LIQUID SPRAYING OR SCREENING DEVICE

Filed June 17, 1964 4 Sheets-Sheet 1

Fig.1

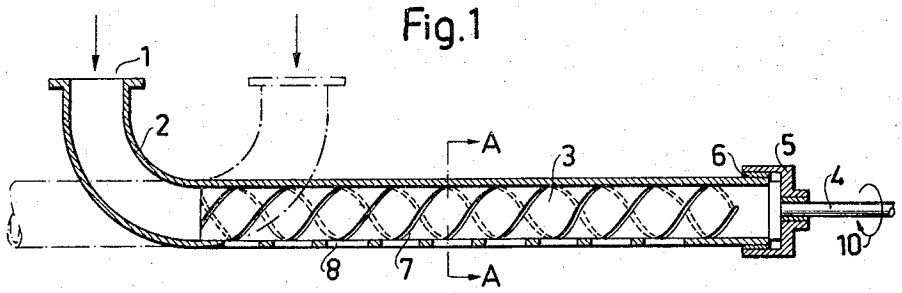



Fig.2

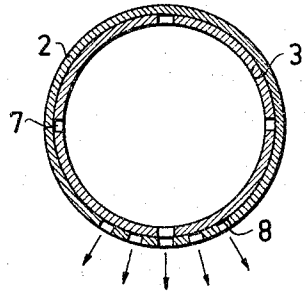



Fig.3

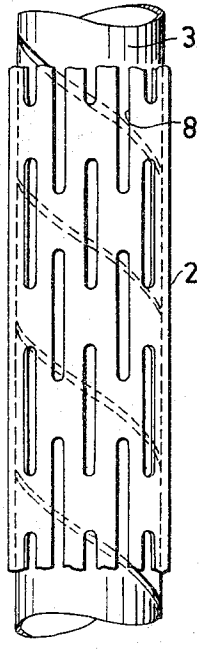



Fig.4

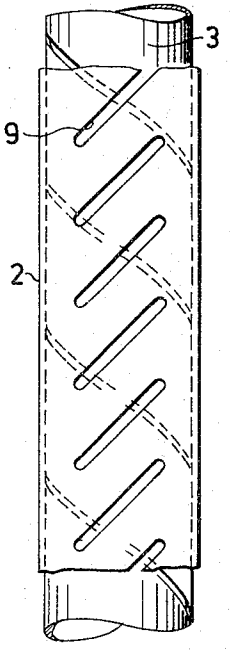


Fig. 5

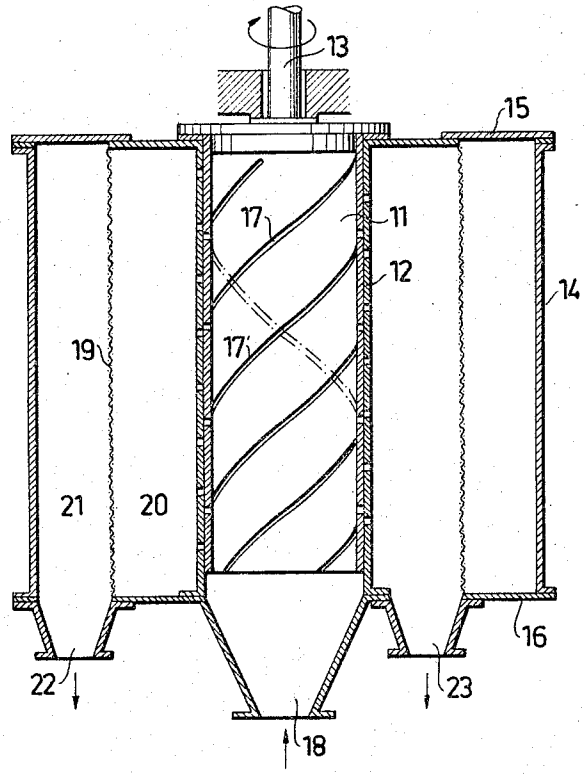

13
15
17
11
12
14
19
17
21
20
16
22
23
18

Fig. 6

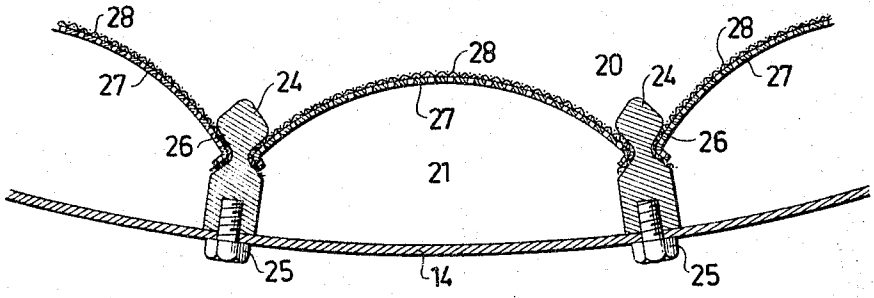

28
27
24
28
20
24
28
27
27
26
26
21
25
14
25

Fig.7

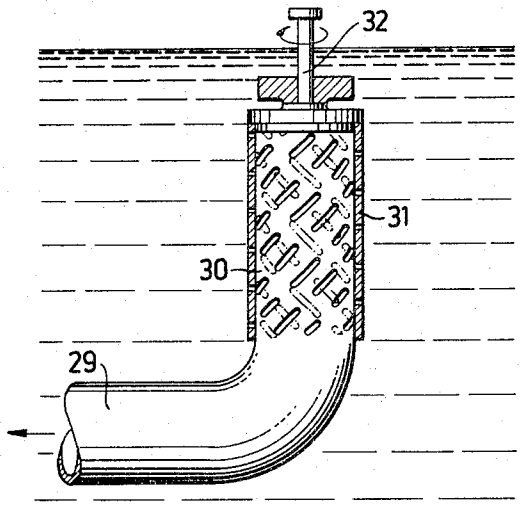
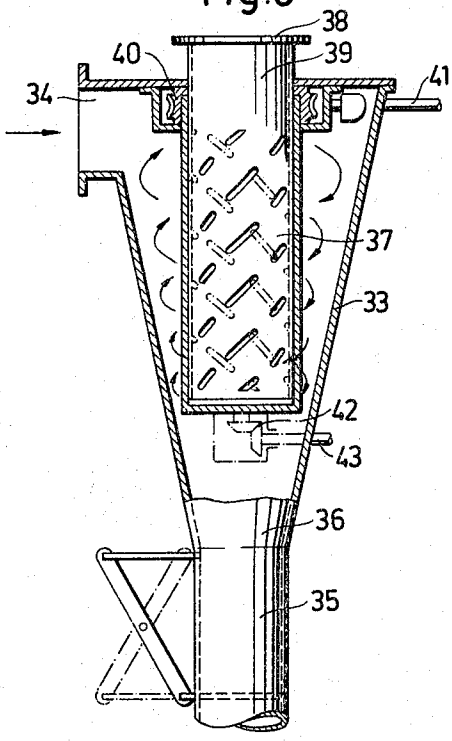



Fig.8



Nov. 21, 1967 E. G. R. RANHAGEN ET AL 3,353,752

LIQUID SPRAYING OR SCREENING DEVICE

Filed June 17, 1964 4 Sheets-Sheet 4

Fig. 9

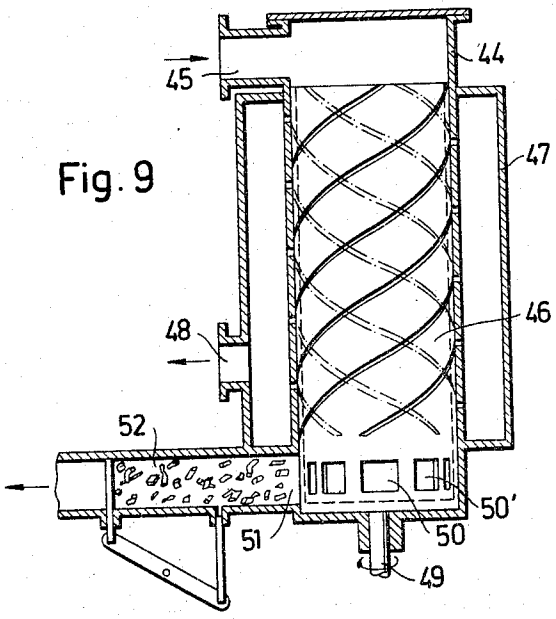
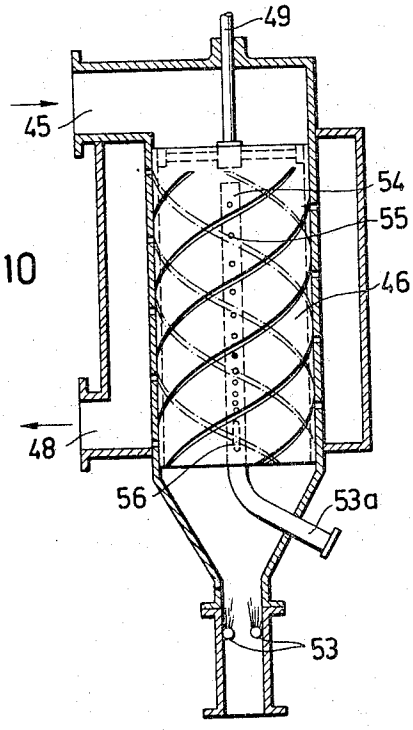



Fig. 10



United States Patent Office 3,353,752 Patented Nov. 21, 1967



3,353,752

# LIQUID SPRAYING OR SCREENING DEVICE

Ernst Gustaf Rane Ranhagen and Erik Gustaf Ranhagen, Danderyd, Sweden, assignors to Aktiebolaget Karlstads Mekaniska Werkstad, Karlstad, Sweden, a joint-stock company of Sweden

Filed June 17, 1964, Ser. No. 375,882
Claims priority, application Sweden, June 19, 1963, 6,845/63
1 Claim. (Cl. 239—538)

The present invention relates to liquid sprayers, or screens for liquids, provided with openings through which the fluid may issue. The object of the invention is to provide a screen or sprayer of a new kind which may be used in a great number of different kinds of industries using liquids in their manufacturing process, for instance in the paper—cellulose—sugar—and mining industries and in the water purifying technic.

The device according to the invention, as further described below, may be used either separate or in combination with other machine elements as a substitute for or a complement to apparatuses for de-watering, separation, screening or straining, classification or fractionating. Apparatuses of the kind indicated that were known prior to this invention were all subject to certain disadvantages with respect to space requirement, capacity, even distribution of the fluid jets and tendency for clogging.

In a device according to the invention these drawbacks are eliminated or reduced and a sprayer according to the invention requires less space for given capacity than any known sprayer. It distributes the fluid jets very uniform and exhibits in addition to this a very small or practically non-existent tendency to clog.

In order to accomplish this a sprayer according to the invention comprises two with respect to each other rotatably movable coaxially arranged shells having surfaces cooperating with each other, which surfaces are rotation symmetrical and substantially uniform to each other so that the shells together form a spraying or screening shell which comprises an outer and an inner shell, the shells further being provided with slots in such a way that the slots in the outer shell and the slots in the inner shell intersect each other thus forming openings to the combined sprayer shell.

In a preferred embodiment according to the invention the shells comprise cylindrical or conical shells of which at least one has at least one, preferably spiral or helical, groove or slot, the other shell having at least one groove or slot so arranged that openings are generated at the points of intersection between the slot or slots in the first shell and the slot or slots in the second shell so that if one of the shells is stationary and the other is rotating the openings thus generated will move with respect to a fixed point on the stationary shell which movement, in dependence of the form of the slots, will be tangentially and/or longitudinal. If the fluid to be sprayed is supplied with sufficient pressure to the inside of the cylinder or the cone the fluid will be forced out to the openings in the form of substantially radially directed jets.

It is obvious that a sprayer of this kind, due to the movement of the openings, has considerably less tendency for clogging than a sprayer having fixed openings.

According to a further embodiment of the invention the material of the shells in the neighbourhood of the slots may comprise a hard metal and the edge of the slot may be formed as a cutting edge which further reduces any tendency for clogging.

The invention will be further described with reference to the accompanying drawings of which:

FIG. 1, partly in section, shows a sprayer or cleaning pipe with moving fluid jets according to the invention,



FIG. 2 is a section along the lines A—A in FIG. 1,

FIG. 3 shows a detail, namely the outer shell of the spraying pipe according to FIG. 1,

FIG. 4 shows a further modification of the outer shell,

FIG. 5 shows a coarse screener according to the invention,

FIG. 6 shows a screen and a screen holder, suitable for use together with the coarse screener shown in FIG. 5,

FIG. 7 shows an embodiment of the invention used for protecting a water inlet,

FIG. 8 shows a further embodiment of the invention applied to screening according to the hydrocyclon principle,

FIG. 9 shows the invention applied to a twig screen, cutter or the like and FIG. 10 shows a modified embodiment of the apparatus shown in FIG. 9.

The apparatus shown in FIG. 1 comprises a sprayer pipe with moving jets according to the invention. Through the opening **1** the liquid to be sprayed, enters into the tube **2** which comprises the outer shell of the sprayer. A further tube **3** is arranged on the inside of the first tube and coaxial therewith and is by means of a suitably journalled axis **4** connected to suitable driving means not shown in the drawings. In addition to this the tube **3** is provided with a flange **5** which over a suitable packing **6** seals against the outer surface of the tube **2**. The tube **3** is also provided with one or more helical slots **7** extending from the end of the tube adjacent the axis **4** and to the other end of the tube where they either may terminate a certain distance from the end, or extend all the way to the end, thus dividing the tube in two or more helical strips.

The outer tube **2** is provided with slots which may be of any suitable form so that these slots intersect the slots in the tube **3**. The slots may either, as the slots **8** in FIG. 3, be arranged longitudinal with respect to the tube or, as the slots **9** in FIG. 4, be more or less inclined with respect to the longitudinal axis of the tubes. In the embodiment shown in FIG. 3 the tube **2** may be provided with equidistant distributed slots around its periphery, so that even distributed fluid jets are produced around the periphery of the tube.

In the embodiment shown in FIG. 4 jets are only generated within a certain sector. FIG. 2 shows a section of the apparatus according to FIG. 1 along the line A—A, where the outer tube is provided with slots **8** along part of its periphery so that fluid jets only are generated within a certain sector. A screener tube **3** as described above is provided with slots **7** which extend all the way to the end of the tube which is opposite to the driving axis **4**. This arrangement substantially reduces the risk for jamming. If, namely the tube **3** rotates in the direction indicated by the arrow **10** and if the supplied fluid for any reason contains solids which are greater than those which the apparatus normally is intended for, there is a certain risk that such a solid will stick in any of the movable openings. When, however, the tube is provided with slots, extending all the way to one of its ends and if it is manufactured from a suitable resilient material, it will yield if a particle gets stuck and thereby locally increase the distance between the inner wall of the tube **2** and the outer wall of the tube **3**. This gives the particle a possibility to move to an adjacent slot and in this way be ground or crushed until its size is reduced so that it may pass through one of the slots.

FIG. 5 shows a coarse screener provided with a spiral sprayer according to the invention. The coarse screener thus comprises a sprayer consisting of an inner shell **11** and an outer shell **12**. The inner shell **11** is at one of its ends by means of an axis **13** connected to suitable driving means so that the shell may be rotated. In the

embodiment shown, the sprayer is substantially coaxially arranged in a casting **14** provided with removable end walls **15** and fixed end walls **16**. The inner shell **11** is provided with one or more helical slots **17**, **17'** and the outer shell **12** is also provided with slots for example helical slots having opposite pitch or the like, or slots of the form indicated by **8** or **9** in FIGS. 3 and 4 respectively. The main thing is that the slots in the outer and the inner shell intersect each other so that openings are provided through the compounded shell.

The space between the outer shell **12** and the sides of the casing **14** is by means of suitable screens **19** divided into two chambers **20** and **21**. The apparatus operates in the following manner:

The fluid which is to be screened or filtered with respect to suspended solids, for example cellulose fibers or the like is under suitable pressure supplied to the inlet **18** which communicates with the stationary outer shell **12**. Since the inner shell is provided with slots along the greater part of its length and manufactured from a suitable resilient material it will be pressed by the fluid pressure against the inner surface of the outer shell and seal against it. Another advantage with this arrangement is that although the surfaces may be worn out they will still, due to the resiliency of the material, seal against each other. A further advantage of the arrangement described above is that if the loading on the inner shell exceeds its stiffness, due to its resiliency, the diameter of the inner shell will be reduced, which aids in reducing or eliminating the risk for jamming. The points mentioned above, where the slots in the outer and inner shells intersect will now constitute the openings to which the fluid is sprayed outwards in the form of radially outward directed jets.

The form of the jets, their distribution and intermittence will obviously be dependent on the arrangement of the slots and the peripheral speed of the inner tube. By suitable choice the jets may be made to travel upwards or downwards along the sprayer pipe and will thereby continuously hit the screen at different points. Hereby the effect is realized that the surface of the screen will be kept clean in an efficient way and the risk for clogging due to the build-up on the screen of remaining material is considerably reduced. Due to the movement of the jets they will flush or spray away material from the screen while at the same time the jets may cause a vibration or oscillation in the screen, which also prevents clogging. Fines, krills and fluid will pass through the screen or filter and leave the apparatus through the outlet **22** while the coarser particles, for example cellulose fibers, together with the remaining water may be extracted through the outlet **23**.

FIG. 7 shows an apparatus according to the invention used as a protection for a water inlet and the sprayer pipe functions as a cutter. The water inlet comprises a pipe **29** connected to the inner shell **30** which is enclosed in a tight fitting outer shell **31** which latter, by means of an axis **32**, is connected to a suitable driving means, not shown in the drawing. The inner shell is in this case provided with a plurality of helical slots for example in right-hand pitch and the outer shell is also provided with a plurality of slots **30** having opposite pitch. It is obvious that since the openings are movable the risk for a water inlet of this kind to clog will be very small. Sea-weed or the like will for example in reality be cut or crushed in the openings and the use of a cutter of this kind will, on account of its reliability, be very advantageous despite the extra arrangements required to keep the outer shell rotating. This will in particular be true for industries which are dependent on an uninterrupted water supply in their production. A cutter of the kind described is also very suitable in sewer systems or the like which may contain particles and matter of a very different kind. A cutter according to the invention may then preferably be connected before a pump so as to prevent clogging of the pump.



The cutter may also, of course, be provided with any suitable means for the removal of such matter which is concentrated around the cutter and which for any reason cannot be chopped by it.

FIG. 8 shows an apparatus according to a further embodiment of the invention adapted for coarse screening according to the hydrocyclon principle. The apparatus comprises a conical downward tapering vessel **33** provided with a tangential inlet **34** and an outlet **36** which is provided with a lock or sluice arrangement **35**. Coaxial with the conical vessel an apparatus according to the invention is provided which comprises a movable outer shell **37** and an outlet **38** which is in communication with a stationary inner shell **39**. Two different means for driving the outer rotating shell **37** have been indicated in the drawing, namely either by means of a worm gear comprising a worm **41** and a gear **40** or by means of an angular gear **42** and an axis **43** cooperating therewith, whereby the axis or worm, respectively, are connected to a suitable driving means not shown in the drawing. The fluid to be coarse-screened is pressure injected in the tangentially directed inlet **34**. This gives rise to a vortex movement of the liquid in the conical vessel causing the coarser and heavier particles to sink in a spiral towards the sluice **35** which is provided in the lower end of the vessel and from which the particles may be sluiced out in a known manner. The coaxially arranged device according to the invention is arranged to operate in approximately the same manner as described for the cutter shown in FIG. 7. Fluid and particles which are small enough to pass through the openings in the shells will consequently be carried away through the outlet **38**. The apparatus described comprises a coarse screener having all the advantages, earlier described with respect to small tendencies for clogging and high capacity.

FIGS. 9 and 10 show two different embodiments of a knot catcher, cutter or the like according to the invention comprising a cutter as described above. The arrangement shown in FIG. 9 comprises a cylinder **44** having an inlet **45** which cylinder is provided with helical slots and surrounded by an outer casing **47**. The outer casing **47** is provided with an outlet **48**. On the inside of the cylinder **44** a further shell **46** is arranged which also is provided with helical slots, preferably having opposite pitch with respect to the slots of the shell **44** so that when the inner shell is rotated the openings which are generated at the points where the slots intersect will be movable in the way previously described. The rotatable cylinder **46** is by means of an axle **49** connected to a motor, not shown in the drawings. The fluid which is to be screened with respect to coarser particles, knots or the like is under pressure fed to the inlet **34**. The fluid and those particles which are small enough to pass through the openings at the intersections of the slots are extracted through the outlet **48**. The casing **47** may, however, also comprise screening elements in approximately the same way as described in connection to FIG. 5 in which case the liquid will pass through the screening element so that concentrated or de-watered material may be extracted through the outlet **48**. The rotating cylinder or shell **46** is, in addition to the slots, also at its lower end provided with large openings **50**, **50'** so as to permit coarser material to pass out to an opening **51** in the outer cylinder and from there for example to a sluice **52**. The apparatus can consequently be used for treating a fluid which contains finer as well as coarser particles so that the coarser particles are removed from the fluid and the remaining suspension is dewatered or concentrated. FIG. 10 shows an apparatus of approximately the same kind as that shown in FIG. 9 with the exception that the inner cylinder **46** is completely open at its lower end so that the coarser material, the so-called reject, in a known manner is washed in counter flow by means of the nozzles **53** which latter arrangement may be used to replace the elements **50**, **51** and **52** shown in FIG. 9. The apparatus shown in

FIG. 10 may further be provided with an inlet 53*a* connected to a tube 54 which is closed in its other end and provided with a plurality of holes 55 or slots 56. Through the tube dilution liquid is added to the material to be screened and the openings may preferably be arranged in such a way that a great amount of dilution liquid will be supplied at the lower end of the apparatus. Such a continuous dilution of the material allows the material along the whole part of the screening surface to be kept at optimum consistency. As a matter of fact the material is gradually dewatered or thickened when it passes to the apparatus from the inlet to the reject outlet as the liquid is passed through the screen. The tube 54 is therefore provided with openings which in the example shown have the same diameter but which are closer spaced at the lower end of the tube.

Although the apparatus above has been described in some detail with reference to preferred embodiments it should be understood that the use of the invention is not limited to these embodiments. Since the apparatus provides a high specific load for unit surface of the screen, and is comparatively small and can be completely enclosed and exhibits a very small or negligible tendency to clog it may be suitable for replacing conventional dewatering apparatus of the drum type which are comparatively large and heavy and it should be especially suitable for dewatering in the lower concentration range.

In addition to this the apparatus described is particularly suitable for screening and fractionating in the paper and cellulose industry for example for screening of raycell fibers and fiber fragments for deinking and for depithing of pulp manufactured from annual plants, for separating pulp in different fractions and so on. The apparatus may also, if completed with suitable screening elements, be usable for ordinary cellulose screening.

What is claimed is:

A screening device for a liquid comprising an outer cylindrical shell having a closed end, an inner cylindrical shell mounted within the outer shell in sealed contact therewith, one of said shells having a plurality of helical slots, the other of the shells having a plurality of slots which are inclined with respect to the helical slots in the said one shell, means for providing relative rotation between said shells to cause said slots to successively register with one another, means for directing a liquid to be screened against a first of said shells such that liquid passes through the registered slots while solids in the liquid are screened by said shells and means for collecting the thus screened liquid.

**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 1,163,734 | 12/1915 | Binns | 239—538 |
| 2,558,376 | 6/1951 | Opp et al. | 239—563 |
| 2,796,146 | 6/1957 | Hersey et al. | 239—563 |
| 2,994,482 | 8/1961 | Valois et al. | 239—568 |
| 3,051,183 | 8/1962 | Jacobs | 239—568 |
| 3,136,324 | 6/1964 | Yendley | 239—538 |
| 3,146,953 | 9/1964 | Komanns | 239—538 |

FOREIGN PATENTS

| | | |
|---|---|---|
| 1,109,997 | 6/1961 | Germany. |

EVERETT W. KIRBY, *Primary Examiner.*

R. S. STROBEL, *Assistant Examiner.*