

April 17, 1962

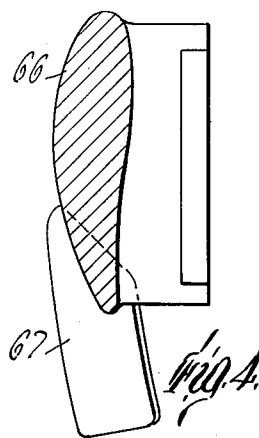
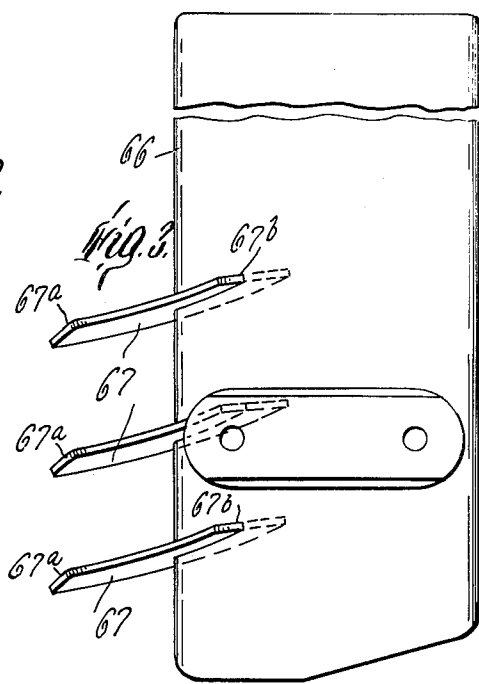
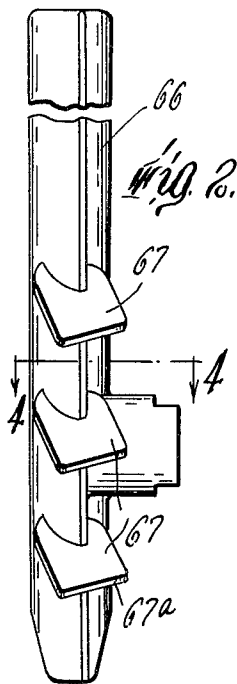
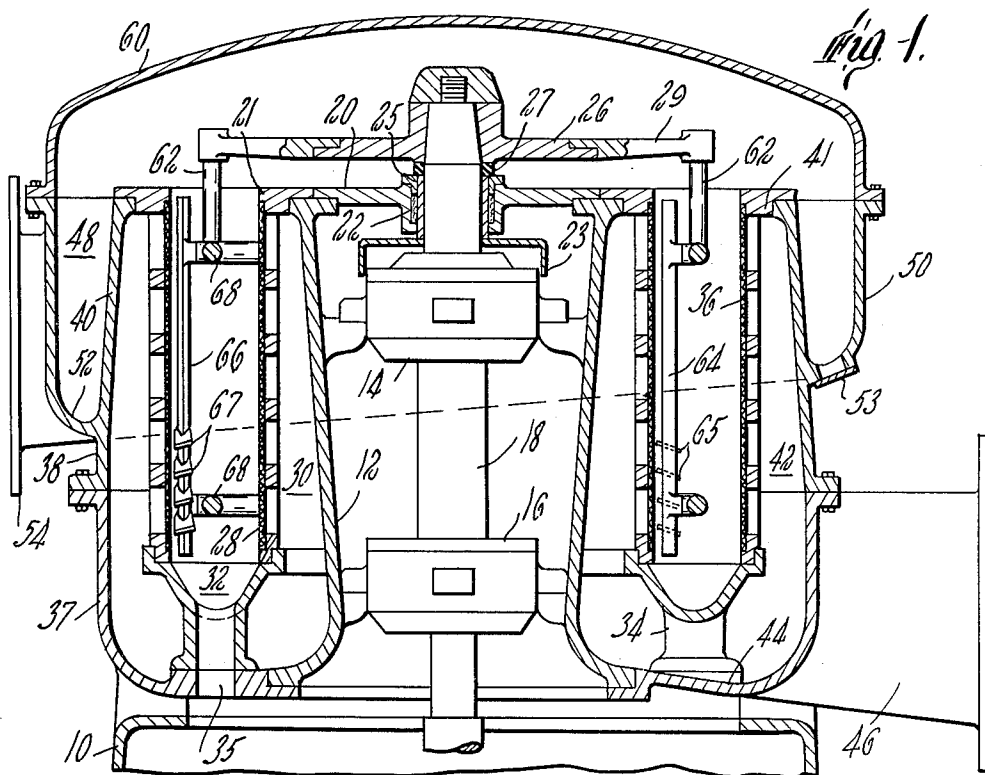
M. M. CANNON

3,029,951

SCREENING DEVICE

Filed Sept. 24, 1958

2 Sheets-Sheet 1



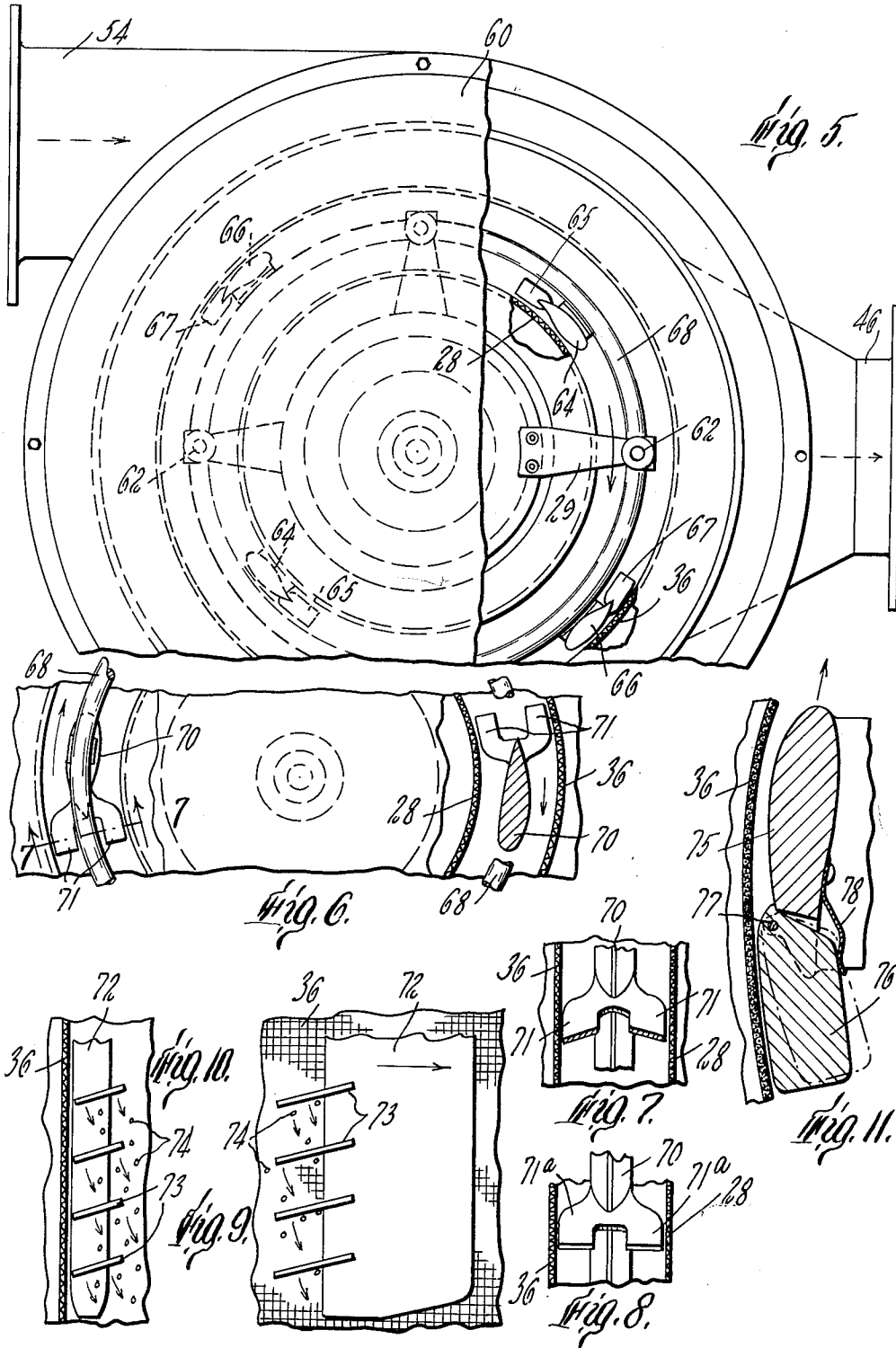
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SCREENING DEVICE

Madison M. Cannon, Wellesley, Mass., assignor to Bird Machine Company, South Walpole, Mass., a corporation of Massachusetts

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This invention relates to a screening device for liquid suspension and pertains more particularly to a screening device for use with suspensions of fibers or other solid particles.

The device of the present invention is an improved screening device of the type which is provided with means to progressively clean the face of a screen for the purpose of lifting an accumulated mat of oversized material from the face of the screen, clearing apertures of the screen which are blinded by the mat, thus permitting suspension to pass through the apertures.

One object of the present invention is to provide a screening device in which liquid suspension flows smoothly from an inlet through the screen to an outlet and oversized material is screened out by the screen, removed from the screen surface, and directed to an outlet with minimum interference to the flow of the liquid suspension through the screen.

Another object is to provide an improved means for progressively cleaning the surface of screens.

Still another object is to provide a cleaning device which causes no wear of the screen and which requires a minimum of power for actuation.

Another object is to provide a device which cleans a screen, but is immune from jamming particles into the apertures of the screen even in the event of encountering extremely oversize particles in the suspension.

A further object is to provide a mechanism for rapidly cleaning screens which are subjected to high flow rates.

Still another object is to provide an improved screening device which causes screened-out material to be positively directed to a waste outlet with a minimum of interference to the flow of material through the screen.

Other and further objects will be apparent from the drawings and the following description.

In the drawings:

FIG. 1 is a view in vertical section of one embodiment of the present invention;

FIG. 2 is a view in rear elevation of a preferred embodiment of the foil-vane assembly of this invention;

FIG. 3 is a view in side elevation of the foil-vane assembly of FIG. 2;

FIG. 4 is a view in section of the foil-vane assembly of FIG. 2 taken along line 4-4 of that figure;

FIG. 5 is a plan view, partly in section, of the embodiment shown in FIG. 1;

FIG. 6 is a plan view, partly in section, of another embodiment of the invention in which single foils are joined with double vanes;

FIG. 7 is a view in section taken along line 7-7 of FIG. 6;

FIG. 8 is a vertical section, corresponding to the view of FIG. 7, of another embodiment of a foil-vane assembly of the single foil-double vane type;

FIG. 9 is a diagrammatic, schematic side view of a foil-vane assembly indicating the effect of the moving apparatus upon particles encountered in suspension.

FIG. 10 is a diagrammatic, schematic rear view of a foil-vane assembly indicating the effect of the moving apparatus upon particles encountered in suspension; and

FIG. 11 is a horizontal cross-section of another embodiment of a foil-vane assembly having a yieldable vane.

In the screening of liquid suspensions of fibrous mate-

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rial, one of the chief problems is, of course, to keep the screen clean of the material screened out of the liquid suspension flowing through the screen. Although both mechanical and hydraulic means have previously been proposed for solving the problem, this invention is believed to be a marked improvement over such means, permitting efficient screen clearing with a minimum interruption of flow of the liquid suspension through the screen while consuming little energy and minimizing wear upon the parts involved.

In accordance with the practice of this invention, it is proposed to introduce liquid suspension into a screen chamber space adjacent to a surface of a cylindrical screen and to clear this surface of accumulated unscreenable oversized material periodically and thus to present clean screen surface to the fresh liquid suspension. The clearing means comprises two elements which together are moved across a screen surface adjacent thereto. The leading element of the clearing means is believed to cause a substantial negative pressure pulse which draws oversized particles from the surface of the screen and to cause a localized loosening turbulence. The second element attached to the rear of the first element and trailing it in movement intercepts the loosened oversized material and imparts a motion to it directing this material towards the waste outlet. Each element is preferably so designed as to have its desired effect with a minimum of drag. Accordingly, the leading element or foil is preferably streamlined, presenting a gently rounded leading edge which merges into a gradually tapering portion extending to the relatively sharp trailing edge. The leading element preferably extends generally parallel to the axis of the cylindrical screen; i.e., extends generally longitudinally of the screen. The trailing element or vane is secured to the foil to extend rearwardly therefrom inclined slightly with respect to the direction of movement of the clearing means toward the waste outlet to impart to the oversized particles in its path a gentle thrust toward the waste outlet through which they are to pass. Each vane is limited in length so that any turbulence set up in the liquid suspension by its passage has an opportunity to be dissipated before the next successive passage of a clearing means across the same portion of the screen face. While more than a single clearing means may be employed with a single cylindrical screen, the trailing edge of the vane of each clearing means must be spaced from the leading edge of the foil of the next successive clearing means by an angular distance of at least 45° about the axis of the screen. The arcuate length of each clearing means, i.e., of each foil with its associated vanes, measured angularly about the axis of the screens, must be 45° or less in order to avoid excessive drag or turbulence.

As used in this description, "liquid suspension" defines a liquid which contains in suspension particles or fibers of various sizes, some adapted to pass through the screen and others to be rejected. There is a tendency of this material to accumulate on the screen surfaces as the large particles clog the holes in the screen. If proper screening is to be had, it is necessary to loosen such material to unclog the screen.

In the embodiment of the invention which is shown in FIGS. 1 through 5 of the drawings, there is included a main frame 10 on which is mounted a hollow inner housing 12, preferably cylindrical, within which are supported main journal bearings 14, 16 in which is journaled a drive shaft 18. The upper end of housing 12 is sealed by a closure 20 which is provided with a stuffing box 22 through which shaft 18 projects. Stuffing box 22 serves to seal the space above closure 20 from the space within housing 12. In addition, flinger plate 23 mounted on sleeve 25 is fixed to shaft 18 beneath stuffing box 22 to

protect bearings 14, 16 from any water which may leak through the stuffing box.

Fixed to the lower end of shaft 18 is a driving means (not shown) such as a multiple V-belt pulley which may be driven by means of a conventional belt drive from any suitable source of power such as an electric motor. Fixed to the upper end of shaft 18 is a hub 26, a soft rubber collar 27 being compressed between hub 26 and the end of sleeve 25 to prevent leakage. Bolted to the margin of hub 26 is a spider 29 the projecting arms of which serve to support and drive the foils or vanes hereinafter described.

A screen chamber is formed by two cylindrical screens 28 and 36 concentric with each other and with the shaft 18. The inner screen 28 is supported from the upper end of housing 12 at flange 21 extending radially outwardly from the upper end of the housing, the inner screen 28 forming one wall of inner receiver chamber 30 into which the screen discharges.

An annular channel 32 of U-shaped cross-sectional configuration is located at the bottom margin of inner screen 28 and is supported by a plurality of legs 34. One leg is hollow serving as an outlet 35 leading to waste. The outer screen 36 is mounted on the outer wall of channel 32. Screens 28 and 36 form a generally annular screen chamber which is open at its upper end throughout its extent.

A generally cylindrical imperforate wall 37 concentric with and spaced outwardly from outer screen 36 is supported by main frame 10. An extension 38 is bolted to the upper margin of wall 37 forming wall 40 and is provided with flange 41 at its upper end to support screen 36 and to form therewith a second generally annular receiver chamber 42. Bottom wall 44 spaced below the bottom of trough 32 seals the lower ends of receiver chambers 30 and 42 and conducts material from the receiver chambers to main outlet 46 for the accepted stock.

Mounted externally of outer receiver chamber 42 is an annular distributor chamber 48 having an imperforate outer wall 50 and bottom 52 integral with extension 38. Mounted tangentially of distributor chamber 48 is inlet 54 for the liquid suspension to be screened. A lid 60 bolted to the upper margin of outer wall 50 covers all of the space within said wall. It will be understood that wall 37 together with outlet 46 may be rotated as a unit with respect to extension 38 and inlet 54 before wall 37 and extension 38 are bolted together, thus adjusting the direction of inlet 54 and outlet 46 as desired.

The arms of spider 29 extend radially outwardly above the space between screens 28 and 36, and from their ends depend hangers 62 and foils 64, 64, 66, 66, each of which is of streamlined cross-sectional configuration, each of foils 64, 64 being disposed adjacent the face of inner screen 28 and each of foils 66, 66 being disposed adjacent the face of outer screen 36. Reinforcing and spacing rings 68, 68 are secured to the foils adjacent their upper and lower ends and serve to maintain the foils in the desired alignment. The clearance between the foils and their respective screens is not critical and may be of the order of 0.06 to 0.30 inch or even more.

As mounted for rotation in a clockwise direction as shown in FIG. 5 there are vanes 65, 65, 67, 67 attached to the trailing portion of each of the foils 64 and 66 and extending rearwardly therefrom. Each vane is preferably a thin generally flat element having an arcuate lateral margin which conforms generally to the curvature of the adjacent screen. Each vane is inclined slightly with respect to its direction of movement, i.e., with respect to the plane in which it moves, sloping rearwardly downwardly to impel any oversized particles with which it comes in contact downwardly toward waste outlet 35. Thus, as shown in FIG. 3, the extreme trailing edge 67a of the vane is lower than the juncture 67b between the vane and the foil. The vane extends from the foil into

close proximity with the adjacent screen, but does not contact it. In the preferred embodiment shown in FIGS. 2 and 3 each vane, in addition to sloping rearwardly downwardly, is canted laterally downwardly toward the adjacent screen face to impel oversized material away from the screen face as well as downwardly toward the outlet.

In the embodiment of FIGS. 1 through 5, only two foils 64, 64 with their associated vanes 65, 65 operate on inner screen 28 while two other foils 66, 66 with their vanes 67, 67 operate on outer screen 36. It will be understood that a single foil with its associated vanes may be used with each screen, or as many as four or even more may be employed with each screen.

In this preferred embodiment the foils 64 and 66 are shaped so as to present a streamlined cross-sectional configuration having a smoothly rounded leading edge merging into a gradually tapering portion which terminates in a relatively thin and sharp trailing edge to avoid unnecessary turbulence which might cause a loss of power and efficiency and to provide maximum pressure pulse at the screen face.

It will be appreciated that spider 29 may be unbolted from hub 26 and removed along with its associated vanes and foils without disturbing shaft 18 or its bearings 14, 16. After removal of spider 29, inner screen 28 may be lifted out for inspection, repair, or replacement. Outer screen 36 may be removed without disturbing spider 29.

In operation of the device, a stream of the liquid suspension such as paper stock is introduced under pressure through inlet 54, the stock flowing tangentially around through distributor chamber 48 and overflowing the upper edge of wall 40 which facilitates uniform distribution of the flow throughout the circumferences of the screens, thence across the top of annular receiver chamber 42 and downwardly into the screen chamber between screens 28, 36, the paper stock continuing to flow gently tangentially as it enters this space. Distributor chamber 48, in addition to distributing the liquid suspension, also serves to trap and remove from the suspension very heavy particles of solid matter. A clean out port 53 may be provided in bottom 52 to permit this material to be removed.

Due to the narrowness of the screen chamber defined by the screens 28 and 36, the liquid suspension will flow in a generally organized way both in a gentle circular distributing movement and downwardly. The motion of the liquid suspension downwardly is due in part to the inclination of vanes 65, 67 and in part to the fact that the screens extend vertically down from the inlet and therefore the path of least resistance to some of the liquid suspension will be down from the inlet midway between the screens and through the bottom portions of the screens. Since in this embodiment the screens are arranged vertically with the inlet at the top and the waste outlet at the bottom, the effect of the downward flow midway between the screens is to cause oversized material which is cleared from the screen surface and removed a sufficient distance therefrom by the foils and vanes to be moved towards the waste outlet.

Shaft 18 is rotated clockwise, as seen in FIG. 5, by the drive belts, carrying with it hub 26, spider 29, foils 64, 64, 66, 66 and vanes 65, 65, 67, 67 which sweep across the faces of screens 28, 36. The motion of the foils with respect to the screen surfaces is believed to produce localized zones or areas of reduced pressure adjacent the thickest portions of the foils. It is believed that the pulse of reduced pressure produced at a point on the face of a screen as a foil passes it, together with the localized turbulence accompanying the passage of each foil through the liquid suspension, produces the desired loosening of clogging and obstructing particles from the screen face. The trailing vanes act upon this loosened material, giving that material an impulse downwards towards the waste outlet 35. In this embodiment, therefore, the waste mate-

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rial is carried downward by the periodic impulses delivered by the series of vanes attached to each foil and, in addition, by the flow of the liquid suspension. The rejected material is thus carried downwardly toward waste outlet 35, while the accepted suspension which passes through the screens 28, 36 is collected in receiver chambers 30, 42 and conducted to the main outlet 46 for accepted stock.

In the absence of vanes 65, 67 the velocity of the downward flow of liquid between screens 28, 36 is at a maximum midway between the screens and at a minimum, because of drag and turbulence, adjacent the screen faces. The effect of the vanes is to tend to equalize the velocity of liquid flow throughout the space between the screens so that the velocity adjacent the screen faces is more nearly equal to the velocity midway between the screens.

While in the embodiment of FIGS. 1 through 5, a series of spaced parallel vanes is shown mounted adjacent the lower end only of each foil, it will be understood that a single vane may be used with each foil as well as a series containing a much larger number of vanes and extending along the full length of each foil. In general, the latter arrangement is more effective than the former.

In still another embodiment, as shown in FIG. 6, each foil 70 is located midway between screens 28, 36 and acts on both screens. In this embodiment the clearance between each foil and the screens may be considerably greater, up to as much as one inch or more, depending upon the distance between the screens and the chord thickness of the foils. This increased allowable distance between the foils and the screens is in part attributable to the fact that each double-acting foil of this embodiment may be much larger than either of a pair of the foils shown in the embodiment of FIGS. 1 through 5 with the total detrimental drag being the same. Such a larger foil causes a considerably larger dislodging effect on the screens. Vanes 71, 71 are mounted on each foil 70 and extend rearwardly downwardly at each side adjacent the respective screen faces. Because of the additional clearance, vanes 71 become of even greater significance in the total effect of the cleaning apparatus of this invention. It should be appreciated that the movement of the liquid adjacent the screen and immediately behind the moving foils is desirably downward, carrying the loosened material down with it. The movement of fluid adjacent the screen in other portions of the screening area is desirably directly towards the screen. It is desirable, therefore, to cause only that portion of fluid immediately following the foil to move downwardly. By virtue of this greater permitted working surface area, the effect of the vanes of FIG. 6 may be substantially greater than the effect of the vanes of FIGS. 1 through 5.

FIG. 7, a cross section of the vanes of FIG. 6, indicates that the vanes not only preferably slope down from the vane towards the waste outlet, but are also canted laterally downwardly toward the screens so as to move oversized particles away from the screens. The embodiment shown in FIG. 8 differs from that shown in FIG. 7 only in that the vanes 71a extend laterally horizontally and slope downwardly toward the rear.

In operation of the device, as shown in FIGS. 9 and 10, when foil 72 moves to the right as shown in FIG. 9, vanes 73 impinge upon particles 74 loosened by foil 72. Because of the angular disposition of vanes 73, particles 74 are given an impulse of motion in a direction toward the waste outlet below the foil. The lateral cant of the vanes, as shown in FIG. 10, tends to impel particles 74 away from the screen face.

The foil 75 in FIG. 11 and its appended vane 76 illustrate an embodiment in which vane 76 is pivotally mounted on the foil by hinge 77. On the opposite side of the vane remote from the screen a compressible leaf spring 78 is positioned. In the event of the foil encountering large objects which tend to jam between the vane and the screen, the large objects will cause a turning moment on the foil 76. Spring 78 will compress, permitting the foil to swing

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away from the screen and allow the large objects to pass by the edge of the vane with little jamming of the objects into screen apertures. This construction is useful when the clearance between the screen and the margin of the vane is less than the clearance between the foil and the screen.

It will be appreciated that in the improved construction of the embodiments of FIGS. 1 through 5, the drive shaft and its bearings are sealed from contact with the liquid suspension in central housing 12, and the spider 29 is located above the space between the screens 28 and 36. This arrangement minimizes disturbance of the flow pattern in the space between the screens and consequently minimizes detrimental turbulent effects. The acceptable liquid suspension flows easily through the screens and the rejected material is gently propelled toward the waste outlet. With the absence of turbulence, already-rejected material is not agitated so as to be re-injected into the stream of flow, and the screening apparatus operates at peak efficiency. Similar results can be obtained by rotating screens 28, 36 while maintaining the foils and vanes stationary.

Although this invention has been described in conjunction with a double screen device, it should be appreciated that similar effects can be obtained with a single screen device, and therefore the invention of this application is not limited to screening devices utilizing two screens.

Although specific embodiments of the invention have been described herein, it is not intended to limit the invention solely thereto, but to include all of the obvious variations and modifications within the spirit and scope of the appended claims.

What is claimed is:

1. A screen device comprising a cylindrical screen, means defining a chamber on one side of the screen, means for introducing a stream of liquid suspension into said chamber, outlet means spatially separated from said introducing means for removing waste from said chamber, means located on the other side of said screen to collect and carry away suspension which passes through the screen, at least one foil located in the chamber extending substantially lengthwise of said cylindrical screen and mounted to be moved in a path concentric with and spaced from the cylindrical screen to loosen blinding particles from the apertures of the screen when moved, means for moving said foil with respect to said screen, and a vane secured to and extending rearwardly from said foil, said vane sloping rearwardly in the direction of said outlet, the total angular length of said foil and vane measured about the axis of said screen being a maximum of 45°.

2. The device defined in claim 1 in which a plurality of spaced parallel vanes is mounted on each foil.

3. The device defined in claim 1 in which each vane cants laterally toward said screen to impel oversized particles of said suspension away from said screen face.

4. A screening device comprising inner and outer concentric, spaced, cylindrical screens, inlet means for introducing a stream of liquid fibrous suspension under pressure between said screens adjacent one end thereof, outlet means for withdrawing rejected material from the space between said screens at the end opposite to said inlet, at least one foil extending into the space between said screens, said foil being of streamlined cross-sectional configuration shaped to reduce drag and a series of spaced-apart parallel vanes extending from the trailing edge away from each foil sloping in a direction toward the outlet means, each foil-vane combination and the screens being mounted for rotation with respect to each other about the axis of said screens with each of said foil-vane combinations being spaced from an opposing face of one of said screens, drive means for rotating each of said foil-vane combinations and said screens relative to each other about said axis at a speed sufficient to produce an area of re-

duced pressure between each of said foils and an adjacent screen portion and sufficient to impart to loosened material an impulse toward said outlet means each time a vane passes near it, a pair of generally annular chambers, one disposed outside of the outer screen and one disposed within said inner screen arranged to receive suspension passing through said screens, whereby acceptable portions of a liquid suspension introduced into the inlet of this device pass through one of the screens and oversized material is screened out by the screens, is loosened from the screens by said foil, and is propelled toward said outlet by said vanes.

5. A screening device for liquid suspensions comprising inner and outer generally vertical, concentric, spaced, cylindrical screens, a pair of generally annular receiver chambers, one disposed outside of the outer screen and the other disposed within said inner screen, arranged to receive suspension passing through said screens, means for removing suspension from said receiver chambers, an annular distributor chamber surrounding the receiver chambers sealed therefrom and communicating with the upper end of the space between said screens over the upper edge thereof, an inlet for introducing a stream of liquid suspension tangentially into said distributor chamber, whereby it flows over the upper edge and downwardly into the space between said screens, a waste outlet located at the bottom of the space between said screens, a plurality of foils extending into the space between said screens generally lengthwise thereof, each foil being mounted for movement about the axis of said screens in a path spaced from the screen face and each foil having a streamlined cross-sectional configuration including a rounded leading edge merging with a portion gradually

tapering to a thin trailing edge, a plurality of spaced parallel vanes mounted on each foil extending rearwardly downwardly therefrom, the angular length of each foil with its vanes measured about said axis being a maximum of 45° and the angular distance between the trailing edge of each vane and the leading edge of the next successive foil following in the same path being at least 45°, and means for moving said foils about said axis across the face of said screens to maintain the apertures of said screen open for the passage of suspension there-through.

6. The device as defined in claim 5 in which each foil with its vanes is disposed adjacent the face of one screen and operates on that screen only.

7. The device as defined in claim 5 in which each foil is disposed adjacent the faces of both screens and operates on both screens, and each foil carries vanes extending outwardly on opposite sides of the trailing edge of the foil toward the faces of the screens.

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