

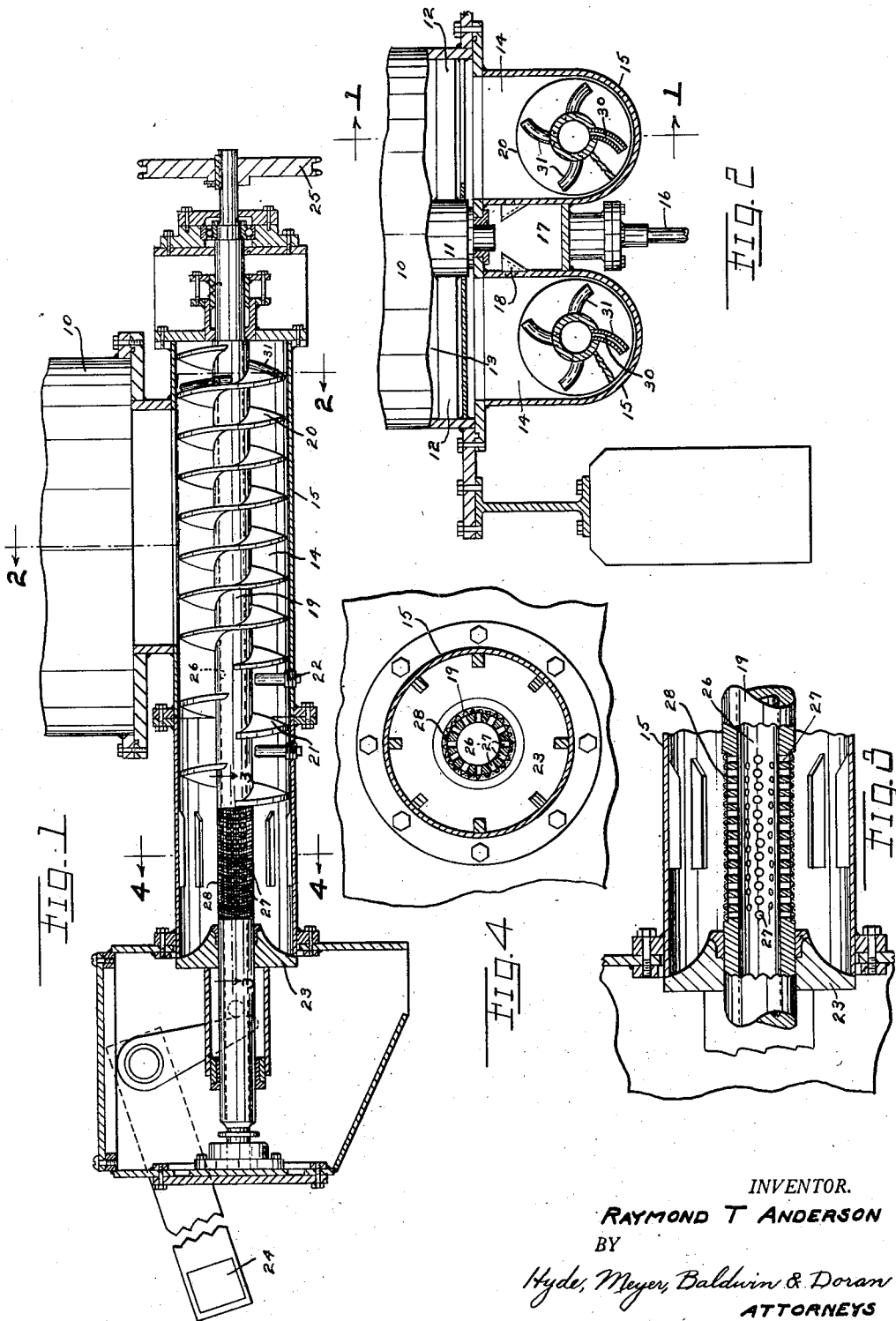
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PLUG DRAIN FOR SOLVENT EXTRACTION PLANTS

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PLUG DRAIN FOR SOLVENT EXTRACTION PLANTS

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This invention relates to solvent extraction method and apparatus, and more particularly to the circulation or flow of the solvent liquid employed therein. In one well-known form of such apparatus, commonly employed to separate oil from solid matter, such as from soybeans or other vegetable material, the solvent liquid, such as hexane, is caused to travel upwardly and the comminuted solid material downwardly in a tall tower, from the bottom of which the treated solid material is withdrawn by way of valve mechanism. Such withdrawn solid material unavoidably carries with it some of the solvent liquid.

One object of the present invention is to materially reduce the quantity of solvent liquid so withdrawn, thereby increasing efficiency of the system as a whole.

Another object is to provide improved valve mechanism controlling the withdrawal of the solid material and provided with means for draining off from the solid material at the moment when it is leaving the system, or a little earlier, a goodly share of any solvent liquid remaining with it, and returning such liquid to the extracting chamber, thus recovering the solvent liquid and causing it to perform its intended duty in the extraction process, and avoiding extra unnecessary cost for evaporation and condensation when the solvent goes out with the solid cake.

Still another object is to provide improved extraction apparatus in which the solid material is withdrawn by way of valve mechanism in the form of a rotatable pressure screw, the shaft of which is of conduit form and arranged to provide a return path to the extracting chamber for residual solvent liquid which otherwise might leave the system with the solid material.

Another object is to provide an improved method of circulating the solvent in such manner as to drain back or return continuously some liquid from the solid plug or cake to the main body of solvent liquid, thus reducing the load on the dryer and condenser and using less solvent per ton of solid material treated.

Finally, the invention has for its object to take advantage of the increase in pressure upon the solid material being treated as it moves from the extracting chamber to the outlet, thus to compel return travel of some of the residual liquid, for recovery and reuse thereof, and to increase the tendency of the liquid to return by the effect of rotation of the screw shaft in the outlet valve mechanism.

Further objects of the invention in part are obvious and in part will appear more in detail hereinafter.

In the drawings,

Fig. 1 represents a longitudinal sectional elevation, on the line 1—1, Fig. 2, through one form of apparatus embodying the invention;

Fig. 2 is a cross section on the line 2—2, Fig. 1; Fig. 3 is a detail section, on a larger scale, on the line 3—3, Fig. 1; and

Fig. 4 is a cross section on the line 4—4, Fig. 1.

In Figs. 1 and 2, 10 represents a tall cylindrical tower, only a portion of which is shown, to the upper portion of which the solid material to be treated, such as soybean fragments, is supplied for downward movement against a stream of solvent liquid (such as hexane) flowing upwardly to an overflow outlet (not shown) at or near the top of the tower. A slowly rotatable vertical shaft 11 carries stirring blades or vanes 12. Chamber 13 within the tower communicates with one or more bottom wells or cavities 14 (two being shown) within the imperforate tubular barrels 15 of outlet valve mechanism for the solid material. Solvent liquid is supplied by conduit 16 leading to a distributing chamber 17 beneath shaft 11 and communicating with the wells 14 by openings 18.

Within each barrel is a rotatable screw including a shaft 19, a continuous helical vane 20 thereon in the zone of the wells, and several individual or separate worm flights 21 beyond said vane, between which are the usual knives or stops 22 for preventing rotation en masse of the solid material. A yieldable conical choke valve 23 biased by weight 24 is located at the end of each tubular barrel 15. The two worm shafts are driven by power supplied to their end sprocket wheels 25.

In operation of the system so far described the slowly rising solvent extracts oil from the slowly descending solid material and leaves the top of the tower as miscella, which is heated to drive off the solvent by vaporization, condensation and ultimate recovery for reuse.

The solid material falls into the wells and is advanced by the screw against the yielding pressure of the choke cone, the pressure increasing as the material moves along until, in the zone just ahead of the cone, it is strong enough to pack or compress the material into a solid plug which serves to prevent the escape of free liquid. Thus, the screw mechanism, as a unit serves as a valve controlling, but permitting, discharge of the solid material. At the same time the discharged solid is not entirely free from solvent liquid, some going with it. Such escaping liquid performs no useful purpose in the process. It leaves the extracting tower before it has had time to absorb or extract any appreciable quantity of oil, and its recovery entails an extra unnecessary cost for steam heat in the evaporator or drier and for cooling in the condenser, all of which is materially reduced by preventing escape of solvent with the solid material.

To overcome these objections I take advantage of the rise in pressure upon the advancing plug

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of solid material, which I cause to compel a considerable or substantial portion of the contained liquid to drain away from the plug and return to the main solvent liquid bath in the tower, where it proceeds with the rising stream and delivers its load of oil to the primary solvent recovery portion of the system. This I accomplish by means now to be described.

Each screw shaft is made hollow throughout, or at least from a point a little ahead of the discharge cone to a point adjacent to or within the supply well into which the fresh solvent liquid is supplied and where the solid material is supplied to the worm for ejection from the system, thus providing a channel 26 for return of the solvent in the manner described.

At the choke end of this channel the shaft tube may be provided with a series of circumferentially distributed small holes 27, lying beneath a short brass sleeve 28 provided with a large number of narrow slits, said sleeve being firmly secured in place, as by soldering. The small holes and slits prevent solid fragments from entering the tube, but permit the passage of liquid. At the other end of channel 26 I provide several radial discharge holes 30 in the tube each communicating with an outwardly extending small tube 31 which may be curved, as shown, in a direction opposite to that of shaft rotation.

Pressure upon the solid material, and the liquid therein, adjacent the choke and in the zone of the sleeve 28, is materially higher than in the zone of tubes 31, at the wells. Consequently, a considerable portion of the liquid which otherwise would escape with the solid, flows into and through the hollow shaft and through tubes 31 joins the main bath of liquid in the tower. Since the shaft rotates at about 30 R. P. M., centrifugal force adds something to the tendency of the liquid to so travel.

The final result is to compel the extra solvent liquid, thus drained back, to perform its full share of the extracting task, without requiring extra expenditure for its recovery, or entailing extra cost in its loss.

Further advantages of the invention will be apparent to those skilled in the art.

What I claim is:

1. Solid material discharge mechanism for a solvent extraction apparatus having a chambered tower wherein a stream of solvent liquid is caused to rise in a chamber through a falling stream of solid particles and wherein the bottom wall of said tower is provided with an aperture through which said solid material is discharged, said discharge mechanism comprising an imperforate tubular barrel communicating at one end

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with said aperture, the other end of said barrel being provided with choke means yieldably biased towards closed position, a rotatable shaft extending axially within and through said barrel, worm flights fixed on said shaft and arranged to impel through said barrel solid material dropping through said aperture into the receiving end of said barrel, and to increasingly compact and discharge material past said choke means whenever the material-impelling force arising from screw pressure exceeds the choke-closing bias, a portion of said shaft being provided with a longitudinal bore extending from a point adjacent the material discharge end of said barrel to a point adjacent the material-receiving end of said barrel, the wall surrounding said shaft bore adjacent said barrel discharge end being provided with liquid inlet means to permit entry into said bore of liquid expressed from the compacted material adjacent said choke means, the wall surrounding said shaft bore adjacent the material-receiving end of said barrel being provided with a series of peripherally spaced holes, a length of tube communicating with each hole and extending outwardly into said barrel to permit expressed liquid in said bore to return to said barrel.

2. Apparatus as defined in claim 1 wherein each said length of tube extending into said barrel is curved in a direction opposite to the direction of shaft rotation.

3. Apparatus as defined in claim 1 wherein the liquid inlet means in the wall of said shaft bore adjacent the barrel discharge end has a portion provided with a plurality of circumferentially distributed apertures, and a tubular sleeve surrounding said shaft radially outwardly from said apertured portion, said sleeve having therethrough a plurality of slits in liquid flow communication with said last named apertures whereby to prevent solid matter from entering said bore.

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