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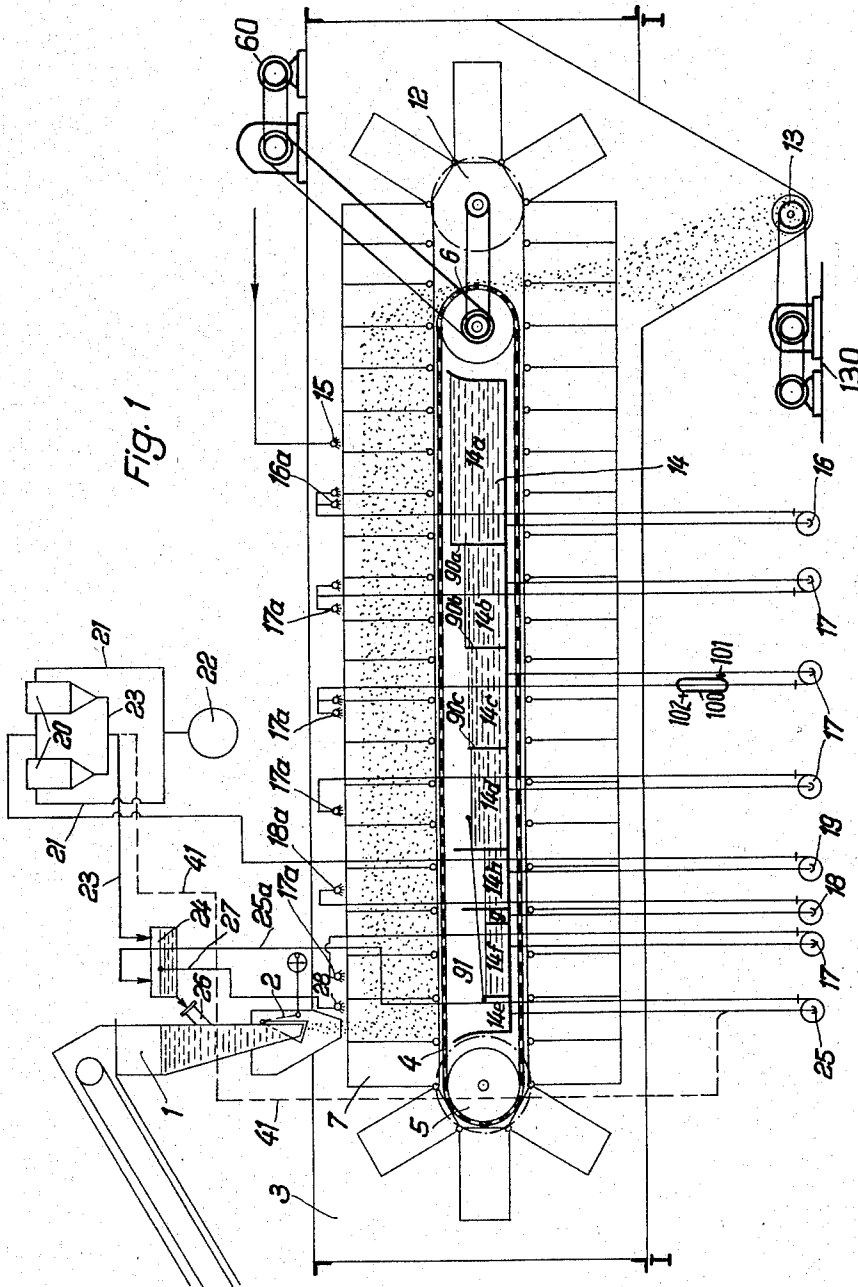
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2,907,640

SOLVENT EXTRACTION APPARATUS

Filed June 10, 1954

7 Sheets-Sheet 1



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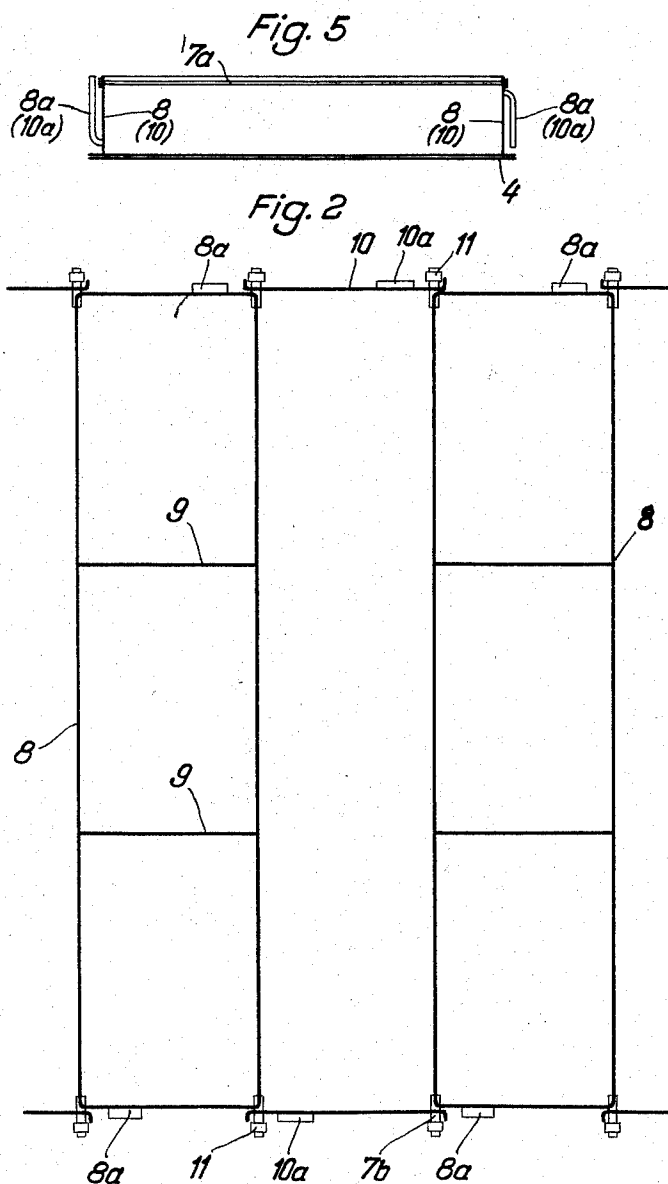
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SOLVENT EXTRACTION APPARATUS

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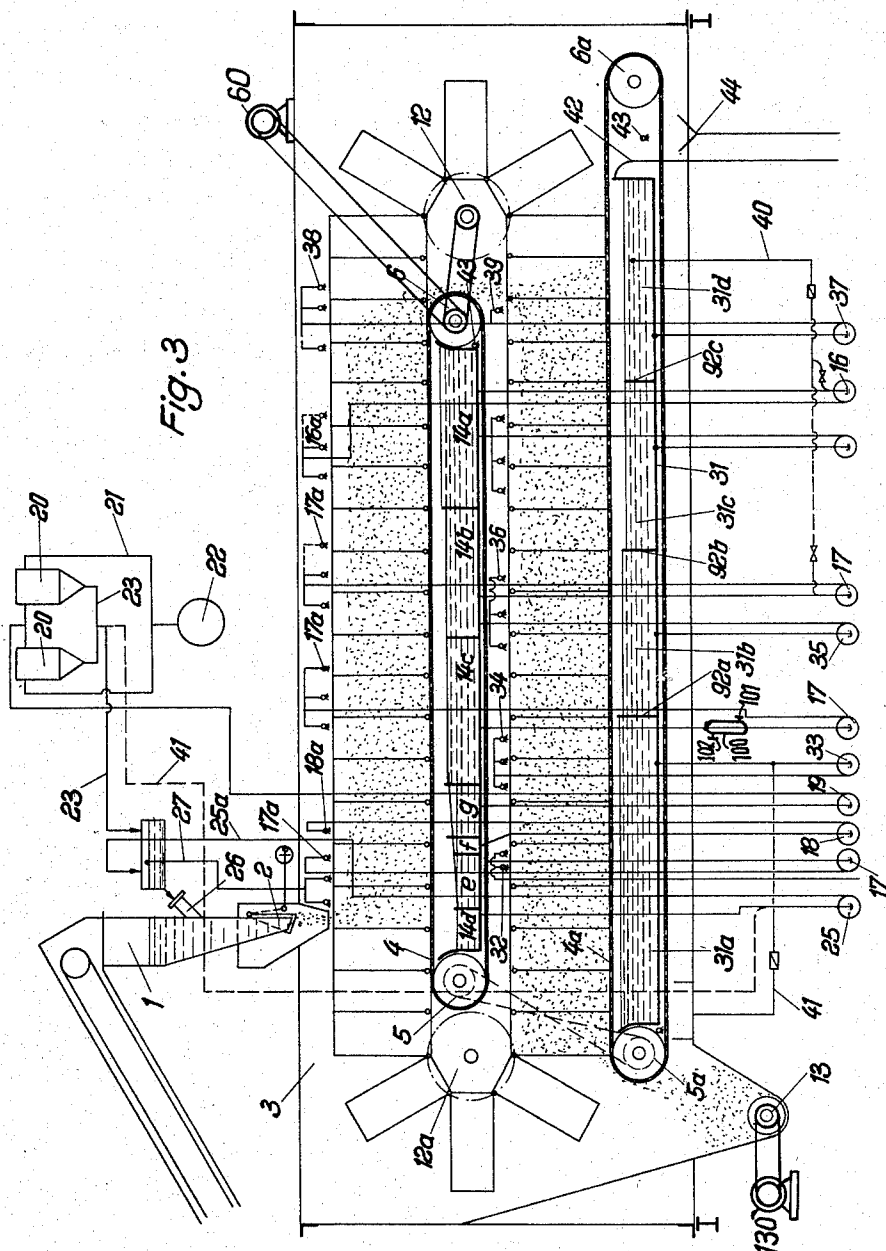
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SOLVENT EXTRACTION APPARATUS

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7 Sheets-Sheet 3



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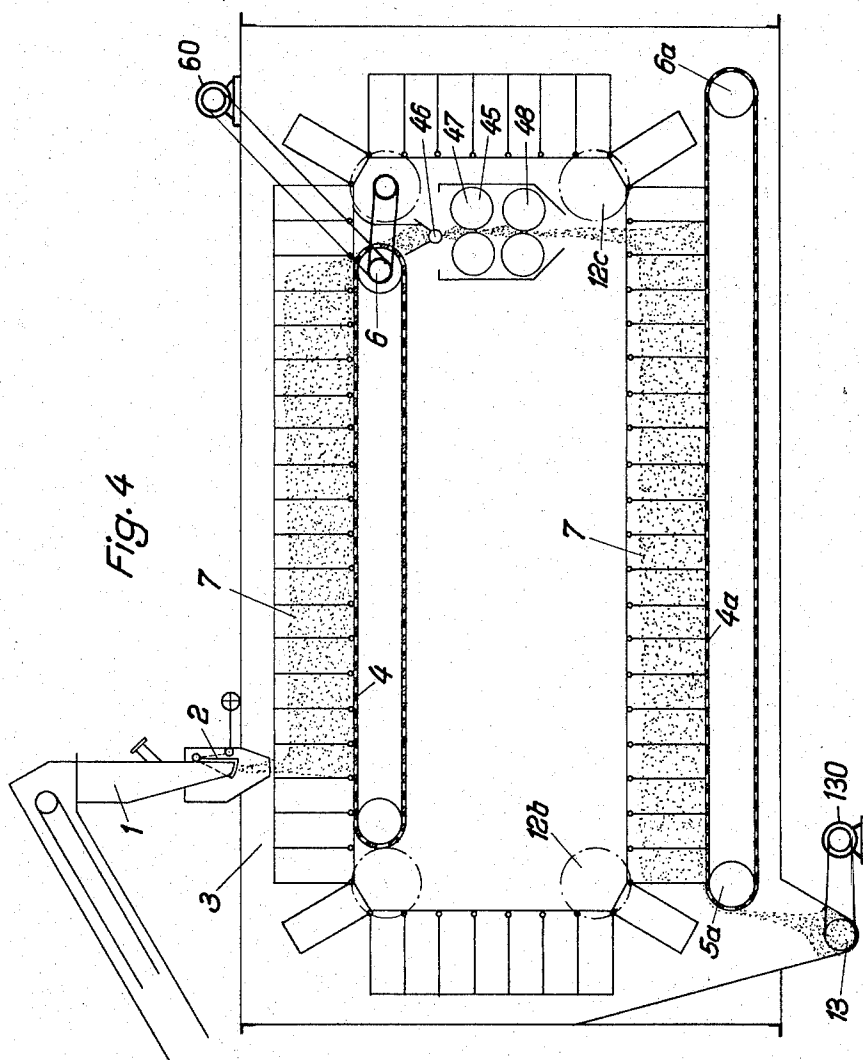
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SOLVENT EXTRACTION APPARATUS

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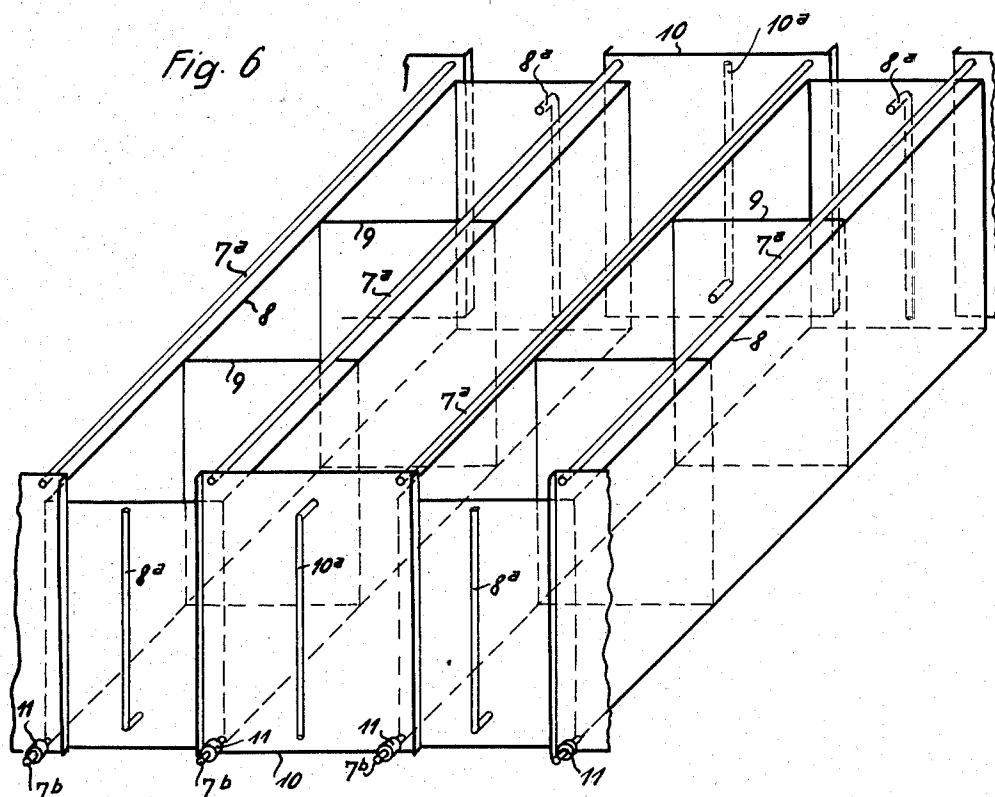
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SOLVENT EXTRACTION APPARATUS

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SOLVENT EXTRACTION APPARATUS

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Fig. 7

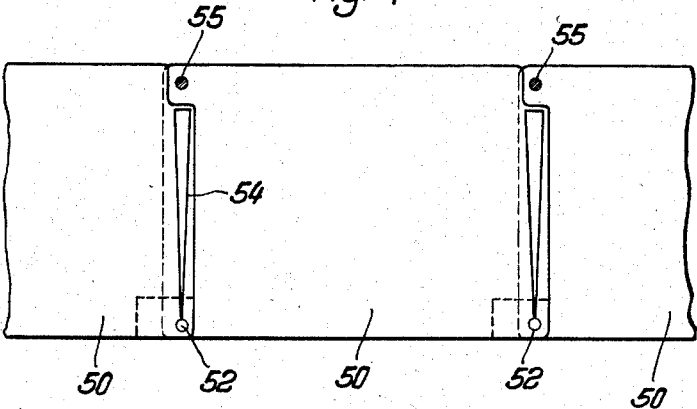
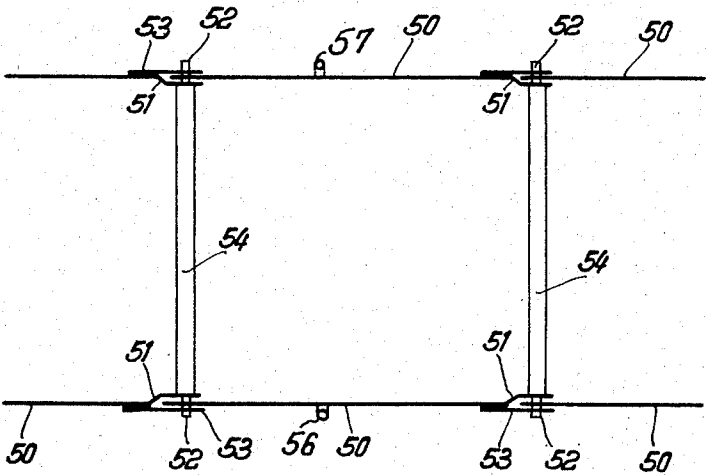


Fig. 8



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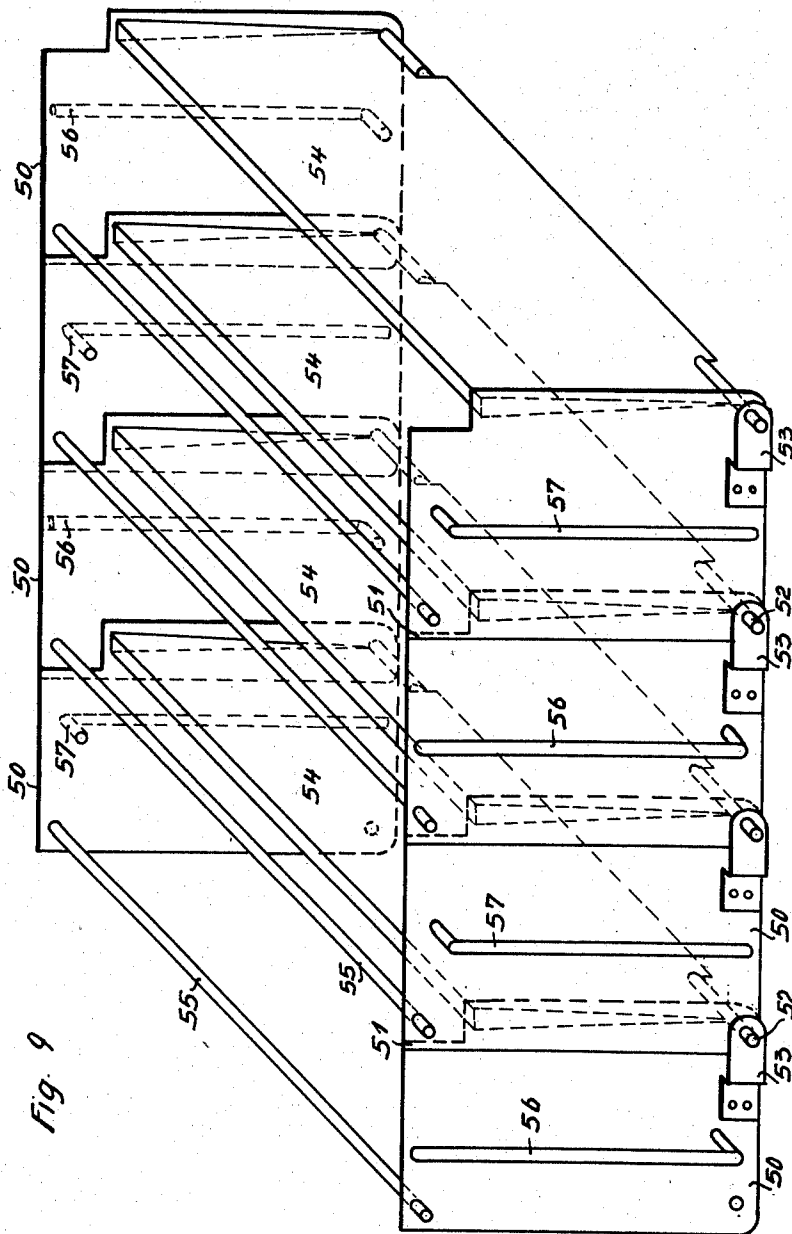
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SOLVENT EXTRACTION APPARATUS

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7 Sheets-Sheet 7



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2,907,640

SOLVENT EXTRACTION APPARATUS

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Claims priority, application Germany August 6, 1953

19 Claims. (Cl. 23—270)

This invention relates to improvements in solvent extraction. It more particularly relates to an improved extraction apparatus and a method for operating the same.

Solvent extraction is used for the recovery of valuable components from solids. Thus, for example, components such as oils, waxes, resins, or chemicals, as, for example, nicotine, caffeine, theobromine and the like are recovered from solid materials which are preferably in crushed form, as, for example, from oil seeds, coffee, cocoa shells, cinchona bark, coals, tobacco, and the like by continuous extraction with suitable solvents.

In accordance with conventional methods of operation for this solvent extraction, the solvent was passed in counter-current flow contact through the material from which the components were to be extracted. For this purpose horizontal extractors were frequently used through which the material was conveyed by means of a screen belt provided on both sides with fixed walls. A number of collector tanks were arranged closely side by side below the belt. The solvent was fed to the material from above, as, for example, through sprinklers, and flowed through the material in a downward direction. After passing through the material and the belt the solvent passed into the collector tanks. The tanks were arranged in such a manner that the solvent could flow in a direction opposite to that of the belt movement from one collector tank to the next, so that the most highly concentrated solution could be withdrawn from the first tank positioned below the device used for charging the belt with the material to be extracted. The solvent used for extraction was recycled from each of the collector tanks by means of a pump to a portion of the screen belt directly thereabove.

Extraction devices are also known in which the screen belt is replaced by an endless chain of tiltable containers provided with liquid-permeable bottoms, such as perforated bottoms, and which, in all other respects, operate in a manner similar to that described above.

The known extractors utilizing the screen belt may be charged with and emptied of the material continuously. These extractors have the disadvantage, however, in that there is no possibility of preventing solvent from flowing in a horizontal direction. In addition, it is not possible to free the material at any point of its passage through the extractor from the solvent by draining and then to treat it with fresh solvent of a different oil content which is of importance in accelerating the extraction. Although the known extractors provided with an endless chain of containers may be so drained and treated with fresh solvent during the passage through the extractor, the same have the disadvantage that the containers must be charged in a discontinuous manner in order to prevent the material from falling through a gap between the containers into the collector tanks for the solvent therebelow. In addition, the solvent fed from above

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to the chain of containers often runs unused between the individual containers into the collector tanks.

One object of this invention is an extractor which may be charged and emptied continuously and which will allow an intermediate draining of the solvent from the material during the extraction.

A further object of this invention is an extractor which will combine the advantages of the known extractors operating with a screen belt and with a chain of containers while at the same time avoiding the disadvantages of these two types of extractors. These, and still further objects will become apparent from the following description read in conjunction with the drawings, in which:

Fig. 1 is a diagrammatic vertical section of an embodiment of an extractor in accordance with the invention;

Fig. 2 is a diagrammatic plan view of a section of the chain of frames in the extractor shown in Fig. 1;

Fig. 3 is a diagrammatic vertical section of a further embodiment of the extractor in accordance with the invention;

Fig. 4 is a vertical section of still a further embodiment of an extractor in accordance with the invention;

Fig. 5 is a diagrammatic front elevation of a portion of the frame shown in Fig. 2;

Fig. 6 is a perspective view of a portion of the chain of frames as shown in Figs. 2 and 5;

Fig. 7 is a diagrammatic partial side elevation of a further embodiment of a chain of frames in accordance with the invention;

Fig. 8 is a diagrammatic plan view of Fig. 7; and

Fig. 9 is a diagrammatic perspective view of a portion of a chain of frames as shown in Figs. 7 and 8.

In accordance with the invention, an extractor is provided with a rotatable liquid-permeable belt having a substantially horizontal upper portion. Means such as an endless chain of frames is provided to subdivide the belt at substantially right angles to the direction of movement thereof and to provide side walls for the belt. Means are provided for feeding material to be extracted on to one end of the horizontal portion for the travel therealong and further means are provided for the passing of solvent onto and through the material and belt.

In the embodiment as shown in Fig. 1, the extractor 3 is provided with a charging bin 1 and a control device therefor 2. The material to be extracted is fed into the charging bin in any known manner, as, for example, on the endless conveyor belt shown, and passes downward from this bin into the extractor. The rate of flow is controlled by the device 2, which, for example, varies the cross-sectional discharge opening from the charging bin. Positioned within the extractor 3 is an endless horizontal screen belt 4 which rotates about the drive drum 6 and idler drum 5.

The endless chain of frames 7 extends about the endless screen belt 4. The endless chain of frames is rotated at one end about the idler drums 5, which is also the idler for the belt 4. At the other end, the chain of frames 7 extends about the drive drum 12, which is spaced at a further distance from the idler drum 5 than the drive drum 6. In this manner the chain of frames extends in its lengthwise direction beyond the reversing point 6 of the belt 4, so that the extracted material is carried by the chain of frames beyond the end of the screen belt and can fall down behind the drive drum 6 into the discharging device 13 driven by the adjustable drive 130.

The drive roller 6 is driven by means of the adjustable drive 60. The drive to roller 12 is connected to the drive roller 6 for rotation at the same speed. Since both the chain of frames 7 and the belt 4 move at the same speed along the upper surface, they form in effect a con-

tainer unit with a permeable bottom, the sides of the frames 7 forming the container sides and the belt 4 forming the permeable container bottom. Since, however, the belt 4 is continuous and moves at a substantially constant rate, the charging with the material through the charging bin 1 and device 2 may be effected at a continuous rate and the discharge over the drum 6 into the device 13 may also be effected at a continuous rate. The chain of frames may be constructed in accordance with the embodiment illustrated in Figs. 2, 5, and 6. A multiple number of rectangular frames 8 are flexibly linked in the form of an endless chain by means of the connecting partitions 10. The distance between the two long walls of a frame is approximately equal to the length of the partition 10, so that, in addition to the frame segments formed by the frames themselves, a third frame is formed between each two frames which are spaced apart and connected by the partitions 10. The partitions 10 are connected to the short walls of the frames which extend in the direction of the belt 4 at the lower portion thereof by means of the pins 7b and are pivoted about these pins. The alternate short walls and partitions 10 may be linked to the links of a chain pivotally connected to each other around the pivots 7b. The pivots 7b are substantially adjacent to the upper surface of the screen belt 4, on which the chain of frames rests on its upper horizontal passage through the extractor. The partitions 10 are maintained in position by means of the spacing bolts 7a, which connect opposed-position partitions 10 at their upper edges. The long walls 8 of the frames, which extend transverse to the direction of motion of the chain of frames, and the screen belt 4 are connected to each other by means of the stiffeners 9. The rollers 11 serve to support the lower end of the chain of frames. Overflows, such as the overflow pipes 8a and 10a, are provided in the frames 8 and partitions 10. The overflows are approximately of the same height as the frames 8 or partitions 10 and two such overflow pipes are preferably arranged in each frame 8 and on each opposed pair of partitions 10 in such a manner that the outlet openings on opposed sides are positioned at the upper and lower edges, respectively, of the frames or partitions, as the case may be. Thus, the overflow pipes 8a or 10a on the right- and left-hand sides, are so positioned that liquid will overflow therethrough at approximately the same liquid level, when the frame is in the position shown or inverted. The liquid will overflow through the pipe 8a on the left-hand side when the frame is in an inverted position, as, for example, on its lower horizontal run, as shown in Figs. 3 and 4.

In order to prevent the remaining liquid from flowing out through the upwardly directed pipe, the two pipes are so positioned that the free opening of the pipe, which, depending on the position of the frames, is positioned in an upward direction and is higher than the opening defined through the side partition 10 leading to the other downwardly directed overflow pipe. Thus, the free end of the overflow pipe 10a extends past the horizontal plane of the opening of the pipe 8a through the partition 10, and vice versa.

Another constructional embodiment of the chain of frames 7 is illustrated in Figs. 7, 8, and 9. In this embodiment the chain of frames consists of the sheets 50, which are offset at 51. The consecutive sheets are connected to each other by the pins 52, which extend through the plates 53 arranged at the partitions 50 before they are bent, and through the bent part of the adjoining partition 50. Through the fixing of the pins, the connection and the flexibility in the chain of frames is simultaneously achieved. The higher sections of opposed partitions 50 are fixed at their upper portion by the spacing bolts 55. The opposed shorter offset portions are connected by the wedge-shaped partition walls 54, which taper in a downward direction. By virtue of this arrangement, the material will fall more easily from the chain of frames

when the screen bottom is reversed. If the chain of frames on the lower portion of its horizontal run is also used for the extraction, as shown in Figs. 3 and 4, then, in spite of the tapering of the partition walls, the material will not be impeded from falling out of the lower portion of the chain of frames, since, due to the inversion of this chain, which takes place near the discharge point, the distances between the upper edges of the partition walls are increased.

As may be seen from these embodiments, the chain of frames is provided with partition walls positioned at right angles to the direction of movement of the chain and of the screen belt. The distance between these partition walls may be relatively small. This is of particular advantage when operation is effected in such a manner that the solvent or the solution of substance to be extracted is fed at several consecutive points to the surface of the material moved along with the screen belt and chain of frames and the liquid is allowed to drain from the material between two feed points. The distances of the partition walls from each other are preferably arranged in accordance with the time which the solution requires for its passage through the layer of material to be extracted. Thus, for example, if this time is two minutes, then the distance is preferably made equal to the distance traversed by the chain of frames in two minutes. In operating in this manner, the depth of the layer of the material suitably is such, that, with one or several passages through the layer, the extracted content, of, for example, oil in the solution attains a state of equilibrium, i.e., the solution leaving the layer has reached its maximum content of material to be extracted in accordance with the content of the material to be extracted in the treated material. In this manner, a particularly excellent extraction performance is achieved.

The chain of frames rests on the upper horizontal portion of screen belt 4. The material fed from the charging device to the chain of frames is deposited on the screen belt 4, moves along the horizontal run of the screen belt confined within the partitions of the frames and falls behind the drum 12 and in front of the drum 6 into the discharge device 13, where it is removed for further treatment. Beneath the upper horizontal run of the screen belt 4, a collecting tank 14 is positioned. This tank is subdivided into a multiple number of compartments, i.e., 14a through 14h. Fresh solvent is supplied to the material through the sprinkler 15 or similar distributing device, and passes through the material to the compartment 14a of the collecting tank. The solvent is recycled from this compartment 14a to the sprinklers 16a by means of the pump 16, and again runs down through the material into the compartment 14a. From the compartment 14a of the collecting tank, the solvent solution flows over the partition wall or overflow weir 90a into the compartment 14b in quantities corresponding to the supply of solvent through the sprinkler 15. The solution is circulated through the material to be extracted from 14b by means of the pump 17 and sprinkler 17a. The same operation is repeated with respect to the compartments 14c and 14d, the solvent solution overflowing from 14d to 14c and from 14c to 14d. As may be seen, the solvent in its passage from 14a through 14d and circulation and recirculation through the material over these collector tank sections or compartments is passed in countercurrent flow to the direction of movement of the material and the solvent becomes more and more enriched with the oil or fat or similar material being extracted.

Should it prove necessary to heat the extraction product of the oil solution, in order, for example, to reduce the viscosity, or to effect the extraction at higher temperatures, the heater 100 in the form of a heat exchanger, may be used. Heating media may be passed into the inlet 101 and out through the outlet 102 to effect this heating. It is also possible to use electric heating devices or the

like positioned in the oil solution circuit or in several of these circuits. In a similar manner the solution may be cooled with the use of suitable coolers as, for example, by passing cooling media through the inlet 101 and out through the outlet 102.

The collector tank compartments 14e, 14f, 14g, and 14h constitute the parallel flow section of the extraction device, which is arranged near the charging device for the material. This section of the extraction is considerably shorter than the counter-current section and is similarly provided with a suitable number of distributors and feeding devices for the solvent. In this section the extracting is conducted in the same direction as the material to be extracted. The solvent solution is drawn off from the compartment of the collecting tank in the parallel flow section which adjoins the counter-current section. If desired, the oil solution may again be fed to the material, and preferably to the drained material on a frame section, whereupon, after passing through the material, the solvent solution leaves the extractor. Thus, from the compartment 14d, the solution flows down the flow plate 91 to the compartment section 14e. In the section 14e the same circulation of the liquid takes place as in 14a to 14d. From 14e, however, the excess solution flows parallel to the direction of the moving material into compartment 14f, where again the recycling circulation is repeated.

The solution then passes from the compartment 14f overflowing into the compartment 14g. The solvent is pumped by the pump 18 from the compartment 14g to the spray nozzle 18. It passes through the material below the spray nozzle 18a and drains into compartment 14h. The material being conveyed above the compartment 14h has been substantially drained of solvent, due to the spacing between the spray 17a and 18a. The passage of the solvent through the drained material into compartment 14h serves for the filtration of the solvent. The proper spacing of the spray nozzles for allowing the solvent to drain from the material to a greater or lesser extent, allows, for example, treatment with solvent in the counter-current section, which has a smaller concentration, and in the parallel flow section approximately the same concentration of oils, fats, or similar extracted substances.

The solvent is pumped by means of the pump 19 from the compartment 14h by means of pump 19 to the filters 20 for fine filtration. The filtered solution flows through the conduit 21 from the filters 20 into the storage tank 22, where it is treated in the known manner. A stream of liquid, such as turbid liquid, as, for example, obtained from filters 20, designed in the manner described in German Patent No. 825,789, is passed through the conduit 23 into the vessel 24. The liquid may also flow through the conduit 41 to the pump 25, by means of which it is circulated through the conduit 25a with the solvent from the compartment 14e to the vessel 24. The solvent flows from the vessel 24 through the pipe 26 into the charging bin 1 for moistening the material contained therein. This has the advantage that on charging the material clogging of the screen belt by particles of the material to be extracted is avoided; that each framed segment is utilized to its maximum capacity; that a better flow of solution is obtained; and that immediately at the commencement of the extraction; the optimum conditions for the extraction are obtained. The excess of the solvent in the container 24 overflows through the line 27 to the sprinkler head 28, where it is passed on to the material initially being charged into the extraction device.

The distance between the individual sprinkler heads, as, for example, the heads 17a, is preferably so arranged that the solvent draining from the material in each framed segment substantially drains back into the compartment below the particular spray head or groups of spray heads. This renders it impossible for the solution draining from the material into the zone of one charging device to

become mixed with the solvent coming from the adjoining charging devices and having different concentrations of dissolved material.

It is also possible in accordance with the invention to utilize the return passage of the chain frames for the extraction by arranging beneath the returning end of the chain of frames a second endless screen belt, on which the chain of frames rests on its return. The lowest screen belt may be equipped similarly and operated in the same manner as the upper belt. It is, however, also possible to only partially extract the material on the upper screen belt and to further treat it on the lower screen belt. Such an embodiment is illustrated, for example, in Fig. 3. In accordance with this embodiment, a lower screen belt 4a is provided. This screen belt rotates about the drive drum 5a and idler drum 6a.

The two screen belts 4 and 4a carry the chain of frames 7, which may be designed in the same manner as described with reference to Figs. 1, 2, 5, or 6 and 7. Beneath the top portion of the lower screen belt 4 a further collecting tank 30a is provided, which is subdivided into the compartments 31a, 31b, 31c, 31d. The material which is fed to the upper part of the screen belt 4 and filled into the upper part of the chain of frames 7, is carried along by the screen belt and chain of frames in the same manner as described in connection with Fig. 1. As the material falls between the drive drums 6 and 12, it passes onto the upper portion of the lower screen belt 4a, which extends past the drive drums 12. As the material falls on the upper horizontal surface of the lower screen belt 4a, it is filled into the lower portion of the chain of frames 7, which passes along the top of and with the lower screen belt 4a. The material will be discharged over the drive roller 5a after passage along the top of the belt 4a in the direction reverse to that of its passage over the belt 4. The material falls into the discharge device 13 driven by drive 130 and may be removed therefrom and treated in the conventional manner. The drive drum 5a, of course, rotates in an opposite direction to that of the drive drum 5.

As the material passes across the lower screen belt 4a, fresh solvent is distributed over the material by means of the sprinklers 32, flows through the material to the compartment 31a, and is recycled again to the material by means of the pump 33 and sprinklers 34. After passing through the material, the solvent returns again to the compartment 31a. The excess of solvent, the quantity of which approximately corresponds to the quantity of fresh solvent supplied by the sprinklers 32, flows from the compartment 31 over the partition wall 92a into the compartment 31b, from which it is pumped by means of the pump 35 and sprinkler 36 back through the material moving above the compartment 31b. The excess of the solvent flows over the partition wall 92b into the compartment 31c and is circulated into the material and overflow to the subsequent compartments in the identical manner.

From the last compartment 31d, the solution is pumped by means of the pump 37 and sprinkler 38 to the material which is being passed from the upper to the lower screen belt. A further sprinkler 39 is also provided in order to spray the material falling into the chain of frames, as it passes on its lower horizontal run over the belt 4a. The excess of the solvent from the last compartment 31d with the lower extraction which may, for example, have a larger or smaller number of compartments than those illustrated, is removed by means of the overflow line 40 to the pumps 16 or 17, and thereafter, by means of the sprinklers 16a and/or 17a, is sprayed on the material which is passing along on the upper screen belt 4. The extraction on the upper screen belt 4 in all other respects is similar to that described with reference to Fig. 1. The collecting tank compartment 31d is provided with an overflow 42, in order to provide a run-off in case of breakdown of the conveyor devices.

The sprinklers 43 are provided for cleaning the screen

belts 4 and 4a and a receiver 44 is provided for returning the solvent used for this cleaning of the lower belt 4a to the circuit.

The embodiment as illustrated in Fig. 4 is similar to that as illustrated in Fig. 3, except that a greater vertical distance is provided between the upper screen belt 4 and the lower screen belt 4a. In order to provide for this vertical displacement, the idler drums 12b and 12c are provided, around which the chain of frames 7 additionally revolves. The chain of frames 7 will thus revolve in a substantially rectangular path. Between the upper screen belt 4 and the lower screen belt 4a the crushing unit 45 is provided. The material being treated is continuously fed from the collector bin 1 by means of the discharging device 2 to the screen belt 4 and the chain of frames 7 exactly in the manner described in connection with Figs. 1 and 3. Upon reaching the reversing point defined by the drive drum 6 of the upper screen belt 4, the material falls into the crushing unit 45. In the crushing unit it is fed from the charging device 46 to the crushing rollers 47, which may, for example, be designed as fluted rolls. These rolls subject the material to a preliminary crushing. Thereafter the material passes through the smooth surfaced pair of rolls 48, which subject the material to a fine crushing, and thereafter the material falls onto the lower screen belt 4a in the identical manner as described with reference to Fig. 3. The solvent circulating system has been omitted in Fig. 4 for the sake of clarity, and may, for example, be identical to that shown in Fig. 3.

The extractor in accordance with the invention may also be devised and operated with different features from those illustrated. For example, the same may be designed only for counter-current extraction, and may be provided with other conventional devices for charging and discharging.

The advantageous effect of the partition walls in accordance with the invention may be obtained in connection with other extraction devices, in which the material is passed through the extractor on an endless belt between side walls. The partition walls are, for example, applicable for the same advantage in extraction equipment in which only the belt revolves, while the side walls which keep the material on the belt are stationary. In this connection the framed segment along the horizontal portion of the belt is formed by the stationary side walls of the belt and the movable transverse partitions, which may, for example, operate in the manner of a flight of scrapers, etc. The transverse partition walls may, for example, also be attached to the belt and revolve with it. The framed segments may also be defined in accordance with the invention by side walls which are firmly attached to the revolving endless belt and by partition walls which are attached either to the belt or side walls. By transverse partition walls there are meant partition walls which, in conjunction with the side walls, define the framed segments and which extend across the endless belt substantially transverse to the direction of motion thereof. These transverse partition walls should preferably be spaced from each other at a distance of about 0.9 or 1.1 to about 1.5 times the distance the same will travel with the endless belt during the time the solvent will pass from the surface of the material to the bottom of the layer of the material being treated.

I claim:

1. An extraction apparatus comprising a revolvably mounted substantially liquid-permeable endless belt having a substantially horizontally extending portion, a separate chain of upright, open-bottomed, box-like frames movable along with said horizontally extending portion of said belt subdividing the same into framed flexibly linked segments, means for passing a solid material on to one end of said horizontally extending portion of said belt for movement therealong, means for removing solid material coming off the other end of said horizontally extending portion of said belt, means for passing solvent in

contact with material passing along said horizontally extending portion of said belt means for collecting at least a portion of the solvent after the contacting and means for recycling the same in contact with material passing along said horizontally extending portion of the belt, means for revolving said belt and means for revolving said chain of frames at substantially the same velocity as said endless belt.

2. Extraction apparatus according to claim 1, in which said endless belt is revolvable about a pair of substantially parallel horizontally spaced apart rollers, and in which said separate chain of frames is an endless chain of frames revolvable about a pair of substantially parallel rollers horizontally spaced apart at a greater distance than the rollers of said endless belt and positioned so that the portion of said chain of frames extending above and along said horizontally extending portion of said belt extends past said belt in the direction of movement thereof.

3. Extraction apparatus according to claim 2, in which a single roller constitutes one of the rollers for each said pair of rollers.

4. Extraction apparatus according to claim 1, including a second revolvably mounted substantially liquid-permeable endless belt having a substantially horizontally extending portion positioned below said first belt and extending past said first belt in the direction of motion thereof, and means for revolving said second belt in a reverse direction with respect to said first belt, in which said separate chain of frames, comprises a revolvably mounted endless chain of open-bottomed frames having the upper portion thereof extending along past said substantially horizontally extending portion of said first belt, and reversing around at least one roller and returning with its bottom portion extending along the substantially horizontally extending portion of said second belt, means for revolving said endless chain of frames at substantially the same velocity as said first belt, means for passing liquid into contact with material being passed along the substantially horizontally extending portion of said second belt, and in which said means for removing material is means for removing material coming off said second belt after falling thereon from said first belt and travelling therealong.

5. Extraction apparatus according to claim 4, including means for crushing material passing from said first belt to said second belt.

6. Apparatus according to claim 1, including a collector tank positioned beneath said substantially horizontally extending portion of said belt, and partition means subdividing said collector tank into a multiple number of compartments, said partition means being so dimensioned with predetermined varying heights that liquid can overflow from one compartment to the next in a direction opposite the direction of movement of said substantially horizontally extending portion of said belt through at least a portion of said compartments.

7. Extraction apparatus according to claim 6, in which said means for contacting the material with solvent comprises means for spraying solvent over material passing above the last compartment in the direction of movement of the substantially horizontally extending portion of the belt, and means for circulating liquid from each compartment to material passing thereabove.

8. Extraction apparatus according to claim 7, in which said means for circulating the liquid includes a pump for pumping the liquid from the compartment to at least one sprinkler nozzle positioned above the compartment.

9. Apparatus according to claim 8, in which the sprinkler nozzles above each compartment are spaced from the sprinkler nozzles above the next adjacent compartment.

10. Extraction apparatus according to claim 9, in which said collector tank is divided into a multiple number of compartments by partition means, which decrease in height in a direction opposite to the direction of motion

of the belt along said substantially horizontally extending portion over a portion of the length of said collector tank to define therein a counter-current overflow section and thereafter increase in height over the remainder of said collector tank to define a parallel flow section, and including means for overflowing liquid from the last compartment of said counter-current overflow section to the first compartment of said parallel flow section.

11. Extraction apparatus according to claim 10, including means for removing liquid from the last compartment of said parallel flow section, filtering the removed liquid, recycling a portion thereof to moisten the material being passed on to said horizontally extending portion of said belt, and recycling the excess material above the first compartment of said parallel flow section.

12. Extraction apparatus according to claim 1, including means defining an overflow pipe through each framed segment.

13. Extraction apparatus according to claim 1, including means for moistening material with solvent prior to being passed on said belt.

14. Extraction apparatus according to claim 1, in which said separate chain of frames is a revolvable endless chain of open-bottomed frames extending above, along and past said substantially horizontally extending portion of said belt, means for revolving said chain of frames in the same direction and at substantially the same velocity as said belt, and means defining overflows through the opposed side walls of each frame, the overflow at one side being defined at the upper portion of the frame and opposite thereto at the lower portion of the frame.

15. Extraction apparatus according to claim 1, in which said separate chain of frames is a revolvable endless chain of frames extending above, along and past said substantially horizontally extending portion of said belt, means for revolving said chain of frames in the same direction and at substantially the same velocity as said

belt, the transverse walls of the frames of said chain of frames being defined by wedge-shaped partition walls tapering in an inward direction.

16. Extraction apparatus according to claim 1, in which said separate chain of frames is a revolvable endless chain of frames extending above, along and past said substantially horizontally extending portion of said belt, means for revolving said chain of frames in the same direction and at substantially the same velocity as said belt, the frames of said chain of frames being defined by separate rectangular frame segments spaced apart from each other at a distance substantially equal to their width in the direction of said belt, said rectangular frame segments being flexibly connected together with side partitions to thereby define an additional frame between each frame segment.

17. Extraction apparatus according to claim 16, in which the partition walls of the frame segments are connected to each other with stiffening means.

18. Extraction apparatus according to claim 16, in which the partitions connecting the frame segments are pivotally connected thereto by pins.

19. Extraction apparatus according to claim 1, in which the upper ends of said partitions opposed to said pins are connected by spacing rods.

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