June 24, 1969 M. E. GINAVEN 3,451,555

DEWATERING DEVICE

Filed April 12, 1967

FIG-1

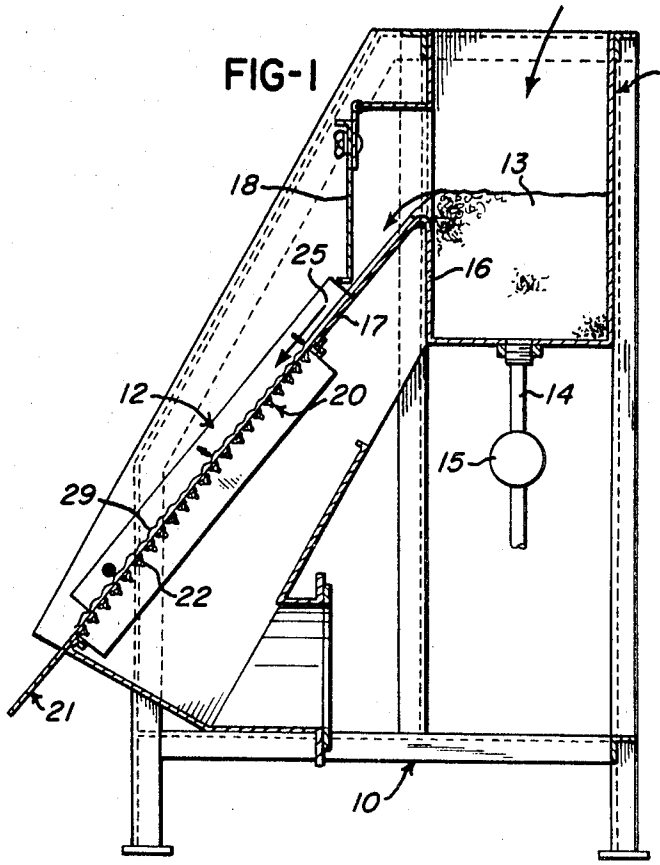


FIG-2

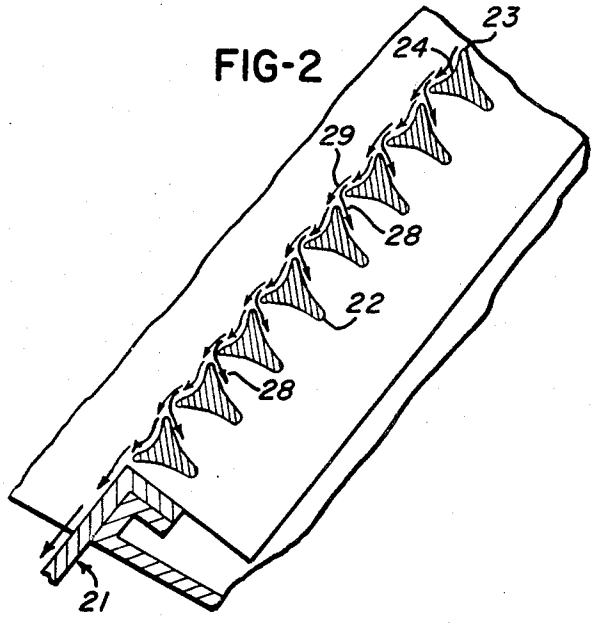
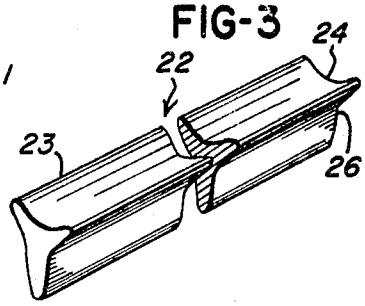


FIG-3



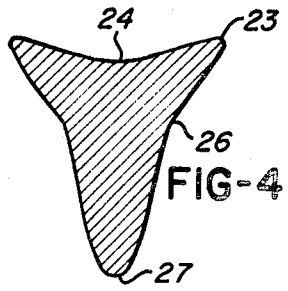


FIG-4

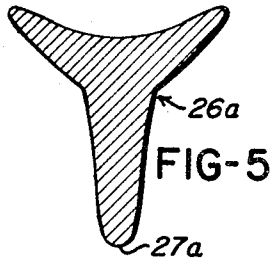


FIG-5

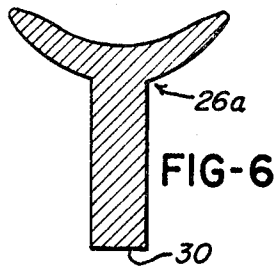


FIG-6

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DEWATERING DEVICE

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U.S. Cl. 210—433 13 Claims

ABSTRACT OF THE DISCLOSURE

A dewatering device for extracting liquid from a flowing slurry, characterized by a perforate drainage unit over which the slurry flows, the drainage unit comprising a series of parallel spaced bars extending transversely to the direction of slurry flow, the surface contour and arrangement of said bars being such as to produce an undulatory motion of the slurry as it progresses from one end to the other of the perforate drainage unit.

This invention relates to improvements in drainage units subjected to surface flow, and, more particularly, to a drainage unit characterized by screen bars having a novel undulatory contour in the direction of flow.

The dewatering device forming the subject matter of the present invention is particularly advantageous in the field of pulp processing and will be so described. However, it is not necessarily and specifically so limited. It has application in any field of endeavor utilizing relatively low density slurries from which an excessive amount of liquid must at some time be removed.

Referring to the pulping industry, by way of example, dewatering equipment is an essential and necessary part of the equipment employed. In processing pulp, regardless of the type of fibers employed and regardless of the end product to be made, the fiber particles being used are immersed in a liquid carrier to produce a slurry of relatively low density. In other words the quantity of liquid is quite large in relation to the actual quantity of the transported fibers. The liquid is generally employed as a carrier for the fibers since such a low density slurry is readily pumped from place to place for various operations throughout a mill. The carrier may however simultaneously function in other manners, depending on its chemical content, but in all instances it becomes necessary at some time or another in the manufacturing process to temporarily or permanently remove the excessive amount of liquid.

This last is due to the fact it has been found that more efficient refining and bleaching or fibrous material may be achieved by utilizing relatively high density slurries. Yet such high density slurries cannot be readily transported or pumped from point to point in the mill. Thus the need for effective dewatering equipment at critical stages of pulp processing.

In order to dewater or thicken the pulp slurry many different types of equipment have heretofore been used, such as rotary screens, presses, centrifugal separators and stationary or vibrating screens. Such equipment is, however, quite large and bulky and in many instances employs moving parts, both factors contributing to a reduction in overall efficiency and an increase in cost of such equipment. Moreover, much of the presently used dewatering devices or thickeners are limited in application, certain types being applicable to only certain types of fibers or to the production of certain types of end products.

The present improvement in dewatering devices enables a substantial reduction not only in the problems previously encountered but also of the cost of the dewatering

equipment presently being used. Simultaneously therewith the present dewatering device produces a finer degree of separation between liquid and fibers, resulting in less fiber loss. Further, the present invention enables a dewatering device which is not only economical to fabricate but one which may be readily substituted for other types of larger and more expensive dewatering equipment presently used in pulp mills.

It is therefore a primary object of the invention to provide a dewatering device which is economical to fabricate, more efficient and satisfactory in use, adaptable to a wide variety of applications and unlikely to malfunction or require excessive maintenance.

A further object of the invention is to provide a dewatering device for pulp and other slurries which is effective in removing a significant portion of the liquid carrier without excessive loss of good fiber.

A further object of the invention is to provide an improved dewatering device for pulp or other slurries incorporating means for effectively controlling and regulating the slurry flow and simultaneously therewith extracting undesirable heavy content.

A further object of the invention is to provide a dewatering device for pulp and other slurries including a unique drainage unit having a surface contour so designed as to induce an undulating flow of the slurry which moves thereacross.

A further object of the invention is to provide a dewatering device in which the desirable fibers or other desirable materials are successively caused to come to the upper strata of a slurry while excessive liquid and undesirable materials are separated to the lower strata and thence drained from the device.

An additional object of the invention is to provide a unique screen bar for use in fabricating improved drainage units.

A further object of the invention is to provide dewatering devices and components thereof possessing the advantageous structural features, the inherent meritorious characteristics and the means and mode of use herein described.

With the above and other incidental objects in view as will more fully appear in the specification, the invention intended to be protected by Letters Patent consists of the features of construction, the parts and combinations thereof, and the mode of operation as hereinafter described or illustrated in the accompanying drawings or their equivalent.

Referring to the accompanying drawing wherein is shown one but obviously not necessarily the only form of embodiment of the invention,

FIG. 1 shows a sectional view of a dewatering device, somewhat diagrammatic, embodying the present invention;

FIG. 2 is a fragmentary view, in cross-section, of a portion of the drainage unit utilized in the dewatering device of FIG. 1;

FIG. 3 is a perspective view of one of the bars used in the manufacture of the drainage unit of FIG. 2;

FIG. 4 is an end view of the bar shown in FIG. 3;

FIG. 5 is an end view of a modified configuration for the bar of FIG. 4; and

FIG. 6 is an end view of a further modification of the contour for the bar shown in FIG. 4.

Like parts are indicated by similar characters of reference throughout the several views.

Referring to FIG. 1, the dewatering device forming the subject matter of the present invention embodies a framework generally designated at **10**, upon which is supported a headbox **11** and a downwardly inclined dewatering section, generally designated **12**. The slurry to be dewatered

is received in the head box **11** from a supply thereof with the heaviest most undesirable particles contained therein immediately going to the bottom or sump area **13** of the box **11**. Such heavy undesirable particles are periodically drawn from the sump **13** through the downwardly extending discharge conduit **14** under control of a valve **15**.

Overflow from the headbox **11** moves toward the dewatering section **12** over a lowered front wall **16** of the headbox and a downwardly inclined extension **17** thereof. Distribution of such overflow into a sheet-like form of substantially uniform thickness is insured by a superposed gate **18** extending above and transversely of the extension **17**. The gate **18** terminates in spaced relation with the extension **17** and is vertically adjustable relative thereto, the relative spacing therebetween determining the thickness of the layer or sheet of slurry overflowing from the headbox. Adjustment of the gate **18**, as permitted by its vertically adjustable dependent plate section shown in FIG. 1, in cooperation with the rate of slurry input to the headbox effectively regulates and controls the slurry flow over extension **17** to the dewatering section **12**. The gate is preferrably hinged, as illustrated, enabling it to control flow yet float on the pulp surface and flatten any tendency to turbulence. Moreover, by this means better performance results since flow across the screen is levelled without there being a holding back of fiber lumps which might cause a channeled flow pattern.

The dewatering section **12** consists primarily of a perforate drainage unit **20** followed by a final imperforate discharge unit **21**. The upper surface of the drainage unit **20** is defined by a series of parallel relatively spaced bars **22** extending transversely of and at right angles to the slurry flow which moves thereacross. The bars **22** are interconnected by underlying, widely spaced, longitudinally extending bars which together therewith form a drainage screen unit. The relative spacing between the straight parallel bars **22** producing the perforate drainage screen unit described is predetermined in correspondence with the particular slurry being treated to produce the optimum results. In use of the invention screen bars the slurry, in passing over the drainage unit from the headbox **11** to the discharge unit **21** loses a good portion of its water or other liquid through the transversely elongated perforations intermediate each of the successively adjacent pairs of parallel spaced bars **22**. The remaining portion of the original slurry passing over the discharge unit **21** is considerably thickened and is discharged into a container (not shown) in the desired condition for further treatment and processing.

Various designs and contours have heretofore been used for the drainage screen units in dewatering devices. In the majority of such units the surface over which the slurry flows has been substantially flat or planar. Moreover, in designs heretofore used the bars or wires forming the surface of the drainage unit have extended longi- slurry flow or, in the alternative, in divergent relation to tudinally thereof in parallel relation to the direction of the direction of slurry flow. In some instances the planar through use of flat surfaced longitudinally extended bars or wires including transversely diverted sections having a curved or arcuate formation.

In contrast, in the present instance the flow surface of the drainage unit **20** is of a vertically undulating configuration, the upper surface of each bar forming the flow surface being concave in contour in the sense of slurry flow.

Referring to FIGS. 3 and 4 of the drawing, the bars **22** forming the drainage unit **20** are each generally triangular in cross-sectional contour and have a depressed or concave area in each side the length thereof. The upper longitudinal edges **23** of the bar are arcuate, having a relatively small radius. Centrally disposed between the edges **23** and extending longitudinally of the bar **22** is its top depression **24**. The arcuate edges **23** of the depression or cavity **24** form the flow surface of each bar of the drainage unit and extend at right angles to the direction of slurry flow, as indicated in the drawings by the arrow **25**.

The two sides of each bar **22** which depend downwardly from its flow surface are each formed with a depression or cavity **26** therein, the length thereof, intermediate a top edge **23** and the lower arcuate terminal or apex **27** of the triangular bar. The cavities **26** are preferably somewhat deeper than the upper cavity **24** and vertically offset from its center, preferably toward the flow surface of the bar and the side edges **23** thereof.

Thus, bars **22** are arranged transverse to the flow, in side by side, parallel, closely spaced relation with one another, with the side edges **23** and concave surfaces **24** forming the drainage flow surface. When so assembled, the spaced relation of successive bars **22** provides transversely extending elongated perforations through which excessive liquid is drained from the flow surface to the underside of the drainage unit. With the drainage unit installed in downwardly inclined position, the slurry flows downwardly thereover in the process of which to pass over successive slots or perforations intermediate successive bars **22**. When so installed the trailing edge **23** of each bar **22** is slightly lower than the opposite leading edge **23** of the same bar.

Shown diagrammatically in FIG. 2 by arrow **29** is the slurry flow pattern. As indicated therein, as the slurry flows over the drainage surface, it is induced by the top surface contour of bars **22** to move in undulatory fashion. As it moves over each bar, it dips in the surface portion **24** and is induced to move upwardly and to lift over the trailing edge **23** in a roller coaster pattern to leap, at least as far as its upper layer is concerned, over the leading edge **23** of the next following bar. This condition is regulated by the spacing of the bars. In the process of flow, the desirable solid fiber material, which is light, tends to move in the upper layer of the undulatory slurry flow and to thereby bridge or jump each elongated opening intermediate the successively adjacent bars **22** during the downward flow of the slurry over the entire surface of the drainage unit **20**. The lower layer of the flowing slurry, which contains liquids and the undesirable heavy or granular solids remaining in the slurry, quickly drops and does not make the bridge between successive bars **22**. The pattern of flow and spacing of bars is such that the liquid embodying the undesirable solids constituting the under layer of the slurry leaving the trailing edge **23** of one bar tends to fall under the influence of gravity and be intercepted by the leading arcuate edge **23** of the next succeeding bar. This condition facilitates and assists in directing the undesired liquids and solids downwardly to the underside of the flow surface. The contour of the side recesses **26** in each bar **22** not only provides for adequate drainage clearance on the underside of the flow surface so there is no obstruction or retardation of the draining fluid flowing downwardly from the flow surface and out of the drainage unit but its form is such to expedite the flow. Such flow is shown diagrammatically in FIG. 2 by the arrow **28** which indicates the deflection of the under layer of the slurry flow by the concave side of a following bar to direct the drainage through an elongated perforation for discharge from the drainage unit.

Thus, the cavities or depressions **24** in the top surface of succeeding bars **22** result in the formation of an undulating flow over the surface of the drainage unit with an elongated perforation underlying the apex or peak of each undulation. The slurry flow is quite distinct from the flat sheet-like flow of the slurry emerging from the headbox **11**. It is noted the undulatory pattern of the slurry flow over the drainage unit as described results in stratification of the slurry flow with the lighter solid or fibrous material therein moving to the upper strata and the heavier solids or fibrous material moving to the lower strata along with the liquid. As the undulating slurry

flow progresses downwardly over the drainage unit and the elongated perforations therein, the lowermost stratum is influenced by gravity and deflected downwardly in passing each successive perforation. Progressive separation of the slurry and reduction of liquid content together with the heavier solids occurs at each successive elongated perforation. As seen, the lighter solids tend to float or jump the perforation and remain in the flow since such perforations occur at each peak or apex of the undulating flow.

The desired degree of separation or thickening can be substantially predetermined by proper design of the frequency of undulations and the number of undulations in the drainage unit. The bars **22** with their longitudinally extending cavities **24** therefore provide a unique stratification means for the slurry flow which is of material assistance in producing the desired degree of separation and thickening of the slurry during its passage over the drainage unit **20** of the present dewatering device.

FIGS. 5 and 6 of the drawing disclose modifications in the shape and contour of the bar **22** shown in FIGS. 3 and 4. In both FIGS. 5 and 6 the side depressions **26***a* are more pronounced and deeper than the corresponding depressions **26** of FIG. 4. In FIG. 5 the lower portions of the side surfaces converge toward the bottom terminal or apex **27***a*. The upper flow surface of the bar in FIG. 5 however is quite similar to that shown in FIGS. 3 and 4.

FIG. 6 differs from FIG. 5 primarily in that the lower portions of the side surfaces extend upwardly in parallel relation with one another from a relatively square bottom terminal or apex **30**. Again however the upper flow surface of the bar shown in FIG. 6 is substantially identical to that shown in FIGS. 3 and 4.

The frequency of undulations in the slurry flow may be easily varied to satisfy the end requirements desired by altering the distance between the edges **23** of the drainage bars as seen in FIGS. 4, 5 and 6. A decrease in such width results in increased frequency while an increase in such width results in decreased frequency of undulation. By the same token the degree of undulation may be altered to suit the end results desired by varying the depth of the top flow surface depression **24**. An increase in the depth of depression **24** with respect to edges **23** results in a higher peak of undulation while a decrease in the depth of depression **24** produces a flatter undulation with lowered peaks.

A dewatering device incorporating a drainage unit as described herein is in most cases capable of removing during a single pass of slurry thereover, somewhat more than fifty percent of the liquid content of the slurry. For example, if the slurry delivered to the headbox **11** and to the drainage unit **20** has a solid content of one percent or less, the resultant slurry discharged by the present dewatering device will have a solid content of approximately two and one-half percent. Such efficiency is of considerable advantage in subsequent processing steps. Furthermore the liquid discharged from the drainage unit containing the heavier solids is in such stage of dilution that it is readily pumpable for return to the processing system ahead of the dewatering device. In this way any fines or usable solids inadvertently discharged through the drainage unit **20** are readily reclaimed and reintroduced into the system for further processing. This advantage is achieved without the necessity of introducing additional liquid in order to handle the rejects from the present dewatering device.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute the invention has been described in language more or less specific as to

structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise but one of several modes of putting the invention into effect, and the invention is therefore claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

Having thus described my invention, I claim:

1. A dewatering device for extracting liquid from a flowing slurry characterized by a perforate drainage unit over a surface of which the slurry flows, said surface including means inducing an undulatory motion of the slurry in said flow, said means being arranged to provide that the undulations of the slurry progress over the drainage unit with slurry flow and extend transversely thereof and including a flow supporting surface comprising the upper surfaces of a plurality of longitudinally spaced bar or rod-like elements arranged in a sense transverse to said flow, each of said elements having a central depression forming a concavity in its flow supporting surface transverse to said flow and merging smoothly with leading and trailing portions of its flow supporting surface, each said leading and trailing portions being reversely curved about a small radius to merge smoothly with said central depression therebetween and form thereby an undulating curve which in slurry flow thereacross produces a spring board effect, the upper layer or layers of the slurry flow moving into and from said central depression in roller-coaster fashion so as to lift over the trailing portion to peak between adjacent of said elements and leap over the leading portion of the next following element to move into and across its centrally depressed portion in like roller-coaster fashion, the radius of said trailing portion inducing an under layer of the flow to follow its curve to exit downwardly between said trailing portion and the leading portion of the next following element.

2. A dewartering device as set forth in claim **1** characterized by each of said bars or rod like elements having depending surfaces respectively forming continuations of the extremities of its said leading and trailing portions and extending downwardly from said flow surface in a manner to provide that the depending surface forming a continuation of said trailing portion of one element and the depending surface forming a continuation of said leading portion of the next following element will immediately below said flow surface be displaced a greater distance than the distance between the adjacent extremities of said trailing and leading portions of following elements whereby to facilitate the exit of said under layer in the course of the slurry flow.

3. The structure as set forth in claim **1**, each of said bars or rod-like elements being further characterized by dependent sides, at least the dependent side at the extremity of its leading portion having a longitudinally extending indentation to provide thereby that said leading portion will overhang the same, said indentation providing a side surface formed to receive thereon said under layer which exits between adjacent of said elements to thereby facilitate its discharge and avoid buildup of materials between adjacent of said elements.

4. The structure as set forth in claim **1** characterized by each bar or rod-like element including dependent sides the surfaces of which initially converge downwardly from said flow surface to provide thereby that said sides on the adjacent trailing and leading portions of successive bars are relatively displaced to insure that said under layer will smoothly exit from said flow surface.

5. The structure set forth in claim **4**, characterized by the lowermost portions of the downwardly converging sides approaching a substantially parallel relation.

6. A drainage screen unit for extracting liquid from a flowing slurry, comprising a flow surface including a plurality of screen bars or wires of elongate form, the flow surface being adapted to have a slurry flow thereacross, said surface including means for inducing an in-

dulatory motion of the slurry in its flow, the upper flow surface of each bar or wire being an undulatory curve in the sense of flow, said upper flow surface being formed with a central arcuate depression in the sense of flow, the depression merging smoothly with the leading and trailing portions of said upper flow surface, the leading and trailing portions being smoothly arcuate in reverse curves to provide with said central depression therebetween a roller coaster like surface which on slurry flow thereacross produces a springboard effect with the upper layer or layers of the slurry moving into and from said central depression in roller coaster fashion so as to lift over the trailing portion while the under layer portion of the flow will follow the curve of the trailing portion, the latter inducing thereby a smooth exit of the under layer from said flow surface to achieve a distinct separation thereof from said upper layer or layers of said flow.

7. A screen unit as in claim **6** characterized by the bars or wires having sides which depend from said undulatory curve, merging smoothly therewith and being convergent in a sense downwardly therefrom, at least at their portions most adjacent to said flow surface.

8. A screen unit as in claim **7** characterized by the bars or wires having the sides thereof being pinched to produce thereby a thin dependent apex portion on said bars or wires.

9. A dewatering device for extracting liquid from a flowing slurry, including a drainage unit which in use is disposed at an angle and over which the slurry flows by gravity, said unit comprising a plurality of bars in parallel spaced relation to one another and arranged transverse to the direction of slurry flow, the upper surfaces of said bars forming a flow surface in which are defined thereby a longitudinally spaced series of transverse drainage slots, each bar having an upper surface formed with an intermediate arcuate depression in the sense of the slurry flow between its leading and trailing portions, said leading and trailing portions being extended in the form of an arcuate reverse curve so that flow over the drainage unit becomes a continuously undulating movement, the said upper surfaces of said bars and the spacing therebetween providing that the slurry flow moves into and out of each arcuate depression in a roller-coaster fashion, the upper layer of the slurry lifting over said trailing portion to peak between adjacent of said bars and leap over the leading portion and move into and across the arcuate depression in the following bar in similar fashion, while the under layer of the flow will be induced by the form of the said trailing portion to follow its curve and exit downwardly between said trailing portion and the leading portion of the next following bar and in the course of its exit impact on the adjacent side of the next following bar whereby to expedite its drainage under the influence of gravity.

10. A dewatering device according to claim **9** characterized in that the upper surface of each of said bars is a continuously undulating rounded curve terminating at the leading and trailing edges of the bars in rounded surfaces of relatively small radius.

11. A dewatering device according to claim **10** characterized in that each of said bars has dependent sides thereof at least the upper surface portions of which slope inwardly from said leading and trailing edges toward an apex and uppermost portions of said sides converge at relatively sharper angles from the leading and trailing edges of said bars than do lowermost portions.

12. A dewatering device according to claim **11** characterized in that said uppermost portions of said sides are short in relation to the length of the lowermost portions thereof.

13. A dewatering device according to claim **11** characterized in that the lowermost portions of said sides approach a substantially parallel relation to the dependent extremity of the bar.

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209—273, 393; 210—499