. This superheated vapor evaporates residual liquids from the solids and causes the net evolved vapor to pass upwards through conduit 38 and solids outlet 20 back into extractor 1. If desired, a separate connection may be made between solids desolventizer 2 and extractor casing 10 through the bottom thereof or elsewhere for the return of net evolved vapors from desolventizer 2 to extractor 1. The use of solids outlet 20 for this purpose is, however, to be preferred. Since these vapors are substantially at the boiling point, extractor 1 can be maintained at optimum operating temperature during the extraction cycle. This optimum operating temperature is substantially at the boiling point of the solvent used which in the case of soybean flake is frequently commercial hexane, a substance which boils at about 150° F.

The solids in desolventizer 2 successively progress until they pass out of the desolventizer through a conduit 50 where they fall between the vanes of a rotating valve 51. Valve 51 is turned by a motor 52 and successively discharges the material in the compartments of the valve into a pipe 53 which may lead to a conventional steam deodorizer before undergoing subsequent steps in the preparation of a finished solid product.

The miscella desolventizer 3 preferably consists of a preheater 57, an evaporator 59, and a vapor-liquid separator 65 serially connected. Miscella constituting the final effluent from extractor 1 is pumped out of the appropriate compartment 21 through a line 54 connected to the intake of a pump 55. Pump 55 forces the miscella through line 56 and through the heating coils of preheater 57 whence the preheated miscella passes through line 58 into evaporator 59. Conventional miscella filters can be interposed between pump 55 and preheater 57 for the purpose of removing fines and any other solid material that may be therein. The heating coils in preheater 57 are heated by steam entering through line 60 and exiting through a line 61. Such steam is delivered at the appropriate temperature and pressure by any suitable source which is not illustrated.

A steam connection 63 is used to admit steam to evap-

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orator 59 between the tube sheets therein to provide heat for the evaporation operation, the condensed steam leaving the evaporator through a line 62. Miscella entering evaporator 59 from pipe 58 flows upwardly inside the tubes (not shown) of evaporator 59, evaporating the solvent and causing solvent vapor and desolventized extract to pass out through pipe 64 to the vapor-liquid separator 65 where the solvent in vapor form and the desolventized oil or other extract are separated. The substantially pure solvent in vapor form passes out of vessel 65 through a line 66 directly connected to extractor casing 10 at vapor inlet 67. Extract from which not all solvent has been evaporated collects in vessel 65 and flows out through a line 68 whence it passes into conventional, stripping, deodorizing and condensing equipment for finishing.

The solvent vapor entering through inlet 67 mingles with net evolved vapors rising in solids outlet 20 from desolventizer 2 and pass together through casing 10 to condenser 4. In the solids desolventizer 2 both solvent vapor and water vapor are generated (the water being derived from the organic material) in substantially the same ratio as in a constant boiling mixture of water and solvent. Hence, the addition to such vapors of pure solvent vapor through inlet 67 from the miscella desolventizer 3 increases the solvent vapor to water vapor ratio to the point where preferential condensation of solvent (if any condensation occurs at all) results in the event of some heat loss from the vapor mixture and condensation of water in the extractor is thus prevented. This is of relatively more importance at the start of an extraction operation. It is upon the initiation of an extraction cycle that preheater 57, evaporator 59 and vessel 65 in the miscella desolventizer 3 may preferably be used to recirculate hot substantially pure solvent vapor through extractor casing 10 to rapidly raise the temperature thereof to operating temperature. At other times, if it is desirable, solvent vapor from vessel 65 may be passed directly to condenser 4.

It will thus be seen that this invention solves the problem which formerly attended the disposal of solid fines contained in condensed water, conserves those fines and preserves the moisture content of the outgoing extracted and desolventized particles to the same extent that water was originally contained in the particles delivered to extractor 1, since under proper operating procedure substantially no condensed water drains into the compartments 21. In addition, this invention tremendously simplifies extraction plants as they have heretofore been known and eliminates the need for such conventional items of equipment as the extractor discharge conveyor, solvent supply tank, solvent decanter, solvent pump, vapor scrubbing devices, and separate condensers for the solids and liquids desolventizers.

Under some circumstances, it may be desirable to remove condensed water directly from the condenser and introduce it into the screw conveyor means for feeding solid organic particles to the extractor. Thus, in the modification illustrated in Figures 3 and 4, the difference between the modified embodiment and the preferred embodiment illustrated in Figures 1, 1A and 2, lies in the means for removing water in liquid phase from the condensate in condenser 4' and returning such water with any fines therein to the inlet of conveyor tube 12'. The parts of the modified embodiment illustrated in Figures 3 and 4 corresponding to elements in Figures 1 and 2 bear the same reference numerals, primed, and are similar in construction and purpose.

Thus, condenser 4' is supplied with vapors from extractor 1' by a conduit 28' which extends upwardly into condenser casing 27'. A cone-shaped separating wall 90 closes the space between the tube 28' and the casing 27', being sealed at its lower end around the exterior of conduit 28' so that it forms a basin 91 for receiving condensed liquid. A shield or cover 92, spaced somewhat above the upper end of tube 28', on supporting brackets 93, shields the opening from any direct shower of con-

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densed liquid, which is thus directed into the basin 91. The bulk of the solvent portion of the condensate (assuming a solvent lighter than water, such as hexane, is used) overflows into tube 28' and thus returns to the extractor. Basin 91 has sufficient capacity to afford the necessary settling time for the condensed aqueous part and solvent to separate. Water, fine solids in aqueous suspension, and a portion of the solvent are withdrawn from the bottom of the basin 91 through pipe 94. The rate of removal of liquid through the pipe 94 preferably exceeds somewhat the rate of condensing aqueous vapors alone, and includes sufficient solvent withdrawn with the water and fines to prevent the formation of a water-solvent interface level in the basin 91. This precaution precludes emulsion accumulation in the decanting basin, which in time would otherwise tend to overflow into the pipe 28' along with solvent.

The lower end of conduit 28' is positioned above a funnel distributor 82' fastened to extractor casing 10' by a suitable bracket 83'. The lower open end of funnel distributor 82' is formed in the shape of a slot 84' which extends radially relative the vertical axis of rotor 16'. In this way, there preferably is a sharp transfer of condensed solvent between cells 17' as the respective partitions 17a' thereof pass beneath the slotted opening 84'. Vapors rising in vapor outlet 28' first pass between the top of distributor 82' and the lower end of the conduit 28'.

The aqueous portion of the liquid from basin 91 is continuously drained through the line 94 which leads to the intake of a pump 95 which delivers the water, contained fines and some solvent through a line 96 into the lower end of hopper 11'. Thus, the aqueous part and the fines mingle with the slurry of fresh solid organic particles and solvent being fed respectively through hopper 11' and pipe 12a' to conveyor tube 12'. The purpose of this modification is to take advantage of the mixing action of the conveyor and thus to incorporate the water and fines into the mass of flakes substantially homogeneously. As in the embodiment of Figures 1 and 2, the aqueous part so recycled in this embodiment does not increase the ultimate moisture content of the solids leaving the solids desolventizer, but causes all moisture to remain in the system without detriment and, further, avoids the dehydration of the solid organic particles which normally would otherwise occur.

Although I have illustrated and described preferred and modified embodiments of this invention, it will be recognized that some further changes may be made therein without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. In a solvent extraction system for solid organic particles, apparatus comprising in combination, an extractor having a casing and a vapor space therein, a movable carrier in said casing within said vapor space and spaced above the bottom of said extractor to support and drain said particles during movement thereof, a vapor outlet in said extractor, a condenser connected to said vapor outlet and adapted to condense liquefiable vapors passing through said outlet, a conduit for returning condensate from said condenser to said extractor, a solids outlet in said extractor, a drained solids desolventizer vessel connected to said solids outlet and adapted to desolventize said particles from said extractor after extraction, a conduit for returning at least a part of the net evolved vapors from said desolventizer to said extractor, means for feeding said particles to said extractor, and means for withdrawing liquid solutions of extract and solvent from said extractor below said carrier.

2. In a system for solvent extraction, apparatus comprising in combination, an extractor having a casing, a horizontally rotating carrier in said casing having draining cells for said particles and a vapor space over a plurality of said cells, a vapor outlet in said extractor in communication with said vapor space, a condenser con-

ected to said vapor outlet and adapted to condense liquefiable vapors from said extractor, a conduit for returning condensate from said condenser to said extractor above said cells, a solids outlet in said extractor separate from said vapor outlet, a solids desolventizer vessel connected to said solids outlet and adapted to desolventize particles passing through said solids outlet after extraction, a conduit for returning net vapors evolved in said solids desolventizer to said extractor, and means for withdrawing liquid solution of extract from said extractor below said carrier.

3. In a system for solvent extraction, apparatus comprising in combination, an extractor having a casing, a horizontally rotating carrier in said casing having draining cells for said particles and a vapor space around said cells, said cells being spaced above the bottom of said extractor, a vapor outlet adjacent the top of said extractor, a condenser connected to said vapor outlet for condensing condensable portions of vapors passing from said extractor through said vapor outlet, miscella outlet means in said extractor below said carrier, means for separating substantially pure solvent in vapor form from the miscella passing from said extractor through said miscella outlet, a pipe for returning said substantially pure solvent vapor directly to said extractor, a solids outlet in said extractor, and means for desolventizing solids passing from said extractor, and means for returning at least part of the net vapors evolved in said last mentioned means to said extractor through said solids outlet.

4. In a sealed solvent extraction system for solid organic particles, apparatus comprising in combination, an extractor having a casing, a horizontally rotating carrier in said casing having draining cells for said particles and a vapor space around said cells, said cells being spaced above the bottom of said extractor, a vapor outlet adjacent the top of said extractor above said cells in communication with said vapor space, a condenser connected to said vapor outlet and substantially positioned above said vapor outlet to return at least some condensate to said cells, a vent connected to said condenser and adapted to vent non-condensable gases, a solids outlet adjacent the bottom of said extractor, a solids desolventizer vessel connected to said solids outlet and substantially positioned below said solids outlet, a liquids outlet adjacent the bottom of said extractor below said carrier, inclined conveying means for feeding said particles into said cells, said conveying means including a fluid-tight casing having an outlet and an inlet wholly below said outlet, and means for supplying liquid to said casing to fill it to a level below said outlet and maintain said inlet submerged, whereby a slurry of particles and liquid is formed in said conveying means to create a vapor seal and any leakage of solvent outwardly from said system through said casing is prevented.

5. In a system for solvent extraction, apparatus comprising in combination, an extractor having a casing, a horizontally rotating carrier in said casing having draining cells for said particles and a vapor space around said cells, said cells being spaced above the bottom of said extractor, a vapor outlet adjacent the top of said extractor, an extracted solution outlet adjacent the bottom of said extractor below said carrier, a solids outlet adjacent the bottom of said extractor, a condenser adapted to condense condensable portions of vapors passing from said extractor through said vapor outlet, a conduit connecting said condenser and said vapor outlet and adapted to return at least part of said condensable portions so condensed to said extractor, a drained solids desolventizer vessel adapted to receive solids from said extractor through said solids outlet and to return net evolved vapors from said desolventizer to said extractor, evaporating means connected to said extracted solution outlet and adapted to separate substantially pure solvent vapor from extract, and a vapor pipe connected to said last-men-

tioned means to return said substantially pure solvent vapor to said extractor.

6. In a solvent extraction system for solid organic particles, apparatus comprising in combination, an extractor having an outside casing, a movable carrier in said extractor spaced above the bottom thereof to support and drain said particles during movement thereof, a solids outlet in said extractor, a drained solids desolventizer vessel connected to said outlet, means for withdrawing net evolved vapors from said desolventizer, a liquids outlet in said extractor below said carrier, a miscella desolventizer connected to said miscella outlet, and means for returning solvent in vapor form from said miscella desolventizer to said extractor, whereby the temperature of said extractor may be maintained substantially at the solvent boiling point and the ratio of solvent vapor to water vapor in said extractor may be maintained favorable in the event of any condensation to the preferential condensation of solvent in the extractor.

7. In a system for solvent extraction, apparatus comprising in combination, an extractor having drainable cells rotatable about a vertical axis with radial partitions therebetween, a vapor outlet adjacent the top of said extractor, a liquids outlet adjacent the bottom of said extractor, a solids outlet adjacent the bottom of said extractor, a condenser adapted to condense condensable portions of vapors passing from said extractor through said vapor outlet, a conduit connecting said condenser and said vapor outlet and adapted to admit said vapors to said condenser and to return solvent from said condensable portions to said extractor, a decanting basin disposed in said conduit so as to permit overflow of solvent liquid into said conduit, a shield mounted in said conduit above said basin obstructing direct downward flow of condensed liquid through said conduit, said shield extending over said basin so as to direct condensed liquid into said basin, a drain connected to said basin, a funnel distributor positioned beneath the lower end of said conduit in said extractor, said distributor having a radially slotted opening in the bottom thereof relative the axis of said extractor, a solids desolventizer vessel adapted to receive solids from said extractor through said solids outlet, a conduit connecting said desolventizer and said solids outlet and adapted to pass said solids to said desolventizer by gravity flow and to return vapors from said desolventizer to said extractor, a liquids desolventizer connected to said liquids outlet and adapted to separate extract and solvent, and a conduit connecting said extractor and said liquids desolventizer and adapted to return solvent vapor to said extractor.

8. In a solvent extraction system for solid organic particles, apparatus comprising in combination, an extractor having draining cells rotatable about a vertical axis, a vapor outlet adjacent the top of said extractor, a liquids outlet adjacent the bottom of said extractor, a solids outlet in said extractor, a condenser adapted to condense condensable portions of vapors passing from said extractor through said vapor outlet, a conduit connecting said condenser and said vapor outlet and adapted to admit said vapors to said condenser and to return solvent from said condensable portions to said extractor, a decanting basin disposed in said conduit so as to permit overflow of solvent liquid into said conduit, a shield mounted in said conduit above said basin obstructing direct downward flow of condensed liquid through said conduit, said shield extending over said basin so as to direct condensed liquid into said basin, a drain connected to said basin, means for feeding solid organic particles to said extractor, said drain being connected adjacent said means to return the aqueous part of said condensed liquid to said particles, a solids desolventizer vessel adapted to receive solids directly from said extractor through said solids outlet and to return net evolved vapor from said desolventizer to said extractor, and means connected to said liquids outlet and adapted to separate substantially pure solvent vapor

from extract, and means to return said substantially pure solvent vapor to said extractor.

9. In a solvent extraction system for solid organic particles, the steps comprising in combination, moving a support on which solid organic particles rest their weight to carry them through a vapor space in a solvent extraction zone, supplying said particles with solvent and draining said particles during said carrying, removing and immediately condensing vapors from said zone, directly returning at least a portion of the resulting condensate to said zone, removing said particles from said zone after extraction, desolventizing said particles so removed in the presence of heat, directly returning evolved vapors from said desolventizing to said zone, removing extract solution from said zone below the level of said particles during said carrying, separating substantially pure solvent in vapor form from said solution, and returning said solvent in vapor form to said zone at least during the initiation of an extraction cycle.

10. In a system for the solvent extraction of solid organic particles, the steps comprising, in combination, moving a support on which solid organic particles rest their weight to carry them through a vapor space in a solvent extraction zone, repeatedly supplying said particles with liquid containing solvent during said carrying, draining off liquid below said particles respectively during said carrying, discharging said particles from said extraction zone, passing said particles into a solids desolventizing zone, evaporating liquid from said particles in said solids desolventizing zone, returning at least some of said evaporated liquid in vapor form to said vapor space in said extraction zone, and removing from said extraction zone liquid drained from said particles in said extraction zone, said removing being below the level of said particles during said carrying and occurring during said carrying.

11. In a system for the solvent extraction of solid organic particles, the steps comprising, in combination, moving a support on which solid organic particles rest their weight to carry them through a vapor space in a solvent extraction zone, repeatedly supplying said particles with solvent solution during said carrying, draining off solvent solution below said particles respectively during said carrying, discharging said particles from said extraction zone, passing said particles into a solids desolventizing zone, evaporating residual liquid from said particles in said solids desolventizing zone, returning at least some of said evaporated liquid in vapor form to said vapor space in said extraction zone, withdrawing solvent solution drained from said particles in said extraction zone below the level of said particles during said carrying, generating vapor from said last-mentioned solvent solution, and returning at least some of said last-mentioned vapor to said vapor space in said extraction zone.

12. In a system for the solvent extraction of solid organic particles, apparatus comprising, in combination, an extractor having a casing, said casing having a vapor space therein, movable carrier means within and spaced from said casing to support said particles within said vapor space and spaced away from said casing, means for feeding said particles onto said carrier means, means for supplying liquid to said particles carried by said carrier means, receiving means beneath said carrier means to receive and discharge liquid draining from said particles below the particles support level of said carrier means, a solids outlet for said particles, means for discharging said particles from said carrier into said solids outlet after said carrier means has moved to a predetermined extent, a solids desolventizer connected to said solids outlet to receive said discharged particles, and means for returning vapor from said solids desolventizer to the interior of said casing.

13. In a system for the solvent extraction of solid organic particles, apparatus comprising, in combination, an extractor having a casing, said casing having a vapor space therein, movable carrier means within and spaced from said casing to support said particles within said vapor space and spaced away from said casing, means for feeding said particles onto said carrier means, means for supplying liquid to said particles carried by said carrier means, receiving means beneath said carrier means to receive liquid draining from said particles, a solids outlet for said particles, means for discharging said particles from said carrier into said solids outlet after said carrier means has moved to a predetermined extent, means for relatively moving said carrier means between said means for feeding and said means for discharging, said particles and carrier means being substantially without movement relative to one another during movement together between the position of said means for feeding and the position of said means for discharging, a solids desolventizer connected to said solids outlet to receive said discharged particles, means for withdrawing liquid from said receiving means below the particles support level of said carrier means, means for evolving solvent vapor from said withdrawn liquid, and means for returning solvent vapor so evolved to the interior of said casing.

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