

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
9 November 2006 (09.11.2006)

PCT

(10) International Publication Number
WO 2006/118938 A2

(51) International Patent Classification: Not classified

(21) International Application Number:
PCT/US2006/015999

(22) International Filing Date: 26 April 2006 (26.04.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/676,691 30 April 2005 (30.04.2005) US

(71) Applicant (for all designated States except US): M-I L.L.C. [US/US]; 5950 North Course Drive, Houston, TX 77072 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): RICHARDSON, Gregory [US/US]; 5519 Baldwin Elm Street, Richmond, TX 77469 (US). CARR, Brian, S. [US/US]; 4664 Catalpa Ct., Burlington, KY 41005 (US). KING, Keith, J.; 1620 Agee Road, Owenton, KY 40359 (US).

(74) Agent: BALLEW, Kimberly, D.; M-I L.L.C., 5950 North Course Drive, Houston, TX 77072 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

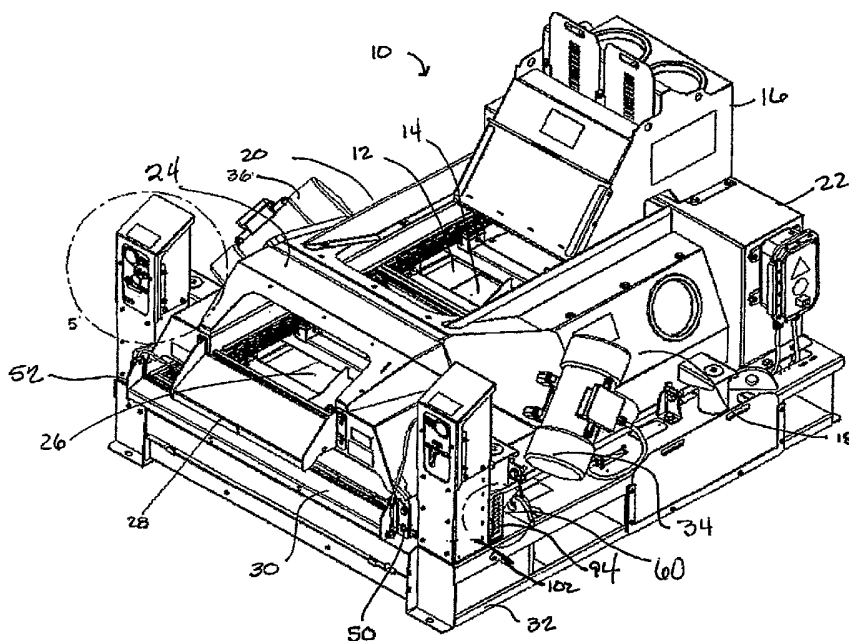
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND APPARATUS FOR ANGULARLY POSITIONING A SHAKER SEPARATOR BED



(57) Abstract: An apparatus for angularly positioning a shaker bed, including a discharge end, includes an air source providing pressurized air, an hydraulic tank in selective communication with the air source and containing a quantity of fluid, at least one bellow in selective fluid communication with the hydraulic tank, and a lift control assembly controlling communication of pressurized air between the air source and the hydraulic tank and controlling communication of fluid between the hydraulic tank and the at least one bellow.

WO 2006/118938 A2

METHOD AND APPARATUS FOR ANGULARLY POSITIONING A SHAKER SEPARATOR BED

This application claims priority to U.S. Provisional Patent Application Serial Number 60/676,691 filed on April 30, 2005 entitled, "Method and Apparatus for Angularly Positioning a Shaker Separator Bed" incorporated herein by reference for all purposes.

BACKGROUND OF INVENTION

Rotary drilling methods employing a drill bit and drill stems have long been used to drill wellbores in subterranean formations. Drilling fluids or muds are commonly circulated in the well during such drilling to cool and lubricate the drilling apparatus, lift drilling cuttings out of the wellbore, and counterbalance the subterranean formation pressure encountered. The recirculation of the drilling mud requires the fast and efficient removal of the drilling cuttings and other entrained solids from the drilling mud prior to reuse. Shaker separators are commonly used to remove the bulk solids from the drilling mud.

A shaker separator consists of an elongated, box-like, rigid bed and a screen attached to, and extending across, the bed. The bed is vibrated as the material to be separated is introduced to the screen which moves the relatively large size material along the screen and off the end of the bed. The liquid and/or relatively small sized material is passed into a pan. The bed can be vibrated by pneumatic, hydraulic, or rotary vibrators, in a conventional manner.

Various solids are brought up from the wellbore with the mud, including drill cuttings, clay, and debris. Sometimes clay that is directed into the shaker separator with the drilling fluid is sticky and heavy. Such solids risk causing screen breakage because they stick to the screen and are not transported to the discharge end of the shaker in an efficient manner. In such cases, it is desirable to lower the discharge end of the shaker bed to assist in the removal of the sticky solids from the screen.

At other times, coarse solids are easily conveyed along the top of the screen by the vibratory motion of the shaker. In order to preserve the drilling mud and increase the volume flow rate of the mud being directed into the separator, it is desirable to raise the discharge end of the shaker bed. When the discharge end is raised, the mud flow rate may be maximized while mud loss over the screen is minimized.

Some shaker separators have been built with systems to elevate the discharge end of the shaker bed. Many of these systems have employed manual operation techniques, such as hand wheels or jacks, to raise and lower the end of the bed. Other systems have included hydraulic lifts that are independently actuated, often requiring time and finesse by the operator to laterally level the discharge end of the shaker bed. Further, these systems have also included solenoids, which may be undesirable in the hazardous locations in which shaker separators are often used, particularly when separating drill cuttings from drilling mud. Thus, there is a need for a system to raise the discharge end of the shaker bed quickly and safely while keeping it level from side to side.

SUMMARY

In one aspect, the invention relates to an apparatus for angularly positioning a shaker bed including a discharge end, the apparatus including an air source providing pressurized air, an hydraulic tank in selective communication with the air source and containing a quantity of fluid, at least one bellow in selective fluid communication with the hydraulic tank, and a lift control assembly controlling communication of pressurized air between the air source and the hydraulic tank and controlling communication of fluid between the hydraulic tank and the at least one bellow.

In another aspect, the invention relates to an apparatus for angularly positioning a shaker bed including a discharge end, the apparatus including an air source providing pressurized air, an hydraulic tank in selective communication with the air source and containing a quantity of fluid, at least one bellow in selective fluid communication with the hydraulic tank, and a lift control assembly controlling communication of pressurized air between the air source and the hydraulic tank and controlling communication of fluid between the hydraulic tank and the at least one bellow, wherein the lift control assembly includes a tank control valve selectively actuated to communicate air between the air source and the hydraulic tank, a skinner fluid valve selectively actuated to communicate fluid between the hydraulic tank and the at least one bellow, a shuttle valve selectively actuated to actuate the skinner fluid valve, a first pilot control valve selectively operable to simultaneously communicate air from the air source to actuate the shuttle valve and to actuate the tank control valve, wherein when the tank control valve is actuated, air is communicated into the hydraulic tank to displace fluid therein and when the shuttle valve is actuated, the skinner fluid valve communicates the displaced fluid from the hydraulic tank to the at least one bellow to raise the discharge end, a second pilot control valve selectively operable to communicate air from the air source to the shuttle valve, wherein when the second pilot control valve is operated, the tank control valve vents air from the hydraulic tank and actuation of the shuttle valve actuates the skinner fluid valve to communicate fluid between the at least one bellow and the hydraulic tank, and wherein the weight of the discharge end compresses the at least one bellow to force fluid from the at least one bellow to the hydraulic tank, thereby lowering the discharge end.

In yet another aspect, the invention is directed to a method of angularly adjusting a shaker bed, wherein the shaker bed includes a discharge end having a discharge end weight, the method including positioning a first valve to set the desired direction of travel for the discharge end, operating a second valve to communicate air from an air source to an actuator of a third valve, wherein air from the air source actuates the third valve to communicate fluid between an hydraulic tank and at least one bellow coupled to the discharge end, wherein when the first valve is positioned to raise the discharge end, air is communicated from the air source to the hydraulic tank, thereby displacing fluid in the hydraulic tank and forcing the fluid into the at least one bellow and when the first valve is positioned to lower the discharge end, air is vented from the hydraulic tank and fluid from the at least one bellow is forced back into the hydraulic tank by the discharge end weight, and releasing the second valve when the discharge end has reached the desired location.

Other aspects and advantages of the claimed subject matter will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a shaker assembly.

FIG. 2 is a perspective view of an embodiment of a shaker lift system.

FIG. 3 is a perspective view of a lift control assembly for the shaker lift system.

FIG. 4 is a piping and instrumentation diagram of an embodiment of the shaker lift system.

FIG. 5 is a perspective view of a control panel.

FIG. 6 is a perspective view of an angle indicator.

FIG. 7 is a piping and instrumentation diagram of an embodiment of the shaker lift system.

DETAILED DESCRIPTION

Referring to FIG. 1, the reference numeral 10 refers, in general, to a vibrating screen separator assembly that includes a frame, or bed 12, that includes a bottom wall 14 having an opening (not shown), a pair of side walls 18 and 20, and a cross support member 24 coupled between the walls 18, 20. Actuator 34 and 36, respectively for imparting motion to the bed 12 are also coupled to the support member 24.

A flow box 16 is located at a feed end 22 of the shaker bed 12 to direct solid-bearing drilling mud to the screens 26, located therein. A slide 28 may be located at the discharge end 30 of the shaker bed 12 to direct separated solids to a collection area (not shown). The shaker 10 may be mounted to a skid 32 to facilitate transport of the shaker 10 to the drill site as well as to aid in the positioning and relocation of the shaker 10 within the drill site.

Referring to FIG. 2, the lift system 40 includes a lift control assembly 42, a hydraulic tank 44, a first bellow 46, and a second bellow 48. The first and second bellows 46, 48 are located near opposing corners 50, 52 of the discharge end 30 of the shaker bed 12 (shown in FIG. 1). A shroud 54 is mounted to each of the first and second bellows 46, 48 to help protect them from damage. An adapter plate 56 mounted to each shroud 54 attaches to an adjacent side wall 18, 20 near the discharge end 30 of the shaker separator 10. In one embodiment, shown in FIG. 2, the lift control assembly 42 is located at the discharge end 30 of the shaker bed 12 and the hydraulic tank 44 is shown to be at the feed end 22 of the shaker bed 12. However the location of the lift control assembly 42 and the hydraulic tank 44 may be varied such that the lift control assembly 42 is located anywhere along the perimeter of the shaker assembly 10 where it is reachable by an operator and the hydraulic tank 44 is located in such proximity to first and second bellows 46 and 48 that fluid communication may reasonably be maintained between the hydraulic tank 44 and the bellows 46, 48.

The lift control assembly 42 is operable to control pressurized air to and from the hydraulic tank 44 as well as to control communication of fluid between the hydraulic tank 44 and each of the bellows 46, 48. As will be described, the lifting system 40 utilizes an air over fluid hydraulic system to raise and lower the discharge end 30 of the shaker bed 12, thereby providing a range of incline to the bed 12 of the shaker separator 10.

The hydraulic tank 44 is provided with a predetermined amount of liquid. In one embodiment, the liquid is water, such as when the shaker separator 10 is to be operated in temperatures where the water will not freeze. In one embodiment, the liquid is a fluid having an hydraulic fluid having a freezing point low enough for use in cold climates. A pneumatic line 72 directs air into the hydraulic tank 44 from the lift control assembly 42. A first hydraulic line 80 directs the liquid to the bellows 46, 48. The flow through the first hydraulic line 80 is controlled by the lift control assembly 42. Thus, there is not a continuously open flow line between the hydraulic tank 44 and the bellows 46, 48.

Referring to FIGS. 3 and 4, the lift control assembly 42 includes an air inlet 62 into which pressurized air is fed. The pressurized air is provided to a first valve 64 via a first pneumatic line 66 and to a second valve 68 via a first pilot line 70. The first valve 64 is connected to a second pneumatic line 72 leading to the hydraulic tank 44. A third valve 74 has an actuator 76 that is connected via a second pilot line 78 to the second valve 68. The third valve 74 opens and closes a pathway between a first hydraulic line 80 from the hydraulic tank 44 and a hydraulic junction 82 providing liquid to second and third hydraulic lines 84, 86 leading to the first and second bellows 46, 48. The lift control assembly 42 is discussed in further detail below.

Fluid to the first bellow 46 is provided through second hydraulic line 84 while fluid to the second bellow 48 is provided through third hydraulic line 86. The second and third hydraulic lines 84, 86 are connected to the hydraulic junction 82 in parallel such that, when the third valve 74 is open, liquid is communicated to the first and second bellows 46, 48 simultaneously. Further, when the third valve 74 is closed, the liquid may be communicated between the first bellow 46 and the second bellow 48 via the second and third hydraulic lines 84, 86.

Continuing to refer to FIGS. 2 – 4, air from a pressurized air supply 88 enters the lift control system 40 through the air inlet 62. A pressure regulator 90 is preferably included at the inlet 62 to provide an air stream at a predetermined pressure to the system. The preferred pressure will depend upon the weight to be lifted and the physical properties of the liquid to be communicated between the hydraulic tank 44 and the first and second bellows 46, 48 at within the anticipated ambient operating conditions. A pressure gauge 92 is preferably included along the second pneumatic line 72 between the first valve 64 and the hydraulic tank 44 to use in the adjustment of the pressure regulator 90.

Air from the pressure regulator 90 is provided to the first valve 64 through the first pneumatic line 66 and to the second valve 68 through the first pilot line 70. The first valve 64 can be toggled between two positions, corresponding to raising and lowering the discharge end 30 of the shaker bed 12. Further, the first valve 64 is a three-way valve, that is there are three ports into or out of which air may be directed. In a first position, corresponding to the operation of raising the discharge end 30, the pressurized air from the regulator 90 enters one port of the first valve 64 and exits a second port of the first valve 64, which port directs the air to the second pneumatic line 72 and the hydraulic tank 44. In a second position of the first valve 64, corresponding to the operation of lowering the discharge end 30, air, displaced by fluid forced back into the hydraulic tank 44, is forced from the hydraulic tank 44 through the second pneumatic line 72 to the first valve 64 is vented through a third port of the first valve 64. In one embodiment, the first valve 64 is a three-way, two position ball valve.

In one embodiment, the second valve 68 is biased to a closed position such that the pressurized air from the first pilot line 70 is not directed to the second pilot line 78 unless the second valve 68 is manually actuated. While in the normally closed position, the second valve 68 provides a vent for air in the second pilot line 78. Upon actuation of the second valve 68, the pressurized air from the first pilot line 70 is directed to the second pilot line 78. Air directed through the second pilot line 78 provides communication to the actuator of the third valve 74, thereby actuating the third valve 74 when the second valve 68 is actuated. In one embodiment, the second valve 68 is a signal valve.

The third valve 74 is biased to a closed position thereby preventing communication of liquid through the first hydraulic line 80 to the hydraulic junction 82. As previously explained, when the third valve 74 is actuated, fluid flow between the hydraulic tank 44 and the first and second bellows 46, 48 is open. In one embodiment, the third valve 74 is a two-way ball valve.

Referring to FIGS. 2, 3, and 6, to operate the lifting system 40, an operator will position the first valve 64 in a desired position corresponding to whether the shaker discharge end 30 will be raised or lowered. To lift the discharge end 30 of the shaker separator 10, the operator will place the first valve 64 in a corresponding position using a handle, knob, or other such operator interface. Air from the air supply 88 as regulated by the pressure regulator 90 is directed through the first valve 64 to the hydraulic tank 44. So long as the third valve

74 is closed, communication of fluid from the hydraulic tank 44 to the first and second bellows 46, 48 is prevented and the shaker 10 will maintain its initial incline. To raise or lower the discharge end 30, the operator actuates the second valve 68 thereby providing pressurized air to the actuator 76 of the third valve 74. Actuation of the third valve 74 opens the passage between the first hydraulic line 80 and the hydraulic junction 82. The pressurized air fed into the hydraulic tank 44 as a result of positioning the first valve 64 in the desired position, forces the liquid in the tank 44 through the first hydraulic line 80 to the hydraulic junction 82. From the hydraulic junction 82, the fluid is directed through the second and third hydraulic lines 84, 86 to the first and second bellows 46, 48 respectively. As the fluid fills the first and second bellows 46, 48, each bellow 46, 48 expands to raise the discharge end 30 of the shaker separator 10. Once the desired incline of the bed 12 is achieved, the operator releases the second valve 68, thereby closing it and releasing the actuator 76 of the third valve 74. When the actuator 76 is released, the third valve 74 returns to a closed position. Thus, the fluid transferred to the first and second bellows 46, 48 and the second and third hydraulic lines 84, 86 is confined. If the first bellow 46 contains more fluid than the second bellow 48 or vice versa, the weight of the shaker separator 10 will force the fluid to equalize between the first bellow 46 and the second bellow 48, thereby leveling the discharge end 30 from side to side.

To lower the discharge end 30 of the shaker separator 10, an operator places the first valve 64 to a second position corresponding to lowering the discharge end 30, again using a handle, knob, or other such interface device. When the first valve 64 is placed into the second position, any air under pressure in the second pneumatic line 72 and the hydraulic tank 44 may be vented. So long as the third valve 74 remains closed, only a minimal amount of air will be vented and the discharge end 30 will remain in the raised position. The operator actuates the second valve 68 to open fluid communication from the air supply 88 to the actuator 76 of the third valve 74. When the air through the second pilot line 78 actuates the third valve 74, the third valve 74 opens to provide fluid communication of the liquid between the first and second bellows 46, 48 and the hydraulic tank 44. With pressure on the fluid released, the fluid moves back into the hydraulic tank 44 while the third valve 74 is open. The weight of the shaker separator 10 on the first and second bellows 46, 48 forces the liquid back into the hydraulic tank 44. Air from the hydraulic tank 44, displaced by the liquid, is forced back through the second pneumatic line 72 and vented through the first valve 64. When the bed 12 of the shaker separator 10 has reached the desired declination angle, the operator releases the second valve 68 to stop the flow of liquid from the first and second bellows 46, 48 to the hydraulic tank 44. This again confines the fluid in the first and second bellows 46, 48 and the second and third hydraulic lines 84, 86 and freezes the discharge end 30 in the desired position.

Referring to FIGS. 1, 2, and 6, to assist the operator in adjusting the discharge end 30 of the shaker separator 10, a means for indicating a position of the discharge end 60 may be coupled between the shaker bed 12 and the floor or skid on which the shaker 10 is located. Indicator plates 94 may be located adjacent to one or both of the bellows 46, 48. The indicator plates 94 may include graduation lines corresponding desired positions of the discharge end 30. Graduation lines may correspond to a height of the discharge end 30 above the skid or the floor. Graduation lines may correspond to an angle of the shaker bed 12 with respect to the skid or the floor. A marker 96, or pointer, such as piece of formed sheet metal coupled to the bed 12 of the shaker separator 10 may be used to mark the angle of incline of the discharge end 30 of the shaker separator 10 relative to the skid 32 or floor to which the shaker separator 10 is mounted.

Referring to FIG. 2, a track system 98 may be provided to guide the vertical movement of each of the first and second bellows 46, 48. The track system 98 includes upright plates 100, 102 located on opposing sides of each bellow 46, 48. The inner upright plate 100 for the first bellow 46 is shown in FIG. 2, while the corresponding outer upright plate 102 may be seen in FIG. 1. Each upright plate 100, 102 has a vertical track 104 along its inner surface 106. Each shroud 54 is provided with rollers 108, which roll along the track 104. A wall 110 extending from each upright plate 100, 102 helps keep the rollers 108 in a confined area near the track 104.

One of skill in the art will appreciate that some variation of the components described are possible. For example the first and second bellows 46, 48 may be replaced with other types of hydraulic lifters. Another variation includes replacing the first and second bellows 46, 48 with a single lifter centrally located along the discharge end 30 of the shaker bed 12.

In one embodiment of the lifting system 40', depicted in FIG. 7, the lift control assembly 42' includes a tank control valve 64', a pair of pilot control valves 68', 68'', a shuttle valve 112, and a skinner fluid valve 74'. The pilot control valves 68', 68'' and the skinner fluid valve 74' are biased to a closed position. Air from an air supply (not shown) is split, with a first stream directed through a pressure regulator 90 to the tank control valve 64' and a second stream split again into a first sub-stream and a second sub-stream. The first sub-stream is directed to the first pilot control valve 68' and the second sub-stream is directed to the second pilot control valve 68''.

A pneumatic line 72 connects the tank control valve 64' to the hydraulic tank 44. A first pilot line 70' connects the first pilot valve 68' to the shuttle valve 112 and a second pilot line 70'' connects the second pilot valve 68'' to the shuttle valve 112. A third pilot line 78' connects the shuttle valve 112 to an actuator 76' on the skinner fluid valve 74'. A first hydraulic line 80' connects the hydraulic tank 44 to the skinner fluid valve 74'. A second hydraulic line 114 splits into two sub-hydraulic lines 84', 86' going to each of the bellows 46, 48, which are coupled to the shaker separator 10 near the discharge end 30.

To raise the discharge end 30 of the shaker separator 10, an operator actuates the first pilot valve 68'. Air flows through the first pilot valve 68' to the shuttle valve 112 and to a pilot port of the tank control valve 64'. The shuttle valve 112 directs the air to the third pilot line 78' and actuates the skinner fluid valve 74'. Actuation of the skinner fluid valve 74' opens fluid communication between the hydraulic tank 44 and the bellows 46, 48 through the first hydraulic line 80' and the second hydraulic line 114. The air flow to the pilot port of the tank control valve 64' actuates the tank control valve 64' to provide pressure regulated air to the hydraulic tank 44. The pressure regulated air displaces fluid in the hydraulic tank 44, causing the fluid to exit the tank 44 through the first hydraulic line 80'. The fluid is forced from the tank 44 through the skinner fluid valve 74' into the bellows 46, 48, causing them to expand and raise the discharge end 30 of the shaker separator 10. When the first pilot valve 68' is released by the operator, air pressure through the first pilot line 70' to the shuttle valve 112 and air pressure to the pilot port of the tank control valve 64' drops. The drop in air pressure on the shuttle valve 112 releases the actuation of the skinner fluid valve 74', returning it to its normally closed position and terminating fluid communication between the hydraulic tank 44 and the bellows 46, 48. The drop in air pressure to the tank control valve 64' releases it to its normal position wherein air in the hydraulic tank 44 and the pneumatic line 72 is vented and air flow into the hydraulic tank 44 from the air supply is stopped.

To lower the discharge end 30 of the shaker separator 10, the operator actuates the second pilot valve 68''. When the second pilot valve 68'' is actuated, air is directed to the shuttle valve 112. The pilot signal to the shuttle valve 112 causes it to open and provide air flow to the third pilot line 78', thereby actuating the skinner fluid valve 74'. Upon actuation of the skinner fluid valve 74', the first and second hydraulic lines 80', 114 are in fluid communication, providing fluid communication between the bellows 80', 114 and the hydraulic tank 44. The tank control valve 64' remains in its biased position wherein air from the hydraulic tank 44 is vented therethrough. The bellows 46, 48 are compressed by the weight of the shaker separator 10 causing the fluid therein to flow back to the hydraulic tank 44. Air displaced by the fluid is vented through the tank control valve 64'. When the bed 12 has reached the desired angle, the operator releases the second pilot valve 68'', forcing the cessation of the pilot signal to the shuttle valve 112 and the return of the skinner fluid valve 74' to its biased, closed position. The closure of the skinner fluid valve 74' stops flow from the bellows 46, 48 to the hydraulic tank 44 and the bed 12 is maintained at the desired angle.

In one embodiment, an electrical interlock solenoid valve 116 is included in parallel with the skinner fluid valve 74' between the first and second hydraulic lines 80', 114. In one embodiment, a needle valve 118 and silencer 120 is included at the venting port of the tank control valve 64'. In one embodiment, a filter 122 is included at the inlet to the lift control assembly 42'.

While the claimed subject matter has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments can be devised which do not depart from the scope of the claimed subject matter as disclosed herein. Accordingly, the scope of the claimed subject matter should be limited only by the attached claims.

WHAT IS CLAIMED:

1. An apparatus for angularly positioning a shaker bed including a discharge end, the apparatus comprising:
 - an air source providing pressurized air;
 - an hydraulic tank in selective communication with the air source and containing a quantity of fluid;
 - at least one bellow in selective fluid communication with the hydraulic tank; and
 - a lift control assembly controlling communication of pressurized air between the air source and the hydraulic tank and controlling communication of fluid between the hydraulic tank and the at least one bellow.
2. The apparatus of claim 1, wherein the lift control assembly comprises:
 - a first valve selectively operable to communicate air between the air source and the hydraulic tank;
 - a second valve selectively operable to communicate air between the air source and a pilot line; and
 - a third valve including an actuator in communication with the pilot line, wherein when air is communicated through the pilot line to the actuator, the third valve communicates fluid between the hydraulic tank and the at least one bellow and when air is not communicated through the pilot line to the actuator, the third valve prevents fluid communication between the hydraulic tank and the at least one bellow.
3. The apparatus of claim 1, further comprising:
 - two bellows in selective fluid communication with the hydraulic tank and in fluid communication with each other; and
 - wherein the lift control assembly includes:
 - a first valve selectively operable to communicate air between the air source and the hydraulic tank;
 - a second valve selectively operable to communicate air between the air source and a pilot line; and
 - a third valve including an actuator in communication with the pilot line, such that when air is communicated through the pilot line to the actuator, the third valve communicates fluid between the hydraulic tank and the bellows and when air is not communicated through the pilot line to the actuator, the third valve prevents fluid communication between the hydraulic tank and the bellows and the bellows remain in fluid communication with each other.
4. The apparatus of claim 1, further comprising:
 - means for indicating a position of the discharge end of the shaker bed coupled between the shaker bed and a skid on which the shaker is located.
5. The apparatus of claim 4, wherein the means for indicating a position of the discharge end of the shaker bed comprises:
 - an indicator plate coupled to the skid and having a graduation lines corresponding to the location of the discharge end;
 - a marker coupled to the shaker bed;
 - wherein the marker moves with the discharge end and points to a location on the indicator plate to designate the position of the discharge end.

6. The apparatus of claim 5, wherein the means for indicating a position of the discharge end of the shaker bed further comprises:
- a track system including:
 - upright plates coupled to the skid;
 - at least one vertical track coupled to each upright plate;
 - a wall extending from each upright plate and spaced apart from the vertical track; and
 - at least one roller coupled to each bellow and in contact with each vertical track such that the roller is retained in the space between the vertical track and the corresponding wall.
7. The apparatus of claim 1 further comprising:
- a regulator communicating air from the air source to the lift control system at a predetermined pressure.
8. The apparatus of claim 7 further comprising:
- a pressure gauge located between the lift control system and the hydraulic tank providing visual indication of the air pressure.
9. An apparatus for angularly positioning a shaker bed including a discharge end, the apparatus comprising:
- an air source providing pressurized air;
 - an hydraulic tank in selective communication with the air source and containing a quantity of fluid;
 - at least one bellow in selective fluid communication with the hydraulic tank; and
 - a lift control assembly controlling communication of pressurized air between the air source and the hydraulic tank and controlling communication of fluid between the hydraulic tank and the at least one bellow;
- wherein the lift control assembly includes:
- a tank control valve selectively actuated to communicate air between the air source and the hydraulic tank;
 - a skinner fluid valve selectively actuated to communicate fluid between the hydraulic tank and the at least one bellow;
 - a shuttle valve selectively actuated to actuate the skinner fluid valve;
 - a first pilot control valve selectively operable to simultaneously communicate air from the air source to actuate the shuttle valve and to actuate the tank control valve;
- wherein when the tank control valve is actuated, air is communicated into the hydraulic tank to displace fluid therein and when the shuttle valve is actuated, the skinner fluid valve communicates the displaced fluid from the hydraulic tank to the at least one bellow to raise the discharge end;
- a second pilot control valve selectively operable to communicate air from the air source to the shuttle valve;
- wherein when the second pilot control valve is operated, the tank control valve vents air from the hydraulic tank and actuation of the shuttle valve actuates the skinner fluid valve to communicate fluid between the at least one bellow and the hydraulic tank; and
- wherein the weight of the discharge end compresses the at least one bellow to force fluid from the at least one bellow to the hydraulic tank, thereby lowering the discharge end.

10. The apparatus of claim 9, further comprising:
means for indicating a position of the discharge end of the shaker bed coupled between the shaker bed and a skid on which the shaker is located.
11. The apparatus of claim 10, wherein the means for indicating a position of the discharge end of the shaker bed comprises:
an indicator plate coupled to the skid and having a graduation lines corresponding to the location of the discharge end;
a marker coupled to the shaker bed;
wherein the marker moves with the discharge end and points to a location on the indicator plate to designate the position of the discharge end.
12. The apparatus of claim 11, wherein the means for indicating a position of the discharge end of the shaker bed further comprises:
a track system including:
upright plates coupled to the skid;
at least one vertical track coupled to each upright plate;
a wall extending from each upright plate and spaced apart from the vertical track; and
at least one roller coupled to each bellow and in contact with each vertical track such that the roller is retained in the space between the vertical track and the corresponding wall.
13. The apparatus of claim 9, further comprising:
a regulator adjustable to communicate air from the air source to the lift control system at a predetermined pressure.
14. A method of angularly adjusting a shaker bed, wherein the shaker bed includes a discharge end having a discharge end weight, the method comprising:
positioning a first valve to set the desired direction of travel for the discharge end;
operating a second valve to communicate air from an air source to an actuator of a third valve, wherein air from the air source actuates the third valve to communicate fluid between an hydraulic tank and at least one bellow coupled to the discharge end;
wherein when the first valve is positioned to raise the discharge end, air is communicated from the air source to the hydraulic tank, thereby displacing fluid in the hydraulic tank and forcing the fluid into the at least one bellow and when the first valve is positioned to lower the discharge end, air is vented from the hydraulic tank and fluid from the at least one bellow is forced back into the hydraulic tank by the discharge end weight; and
releasing the second valve when the discharge end has reached the desired location.
15. The method of claim 14 further comprising:
adjusting a regulator to provide air from the air source at a predetermined pressure.
16. The method of 14 further comprising:
measuring the location of the discharge end.
17. The method of claim 16, wherein measuring the location of the discharge end comprises:
observing a location of a marker coupled to the discharge end;
comparing the location of the marker with a stationary indicator plate.

18. The method of claim 17, wherein the indicator plate includes graduation lines corresponding to predetermined positions of the discharge end.

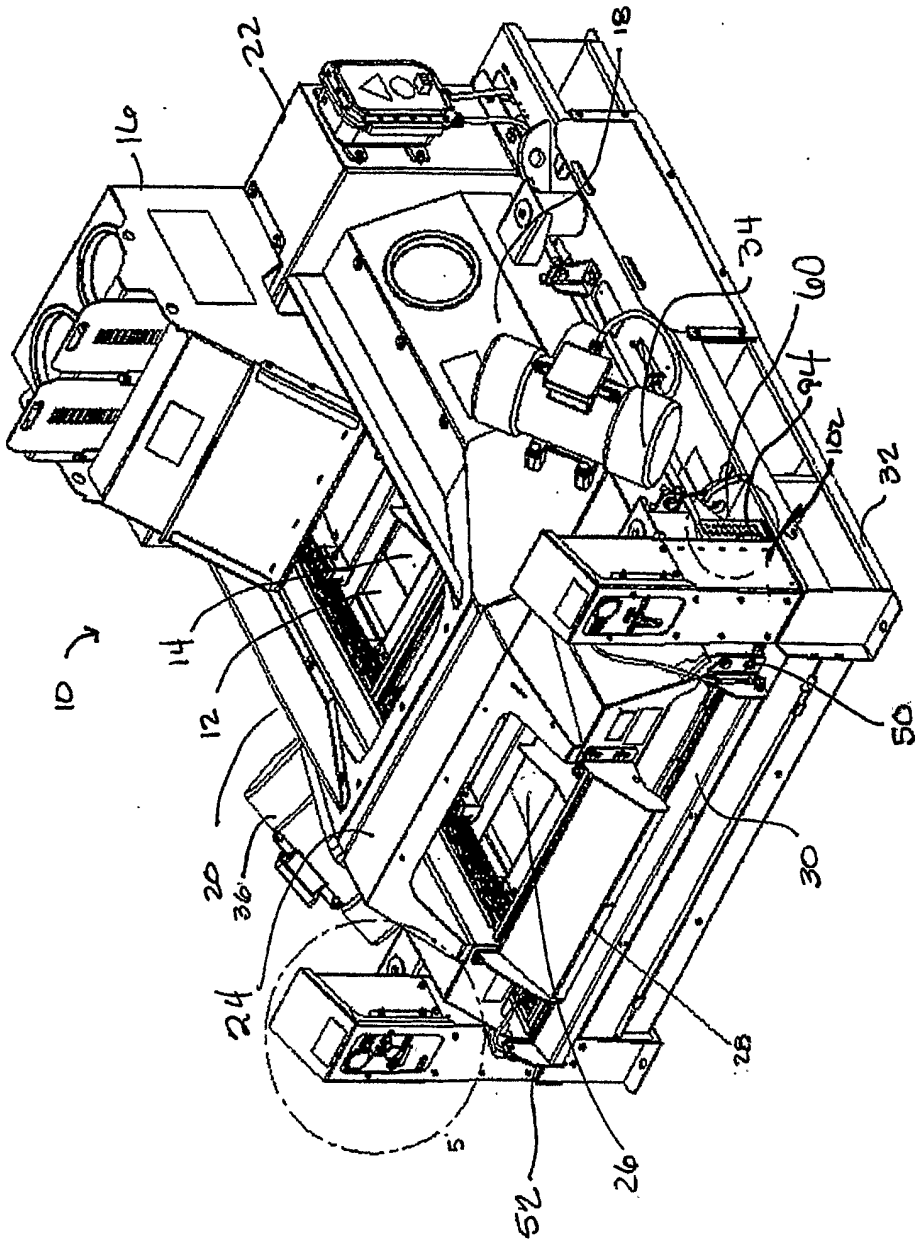


FIG. 1

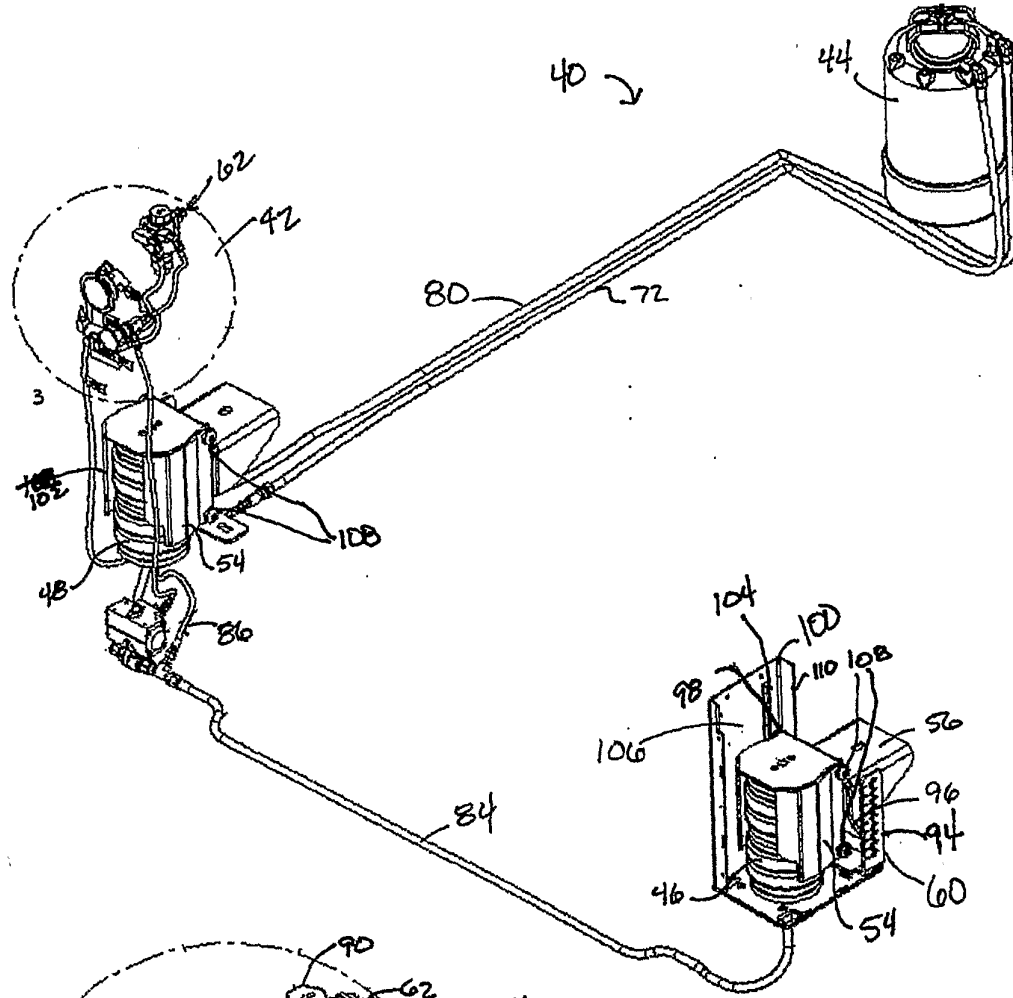


FIG. 2

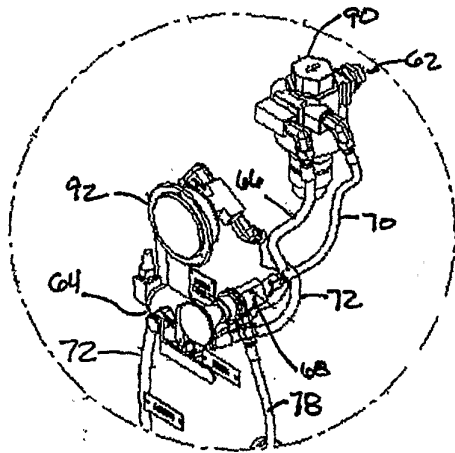


FIG. 3

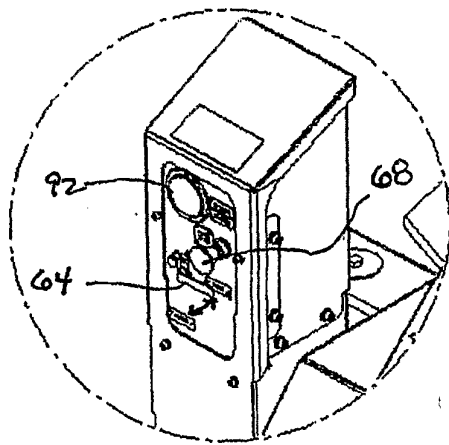
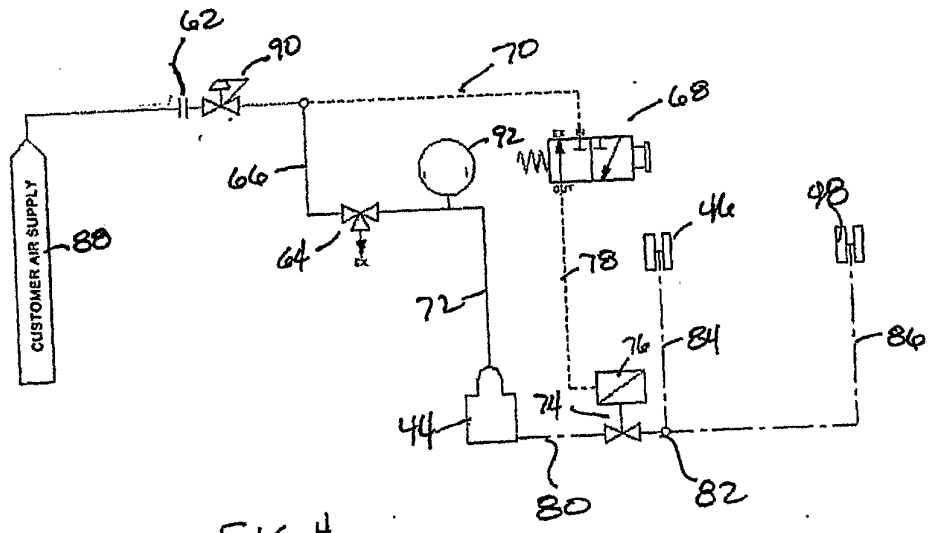
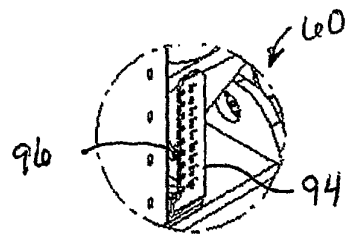


FIG. 5



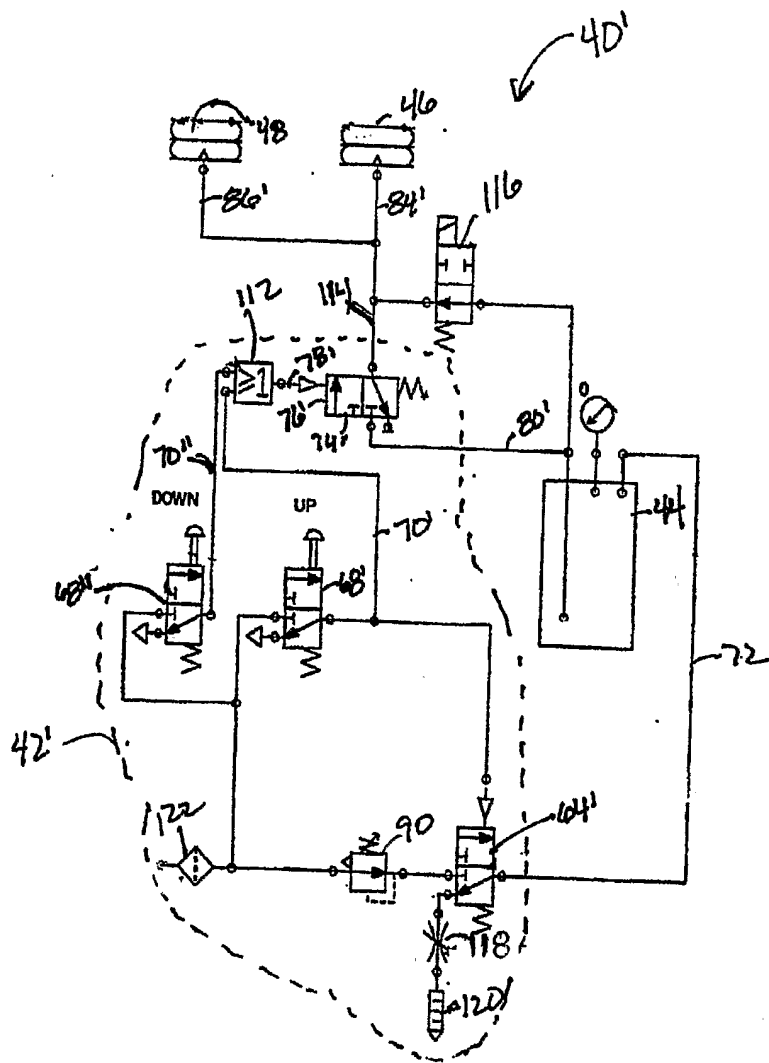


FIG 7