

Screen Separator

Field of the Invention

[001] This invention relates to a screen separator and refers particularly, though not exclusively, to a screen separator using vibrating motors.

Background of the Invention

[002] Present screen separators using vibrating motors may be relatively large structures. Covers are used to enclose the screen assemblies with it being normal for there to be a cover for each screen assembly. It can take two or more workers some time to remove the covers to enable a visual inspection to take place. Plus an elevated walkway is often required for this to be done.

[003] Also, present screen separators often have many components thus requiring a large inventory for manufacturers. This increases manufacturing costs, and makes maintenance more difficult.

[004] Furthermore, present screen separators have the screen assemblies installed so that it can be time consuming and difficult to remove one or more screen assemblies – particularly the screen assembly at the opposite end to the removal opening.

Summary of the Invention

[005] According to a first preferred aspect there is provided a screen separator comprising:

- (a) a frame;
- (b) a separator compartment mounted to and supported by the frame;
- (c) a separator compartment comprising:
 - (i) a pan,
 - (ii) at least one screen assembly for mounting in the separator compartment and having a screen frame and a screen,
 - (iii) and a cover mounted for pivotal movement relative to the pan between an open position and closed position;

wherein

(d) the cover when in the closed position and the pan co-operating to, in use, securely locate and retain the at least one screen assembly in position by application of force onto at least a part of the screen frame.

[006] According to a second preferred aspect there is provided a screen separator comprising:

- (a) a frame;
- (b) a separator compartment mounted to and supported by the frame;
- (c) the separator compartment comprising:
 - (i) a pan,
 - (ii) a cover mounted for pivotal movement relative to the pan between an open position and a closed position,
 - (iii) and a plurality of hold-down clamps for releasably holding the cover in the closed position;

wherein

(d) the cover, when in the closed position with the hold-down clamps engaged, the pan and the frame form a monocoque construction.

[007] According to a third preferred aspect there is provided a screen separator comprising:

- (a) a frame;
- (b) a separator compartment mounted to and supported by the frame;
- (c) the separator compartment comprising:
 - (i) a pan,
 - (ii) at least one screen assembly for mounting in the separator compartment and having a screen frame and a screen,
 - (iii) and a cover;

wherein

(d) the screen frame has compressive and tensile forces applied it when the cover is closed to force the screen into a slightly convex shape.

[008] According to a fourth preferred aspect there is provided a screen separator comprising:

- (a) a frame;
- (b) a separator compartment mounted to and supported by the frame and comprising a pan mounted to and suspended from the frame;

- (c) the frame comprising an upper frame comprising:
 - (i) a pair of spaced apart and generally parallel side rails,
 - (ii) and a pair of arcuate side members, each arcuate side member extending from adjacent a first end of the side rail to adjacent a second end of the side rail and being external of the side rail;
- (d) the frame further comprising a lower frame, the upper frame being mounted to the lower frame by the pair of arcuate side members.

[009] For all aspects the pan may have a tapered base with a central discharge outlet for screened material, and an air vent.

[010] The pan may further comprise an internal partition adjacent one end of the pan to form a discharge chamber, the discharge chamber having an oversize discharge outlet for oversize material.

[011] The frame may comprise an upper frame and a lower frame; the lower frame may comprise four corner posts each with a spring mounted to an upper end of the corner post; the upper frame may be mounted to a top pad attached to an upper end of each spring.

[012] The upper frame may comprise a pair spaced apart and generally parallel side rails, and an arcuate side member extending from adjacent a first end of each of the side rails to adjacent a second end of the side rail and being external of the side rail.

[013] The upper frame may further comprise end cross members extending between and joining the side rails, and cross-bracing members joining and being operatively connected to the arcuate side members and the side rails.

[014] The cover may further comprise an inlet feed, an air vent, and a longitudinally extending brace. The brace may have a hollow interior operatively connected to an inlet for fluid. There may also be at least one top spray nozzle mounted within the cover and being operatively connected to the hollow interior of the brace.

[015] The cover may further comprise a plurality of inspection ports arranged longitudinally on each side of the cover. Each inspection port may have a removable port cover.

[016] There may also be a pair of motors, each motor being mounted to a mounting plate, each mounting plate being mounted to the upper frame on opposite sides of the separator compartment, the mounting to the upper frame being to the cross-bracing members and to a beam extending between the mounting plates and being secured to the side rails.

[017] The beam and the cross-bracing members may extend through and be attached to the pan.

[018] When the cover is closed, the inlet feed may be located above a feed chute for feeding inlet material to the at least one screen assembly.

[019] The cover may further comprise a plurality of clean-in-place nozzles mounted internally of the cover and operatively connected to a manifold extending around the external periphery of the cover.

[020] The cover may have an outwardly extending peripheral flange below the manifold, there being an upper peripheral seal located between the peripheral flange and the manifold.

[021] The pan may have a peripheral vertical lip and a peripheral angle bar mounted to the pan below the peripheral vertical lip, and the upper frame may further comprise a channel section; there being a lower peripheral seal mounted between the peripheral vertical lip, the peripheral angle bar and the channel section.

[022] The end cross members and the cross-bracing members may each have at least one transverse seal mounted thereon, each transverse seal being in a retainer.

[023] The upper peripheral seal, the lower peripheral seal and the transverse seals may all be active seals.

[024] An active seal may comprise a first portion of a first material and/or character; and a second portion mounted in or to the first portion, the second portion being of a second material and/or character and being different to the first portion.

[025] The second portion may be an inflatable seal.

[026] The peripheral flange may press on ends of the at least one screen assembly to compress the ends against the lower peripheral seal.

[027] The transverse seals may press upwardly underneath sides of the at least one screen assembly to force the screen assembly into a slightly convex shape.

[028] The cross-bracing members and the arcuate side members may be hollow and may be operatively connected for the supply of a fluid to a plurality of lower nozzles mounted below, and operatively connected to, the cross-bracing members.

[029] The number of inspection ports on each side of the cover may be the same as the number of screen assemblies.

Brief Description of the Drawings

[030] In order that the present invention may be fully understood and readily put into practical effect, there shall now be described by way of non-limitative example only preferred embodiments of the present invention, the description being with reference to the accompanying illustrative drawings:

[031] In the drawings:

Figure 1 is a rear isometric view from above of the preferred embodiment with the cover closed;

Figure 2 is a rear isometric view from below corresponding to Figure 1;

Figure 3 is a top plan view of the frame of the preferred embodiment;

Figure 4 is a side view of the frame of Figure 3;

Figure 5 is a top plan view of the preferred embodiment;

Figure 6 is a side view of the preferred embodiment;

Figure 7 is an underneath view of the preferred embodiment;

Figure 8 is a top plan view in partial section;

Figure 9 is an enlarged cross-sectional view of a part of Figure 8;

Figure 10 is a cross-sectional view along the lines and in the direction of arrows A-A on Figure 8;

Figure 11 is an enlarged detail view of detail A on Figure 10;

Figure 12 is a longitudinal cross-section along the lines and in the direction of arrows B-B on Figure 8;

Figure 13 is an enlarged view of detail B on Figure 12; and

Figure 14 is a lateral, vertical cross-section of the preferred embodiment.

Detailed Description of the Preferred Embodiments

[032] The screen separator illustrated has a separator compartment 8 comprising cover 10 and a pan 12. The compartment 8 is mounted to and supported by a frame 14. The frame 14 comprises an upper frame 16 and a lower frame 18 with springs 20 between them. Motors 22 are mounted on either side of upper frame 16 to provide the vibration for the screening action.

[033] The cover 10 is preferably a single cover for covering all screen assemblies 104 within compartment 8 and is hingedly mounted at the rear of compartment 8 to a rigid end member 28. Rigid end member 28 forms part of the upper frame 16. The mounting is by hinges 30. One or more handles 32 on the front of the cover 10 may be used to assist the opening and closing of cover 10. A hydraulic or pneumatic ram 34 or one or both sides of compartment 8 may be used to provide mechanical assistance in the lifting of the cover 10, and to dampen the lowering of the cover 10. The rams 34 are preferably attached to the cover 10 at approximately the mid-point of the length of each side of cover 10 by an L-shaped bracket 36, the other end of each ram 34 being pivotally attached to a side rail 38 that forms part of the upper frame 16. The cover 10 is moveable relative to the pan 12 between an open position and as closed position.

[034] Mounted to the cover and approximately equally spaced around the cover 10, the periphery of cover 10, are a plurality of hold-down clamps 40. Each clamp 40 has a threaded rod 42 pivotally attached to cover 10, with a wing nut 44 threadingly engaged on rod 42. The rod 42 engages a latch 46 securely mounted on side rails 38 and end members 28 with a "pull, engage and tighten"

methodology. Preferably, the tightening (and thus loosening) requires a tool to prevent accidental release. In this way the cover 10, when closed, can be held securely closed.

[035] Inspection ports 48 with removable covers 50 may be provided along each side of cover 10 to enable operators to easily inspect the interior of compartment 8. The covers 50 may be able to be removed by hand action. Preferably, each port 48 is aligned with the centerline of a screen assembly 104 mounted within the compartment 8. More preferably, the number of inspection ports 48 in each side of cover 10 is the same as the number of screen assemblies within compartment 8.

[036] The cover 10 has an inlet feed 64 adjacent the rear end, and an air vent 66 adjacent the front end. A brace 68 extends along the longitudinal centre line of cover 10 from adjacent the rear end to adjacent the front end. The brace 68 may be hollow and may be used as a conduit and/or manifold for at least one spray nozzle 80 mounted within the cover 10 for providing a mist spray onto the produce being screened and/or for cleaning.

[037] An inlet 82 for fluid for the spray nozzle 80 is provided in cover 10, the inlet 82 being operatively connected to the interior of brace 68.

[038] When the cover 10 is closed, the inlet 64 is located above a feed chute 164 that feeds the input material to the screen assemblies 104.

[039] The upper frame member 16 comprises the rigid end members 28 (not shown on Figure 3 and 4), and the side rails 38; as well as end cross members 52 that join the side rails 38, arcuate side members 54, and cross-bracing members 56 that join and are operatively connected to the arcuate side members 54 and the side rails 38. The side rails 38 are generally parallel and spaced apart. The end cross members 52 the cross-bracing members 56 are parallel to each other, spaced apart, and perpendicular to the side rails 38. Each arcuate side member 54 is attached to the side rail 38 adjacent to each end of the side rail 38 and extends in an arcuate manner externally of the side rail 38.

[040] The arcuate side members 54 locate in grooves (not shown) in top pads 58 that engage in springs 20. By virtue of the curved nature of arcuate side members 54, this provides an accurate and secure mounting. The springs 20 are each

mounted on top of corner posts 60 of the lower frame 20. The corner posts 60 are joined by tubes 62. Shipping brackets 70 may be placed around springs 20 for shipping the screen separator.

[041] Mounted between each arcuate side member 54 and each side rail 38 are the two motors 22. Each motor 22 is a vibrating motor and is mounted on an mounting plate 24 that is securely attached to the cross-brace members 56. Each mounting plate 24 has the shape of a double S and is somewhat wave like. A motor mounting beam 72 extends across the compartment 8 and is securely attached to the side rails 38 as well as the mounting plates 24.

[042] Securely mounted to and suspended from the upper frame 16 is a pan 72 having a central discharge outlet 74 and an air vent 76. The pan 72 has a tapered base 78 to guide the screened material towards the discharge outlet 74. By pan 72 being securely mounted to upper frame 16, and the cover 10 being releasably but securely attached to the upper frame 16, when the cover 10 is closed and the hold-down clamps 40 engaged, both the pan 72 and the cover 10 contribute to the overall rigidity of the screen separator when in use. In this way, a monocoque-style construction is used. By utilizing a shape that is generally ovular or elliptical, this is further enhanced. The generally curved shape also reduces stress concentration in corners. It also means the weight can be reduced, thus enabling the size and power of motors 22 to be reduced. This has the effect of reducing operating costs by reducing power consumption.

[043] Further, as the motors 22 rotate in opposite directions and are inclined at 45° relative to the top frame 16, and are placed exactly opposite each other, the rotating weights create linear forces lifting the assembly upwards and forwards in a parallel plane. The motion is in one plane at 45° to the horizontal. The frequency matches the speed of the drive motors. In this way the centre of the forces is above the upper frame 16.

[044] As the pan 72 is welded or otherwise secured to the frame 16, it vibrates along with the frame 16. This ensures the discharge of all products, wet or dry, that pass through the screen assemblies 104. The linear motion of the screen assemblies 104 also transports the oversize material along the top of the screen assemblies 104 to a discharge outlet 82 for oversize material. This a continuous process as long as the motors 22 are running.

[045] The oversize discharge outlet 82 is from a discharge chamber 84 that is part of the pan 72 but is separated from the remainder of the pan 72 by an internal partition 86.

[046] In Figures 10 and 11 there is shown a plurality of clean-in-place ("CIP") nozzles 88 mounted to cover 10 and operatively connected to and supplied by a conduit/manifold 90 extending around the external periphery of cover 10. Manifold 90 is operatively connected to a CIP inlet 92. The CIP inlet 22 and nozzles 88 may be for a fluid such as water, a cleaning solution, or the like.

[047] If desired or required, the end cross members 52, cross-bracing members 56 and beam 26 may pass through pan 72. This enables pan 72 to be secured to them, further enhancing the structural rigidity of the screen separator.

[048] Furthermore, and as shown in Figures 8 and 9, the arcuate side members 54 and the cross-bracing members 56 may be hollow, with the hollow interiors being operatively connected. In that way a fluid (e.g. water, cleaning solution, or the like) can be sprayed into the pan 72 by pan nozzles 106 mounted to cross-bracing members 56 and operatively connected to the hollow interior of cross-bracing members 56.

[049] The pan 72 terminates at its upper periphery with a vertically extending lip 94. To the pan 72 below lip 94 is securely attached an L-shaped peripheral angle bar 96. Upper frame 16 has a channel section 98 secured thereto to which the latches 46 are mounted. Between lip 94, angle bar 96 and channel section 98 is mounted a lower, peripheral seal 10. The end 122 of frames 102 of the screen assemblies 104 locate on lower peripheral seal 10..

[050] The cover 10 has a peripheral flange 108 extending generally outwardly of cover 10. Between flange 108 and CIP manifold 90 is mounted an upper peripheral seal 110 for providing a seal between cover 10 and the channel section 98. Flange 108 locates on frame 102 of screen assemblies 104 when cover 10 is closed, and the closing action of hold-down clamps 40 forces flange 108 downwardly and outwardly to enhance the sealing action of seals 100 and 110, and to force the ends 122 of frames 102 of screen assemblies 104 downwardly onto lower peripheral seals 100.

[051] There are three screen assemblies 104 in the embodiment shown. However, there may be any required or desired number of screen assemblies 104 – one, two, three, four, five and so forth.

[052] As is described above, each screen assembly 104 locates on the lower peripheral seal 100 along the side rails 38. The transverse sides 124 of each screen assembly 104 locate on one of the end cross members 52 and/or cross-bracing members 56. The end cross members 52 each have a single transverse seal 112, and the cross-bracing members 56 each have two transverse seals 112.

[053] Each transverse seal 112 is located in a U-shaped retainer 114, each retainer 114 being secured to the respective member 52, 56.

[054] The seals 100, 110, 112 may be of any suitable type or form. Preferably, they are an active seal of the form having a first portion 116 of a first category and/or material, and a second portion 118 located in a groove in or above the first portion 116, and being of a second category and/or material. As illustrated, the first portion 116 is a static seal of a suitable material such as, for example, silicon; and the second portion is an inflatable seal using, for example, a fluid such as air, water, or an oil.

[055] Preferably, all second portions 118 of seals 100, 110, 112 are operatively joined or supplied from the same source of fluid so that when the seals 100, 110, 112 are activated by the supply of the fluid, all seals 100, 110 and 112 are activated together. In relative terms, this will be substantially simultaneously. The second portions have a central conduit 120 for this to happen.

[056] Therefore, when the cover 10 is closed and the hold-down clamps 40 engaged, flange 108 presses down on the frames 102 of each screen assembly 104. This, plus the active nature of seals 100, 110, 112, forces the ends 122 of screen frames 102 slightly downwardly and a compressive force is applied to the ends 122. At the same time, the sides 124 of screen frames are forced slightly upwardly due to seals 112. Therefore, the screens 126 of the screen assemblies 104 become slightly convex and thus are in tension. It also holds the screen assemblies 104 rigidly in place. This further enhances the structural rigidity of the screen separator. The slight convexity, plus the compressive and _____ forces,

It may also reduce the tendency of the screens 126 to flap. Furthermore, when the supply of fluid to the seals 100, 110, 112 is removed, hold-down clamps 40 released, and cover 10 raised, the forces that create the slight convexity are removed and thus the screen assemblies 104 will all resume their "normal" shape. This will break the seal between the screen assemblies 104 and the seals 100, 110, 112 to make it easier to remove the screen assemblies 104.

[057] The screen separator may be used in wet or dry single filtering, dewatering, scalping, de-dusting and classification applications. Relevant industries include, food, mining, chemicals, petrol-chemicals, powdered metals, pulp and paper, ceramics, electronic or specialty powders, rubbers, and reclaiming processes used in plastics.

[058] Whilst there has been described in the foregoing description preferred embodiments of the present invention, it will be understood by those skilled in the technology concerned that many variations or modifications in details of design or construction may be made without departing from the present invention. For example, the brace 68 could be a hollow strengthening rib in cover 10 integrally formed with the cover 10.

THE CLAIMS

1. A screen separator comprising:
 - (a) a frame;
 - (b) a separator compartment mounted to and supported by the frame;
 - (c) a separator compartment comprising:
 - (i) a pan,
 - (ii) at least one screen assembly for mounting in the separator compartment and having a screen frame and a screen,
 - (iii) and a cover mounted for pivotal movement relative to the pan between an open position and closed position;

wherein

 - (d) the cover when in the closed position and the pan co-operating to, in use, securely locate and retain the at least one screen assembly in position by application of force onto at least a part of the screen frame.

2. A screen separator comprising:
 - (a) a frame;
 - (b) a separator compartment mounted to and supported by the frame;
 - (c) the separator compartment comprising:
 - (i) a pan,
 - (ii) a cover mounted for pivotal movement relative to the pan between an open position and a closed position,
 - (iii) a plurality of hold-down clamps for releasably holding the cover in the closed position;

wherein

 - (d) the cover when in the closed position with the hold-down clamps engaged, the pan and the frame form a monocoque construction.

3. A screen separator comprising:
 - (a) a frame;
 - (b) a separator compartment mounted to and supported by the frame;
 - (c) the separator compartment comprising:
 - (i) a pan,
 - (ii) at least one screen assembly for mounting in the separator compartment and having a screen frame and a screen,
 - (iii) and a cover;

wherein

(d) the screen frame has compressive and tensile forces applied it when the cover is closed to force the screen into a slightly convex shape.

4. A screen separator comprising:

(a) a frame;

(b) a separator compartment mounted to and supported by the frame and comprising a pan mounted to and suspended from the frame;

(c) the frame comprising an upper frame comprising:

(i) a pair of spaced apart and generally parallel side rails,

(ii) and a pair of arcuate side members, each arcuate side member extending from adjacent a first end of the side rail to adjacent a second end of the side rail and being external of the side rail;

(d) the frame further comprising a lower frame, the upper frame being mounted to the lower frame by the pair of arcuate side members.

5. A screen separator as claimed in any one of claims 1 to 4, wherein the pan has a tapered base with a central discharge outlet for screened material, and an air vent.

6. A screen separator as claimed in any one of claim 1 to 5, wherein the pan further comprises an internal partition adjacent one end of the pan to form a discharge chamber, the discharge chamber having an oversize discharge outlet for oversize material.

7. A screen separator as claimed in any one of claims 1 to 3, 5 or 6, wherein the frame comprises an upper frame and a lower frame; the lower frame comprising four corner posts each with a spring mounted to an upper end of the corner post; the upper frame being mounted to a top pad attached to an upper end of each spring.

8. A screen separator as claimed in claim 7 when the upper frame comprises a pair spaced apart and generally parallel side rails, an arcuate side member extending from adjacent a first end of each of the side rails to adjacent a second end of the side rail and being external of the side rail.

9. A screen separator as claimed in claim 4, 7 or 8, wherein the upper frame further comprises end cross members extending between and joining the side rails, and cross-bracing members joining and being operatively connected to the arcuate side members and the side rails.
10. A screen separator as claimed in any one of claims 1 to 9, wherein the cover further comprises an inlet feed, an air vent, and a longitudinally extending brace; the brace having a hollow interior and being operatively connected to an inlet for fluid, at least one top spray nozzle being mounted within the cover and being operatively connected to the hollow interior of the brace.
11. A screen separator as claimed in any one of claims 1 to 10, wherein the cover further comprises a plurality of inspection ports arranged longitudinally on each side of the cover, each inspection port having a removable port cover.
12. A screen separator as claimed in claim 9 further comprising a pair of motors, each motor being mounted on a mounting plate, each mounting plate being mounted to the upper frame on opposite sides of the separator compartment, the mounting to the upper frame being to the cross-bracing members and to a beam extending between the mounting plates and being secured to the side rails.
13. A screen separator as claimed in claim 12, wherein the beam and the cross-bracing members extend through and are attached to the pan.
14. A screen separator as claimed in claim 10 when appended to claim 1 or claim 3, wherein, when the cover is closed, the inlet feed is located above a feed chute for feeding inlet material to the at least one screen assembly.
15. A screen assembly as claimed in any one of claims 1 to 14, wherein the cover further comprises a plurality of clean-in-place nozzles mounted internally of the cover and operatively connected to a manifold extending around the external periphery of the cover.
16. A screen assembly as claimed in claim 15, wherein the cover has an outwardly extending peripheral flange below the manifold, there being an upper peripheral seal located between the peripheral flange and the manifold.

17. A screen assembly as claimed in claim 7 or any one of claims 8 to 16 where appended to claim 7, wherein the pan has a peripheral vertical lip, an a peripheral angle bar mounted to the pan below the peripheral vertical lip; and the upper frame further comprises a channel section; there being a lower peripheral seal mounted between the peripheral vertical lip, the peripheral angle bar and the channel section.

18. A screen separator as claimed in 9 or any one of claims 10 to 17 when appended to claim 9, wherein the end cross members and the cross-bracing members each has at least one transverse seal mounted thereon, each transverse seal being in a retainer.

19. A screen separator as claimed in claims 16, 17 and 18, wherein the upper peripheral seal, the lower peripheral seal and the transverse seals are all active seals.

20. A screen separator as claimed in claim 19, wherein the active seals comprise a first portion of a first material and/or character; and a second portion mounted in or to the first portion, the second portion being of a second material and/or character and being different to the first portion.

21. A screen separator as claimed in claim 20, wherein the second portion is an inflatable seal.

22. A screen separator as claimed in any one of claims 19 to 21, wherein the peripheral flange presses an ends of the at least one screen assembly to compress the ends against the lower peripheral seal.

23. A screen separator as claimed in any one of claims 19 to 22, wherein the transverse seals press upwardly underneath sides of the at least one screen assembly to force the screen assembly into a slightly convex shape.

24. A screen separator as claimed in any one of claims 10 to 23, when appended to claim 9, wherein the cross-bracing members and the arcuate side members are hollow and are operatively connected for the supply of a fluid to a plurality of lower nozzles mounted below and operatively connected to the cross-bracing members.

25. A screen separator as claimed in claim 11 or any one of claims 12 to 24 when appended to claim 11, wherein the number of inspection ports on each side of the cover is the same as the number of screen assemblies.