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(54) Title: COMPLETIONS READY SUB-SYSTEM

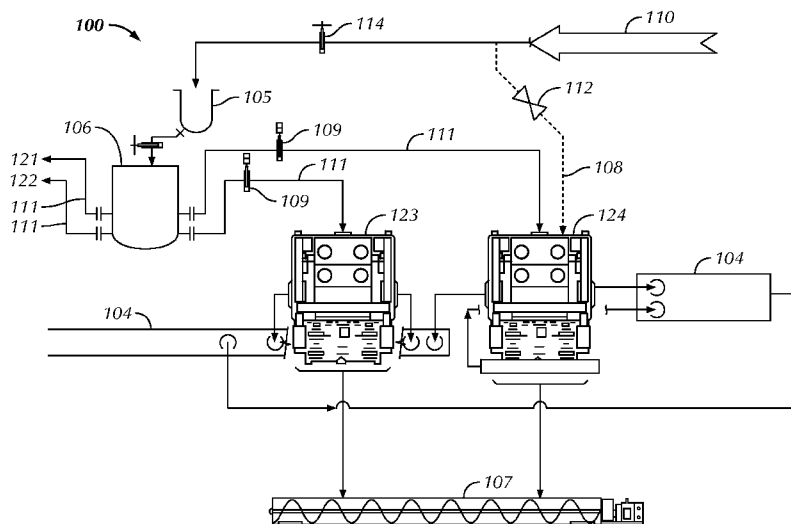


FIG. 1

(57) Abstract: A system and a method relate to handling return fluid from a wellbore. The method includes isolating a fluid shaker from return fluid flowing through a main fluid return line, cleaning the fluid shaker, and rerouting the return fluid through an auxiliary flow line to the fluid shaker. Further, a fluid handling system includes a main fluid return line, a plurality of fluid shakers to receive return fluid through the main fluid return line, and an auxiliary flow line connected between the main fluid return line and at least one of the plurality of fluid shakers.

COMPLETIONS READY SUB-SYSTEM

Background Art

[0001] During the drilling of a wellbore, various fluids are often used in the well for a variety of functions. The fluids may be circulated through a drill pipe and drill bit into the wellbore, and then may subsequently flow upward through the wellbore to the surface. During this circulation, a wellbore fluid may act to remove drill cuttings from the bottom of the hole to the surface, to suspend cuttings and weighting material when circulation is interrupted, to control subsurface pressures, to maintain the integrity of the wellbore until the well section is cased and cemented, to isolate the fluids from the formation by providing sufficient hydrostatic pressure to prevent the ingress of formation fluids into the wellbore, to cool and lubricate the drill string and bit, and/or to maximize penetration rate.

[0002] Another wellbore fluid used following the drilling operation is a completion fluid. Completion fluids broadly refer to any fluid pumped down a well after drilling operations have been completed, including fluids introduced during acidizing, perforating, fracturing, workover operations, etc. A drill-in fluid is a specific type of wellbore fluid that is designed to drill and complete the reservoir section of a well in an open hole, *i.e.*, the “producing” part of the formation. Such fluids are designed to balance the demands of the reservoir with drilling and completion processes. In particular, it is desirable to protect the formation from damage and fluid loss, and not impede future production. Most drill-in fluids contain several solid materials including viscosifiers, drill solids, additives used as bridging agents to prevent lost circulation, proppants, and barite weighting materials to control pressure formation.

[0003] Wellbore fluid displacement, also known as “mud displacement,” is performed after reaching a target depth (“TD”) of the wellbore. Mud displacement involves removing the drilling mud and replacing it with a completion fluid. However, contamination of the completion fluid with remnant drilling fluid may occur in the wellbore and on surface fluid equipment used during drilling (*e.g.*, shakers). Therefore,

the fluid equipment is cleaned thoroughly prior to completion to prevent contamination of the completion fluid once in the system. The amount of time to remove the drilling fluid, clean the fluid equipment, and replace with completion fluid may be hours. Given rig costs of upwards of \$60,000/hour, several hours of non-productive time ("NPT") may be very costly.

BRIEF DESCRIPTION OF DRAWINGS

[0004] Figure 1 shows a schematic view of a fluid handling system in accordance with one or more embodiments of the present disclosure.

DETAILED DESCRIPTION

[0005] The following is directed to various embodiments of the disclosure. Embodiments disclosed should not be interpreted, or otherwise used, as limiting the scope of the disclosure, including the claims. In addition, those having ordinary skill in the art will appreciate that the following description has broad application and not intended to suggest that the scope of the disclosure, including the claims, is limited to that embodiment.

[0006] In one aspect, embodiments disclosed herein relate to systems and methods for handling one or more wellbore fluids. More specifically, embodiments disclosed herein relate to a completions ready system and methods for displacing a drilling fluid with a completion fluid. More specifically still, embodiments disclosed herein relate to a completions ready system and methods for reducing the time to fully displace a drilling fluid with a completion fluid in a wellbore by providing cleaning methods of one or more fluid shakers or other surface fluid equipment while drilling operations continue.

[0007] Generally, during drilling of a well, drill cuttings are produced as a drill bit contacts the formation being drilled. As drilling progresses, the drill cuttings are carried to the surface of the wellbore entrained in drilling fluids. At the surface of the wellbore, the drilling fluid, including the cuttings entrained therein, may be subjected to separatory operations, cleaning, and waste remediation, such that drilling fluids may be recovered for reuse in the drilling operation, while drilling cuttings may be disposed of. Generally,

a primary separatory operation at a drilling location may include passing the drilling fluid over a separator, such as a vibratory shaker. During such a separatory operation, the drilling fluid flows over a vibratory shaker having a plurality of screens and filtering elements disposed thereon.

[0008] As vibrations are imparted to the drilling fluid, a substantially liquid phase of the drilling fluid is allowed to pass through the screens of the vibratory shaker, while larger solid particles remain on the screen. Perforations in filtering elements of the screens of the vibratory shaker determine a maximum sized particle that may pass therethrough. As such, fine particles may pass with the liquid phase through the perforations in the screen. The liquid phase, including the fine particles, may then be collected for further treatment in secondary separatory operations, or may otherwise be recycled for use in other aspects of the drilling operation (*e.g.*, the liquid may be treated and pumped back into the wellbore).

[0009] While the liquids may be reused in the drilling operation, the separated solid particles may be either collected for eventual disposal, or otherwise treated using secondary separatory operations. Examples of first or secondary separatory operations may include one or more fluid separatory devices, such as vibratory shakers, centrifuges, hydrocyclones, thermal desorption units, and/or other devices or methods of separating liquids from solids known in the art. The secondary separatory operations may thereby provide for the collection of an additional liquid phase that may be reused in the drilling operation, as well as further cleaning the solid particles prior to disposal. Depending on the local regulations where the wellbore is being drilled, the solid particles may be cleaned, such that hydrocarbon and chemical levels of the solid particles are reduced to environmentally safe levels. For example, due to regulations in certain locations, land disposal of the cuttings may be allowed if the total petroleum hydrocarbon content is less than 0.1% by weight. Thus, multiple cleaning and remediation steps prior to disposal may result from decreasing the hydrocarbon levels of the solid particles.

[0010] Once the drilling phase is complete, most operators clean up the well before running the completion string. The objective is to leave the well with a clean fluid that

has very low solids content, such as less than about 0.05%. For example, before completions operations are initiated, the drilling mud may be displaced by circulating spacer fluids throughout the well. During displacement, such as when switching from drilling with an oil-based mud to a water-based mud, the fluid in the wellbore may be displaced with a different fluid such as a spacer fluid. For example, an oil-based mud may be displaced by several washes of another oil-based spacer fluid to clean the wellbore, and transitioning to an aqueous wellbore fluid such as a breaker fluid may result in further washes with a water-based cleanup spacer fluid.

[0011] Clear fluids may be used to displace the particle-laden drilling fluid prior to entering the completion phase in drilling and completion operations. Well completion solutions may be chosen on the basis of production strategy, reservoir properties and quality, well design, well lifetime, and re-entry abilities. Embodiments disclosed herein may be useful in combination with any number of completion solutions, including, but not limited to, cased holes, preperforated liners, standalone screens, gravel packs, and/or other completion solutions known to one skilled in the art. Moreover, embodiments disclosed herein may be useful in combination with either direct or indirect fluid displacement operations.

[0012] Direct displacement may be performed with open blowout preventers so the drillpipe may be rotated and reciprocated, and may be performed in wells where the formation is exposed or underbalanced in cased-hole situations. Displacement of a clean fluid by maintaining a static or dynamic overbalance throughout the displacement often uses weighted chemical cleanup systems and displacement fluid. Displacements to a more expensive brine system may result in topside filtration to be used ahead of, during, or after the displacement. Indirect displacement, such as when maintaining a constant bottomhole pressure, may mean a displacement through choke/kill lines offshore, where the riser will have to be displaced separately. The riser displacement may be performed either before or after the main displacement, and a booster pump may be used to achieve the highest possible velocity of the displacing fluid in the riser section. A constant bottomhole pressure is maintained by adjusting the choke setting on the return line or by

a combination of adjusting choke setting and displacement rate according to hydraulic simulations.

[0013] The surface equipment may be used to receive the brine from a source, such as a barge or truck transport, and to treat the brine to a solids-free condition for placement into the wellbore equipment. Solids contaminated brines may be treated to the desired solids free condition in the surface equipment. However, the surface equipment should be substantially free of drilling mud prior to treating the brine solution to insure efficient results from the process.

[0014] The surface equipment may be cleaned of drilling fluid by suitable chemical and water washes so that undesired solids are not introduced into the wellbore equipment. In many applications, a slug of treated water is introduced in the wellbore equipment to effectively displace the drilling fluid from the system. In this case, the treated water is itself displaced directly by circulating solids-free brine into the wellbore equipment. The treated water may be a mixture of surfactant and alcohol in clean water, in certain instances. The treated water slug effectively displaces and carries the drilling fluid from the wellbore equipment, and, as a result, the circulating brine will acquire no solids, or such small amounts of solids that a short period of filtering makes the brine solids-free.

[0015] Embodiments disclosed herein may provide methods of cleaning surface equipment while continuing to drill. This may expedite the completions process once drilling is complete and reduce downtime between drilling operations and completion operations. In certain embodiments, methods of cleaning surface equipment may involve isolating one or more vibratory fluid shakers from returning drilling fluid while drilling operations continue such that the one or more isolated vibratory fluid shakers may be cleaned.

[0016] Referring now to Figure 1, a schematic view of a wellbore fluids handling system 100 in accordance with one or more embodiments of the present disclosure is shown. Surface fluid equipment may include one or more fluid shakers (shakers are indicated as 121, 122, 123, and 124 in Figure 1 for illustrative purposes only) and one or more mud pits 104 fluidly connected to the fluid shakers 121, 122, 123, 124. The fluid shakers 121,

122, 123, 124 may receive fluid returning from a wellbore (not shown) through a main fluid return line 110. An isolation valve 114 may be opened and closed to control fluid flow through the main fluid return line 110. The isolation valve 114 may be manually operated, or it may be operated, such as by electrical or hydraulic power, remotely by an operator.

[0017] The main fluid return line 110 may deliver the wellbore fluid first to a flow receiver box 105, and then follow to a fluid distribution box 106. The flow receiver box 105 may be used to store, at least temporarily, fluid flow received therein, and the fluid distribution box 106 may be used to facilitate distributing fluid flow received therein from one inlet and redistribute the flow amongst multiple outlets. As such, the fluid distribution box 106 may distribute the wellbore fluid through one or more individual fluid distribution lines 111 to the one or more fluid shakers 121, 122, 123, 124. Fluid flow through individual fluid distribution lines 111 may be controlled by opening and closing fluid distribution line valves 109. Fluid distribution line valves 109 may be manually operated, or it may be operated, such as by electrical or hydraulic power, remotely by an operator. Otherwise, the returning wellbore fluid may flow directly to a fluid distribution box 106 that then distributes the fluid to the one or more shakers 121, 122, 123, 124 through individual fluid distribution lines 111. Once the wellbore fluid is processed through the fluid shakers 121, 122, 123, 124, fluid leaving the fluid shakers 121, 122, 123, 124 may then flow to one or more mud pits 104, while cuttings may be sent to a cuttings conveyor 107.

[0018] In accordance with one or more embodiments disclosed herein, at least one of the fluid shakers 121, 122, 123, 124, such as fluid shaker 124, may have an auxiliary flow line 108 that connects from the main fluid return line 110, upstream of the isolation valve 114, the flow receiver box 105, and/or the fluid distribution box 106, directly or indirectly to fluid shaker 124, to provide a flow of fluid to shaker 124. The auxiliary flow line 108 may have an isolation valve 112 that may be opened and closed to control fluid flow through the auxiliary flow line 108. Isolation valve 112 may be manually operated, or it may be operated, such as by electrical or hydraulic power, remotely by an operator. It should be understood by one skilled in the art that, while the auxiliary flow

line 108 is shown fluidly connected to fluid shaker 124, the auxiliary flow line 108 may be fluidly connected to any of the one or more fluid shakers 121, 122, 123, 124 in accordance with one or more embodiments disclosed herein. Further, in accordance with other embodiments of the present disclosure, the wellbore fluids handling system may include additional or multiple auxiliary flow lines connected to multiple fluid shakers.

[0019] In certain embodiments, the one or more fluid shakers 121, 122, 123, 124 may be arranged in parallel such that return fluid is directed equally to the one or more fluid shakers 121, 122, 123, 124 for fluid processing. For example, “parallel” means that return fluid may be directed to each of the one or more fluid shakers 121, 122, 123, 124, and upon leaving the one or more fluid shakers 121, 122, 123, 124, may flow to one or more mud pits 104. In other embodiments, the one or more fluid shakers 121, 122, 123, 124 may be arranged in series such that return fluid is directed in series from one fluid shaker to another. For example, “series” means that the return fluid may be directed to a first fluid shaker for processing, and upon leaving the first fluid shaker enter a second fluid shaker for further fluid processing, and so on. Still further, in other embodiments, one or more fluid shakers 121, 122, 123, 124 may be arranged in a combination of parallel and series configurations, as will be understood by one skilled in the art.

[0020] Methods of using the wellbore fluids system in accordance with one or more embodiments of the present disclosure are described in reference to Figure 1. A completions ready fluid system of the present disclosure may be useful for decreasing the non-productive time of a drilling rig when the well reaches a target depth and drilling operations are switched to completion operations. As drilling operations approach a target depth of a wellbore, a fluid shaker may be taken offline, *i.e.*, the fluid shaker may be isolated from fluid return through the main fluid return line such that the fluid shaker no longer processes return fluid. As an example, isolating shaker 124 shown in Figure 1 may involve closing valve 109 in the fluid distribution line 111 to shaker 124. Also, valve 112 in auxiliary flow line 108 may be closed, such that no fluid can reach shaker 124 while being cleaned.

[0021] In certain embodiments, multiple fluid shakers 121, 122, 123, 124 may be taken offline prior to reaching the target depth of the wellbore. For example, multiple fluid shakers 121, 122, 123, 124 may have multiple auxiliary flow lines 108 connected thereto. An operator may decide to take two fluid shakers offline in certain embodiments. In other embodiments, an operator may decide to take three, four, five, or more fluid shakers offline prior to reaching a target depth of the wellbore. One skilled in the art will appreciate that any number of fluid shakers may have a dedicated auxiliary flow line connected thereto, which allows any number of fluid shakers to be taken offline.

[0022] Once the one or more fluid shakers 121, 122, 123, 124 are taken offline, methods of cleaning may be performed as previously described. For example, cleaning the fluid shaker may involve manual spraying internal components for removal of residual waste in certain embodiments. Other methods of cleaning the fluid shaker may involve automatic spray cleaning using one or more spray nozzles mounted on the fluid shaker that may remove and/or assist the manual labor component of the cleaning process. The spray nozzles may be actuated at different locations on the fluid shaker according to a predetermined sequence. For example, the sequencing may include actuating the nozzles to clean the inside of the fluid shaker first, then actuating nozzles in other areas of the fluid shaker, such as a sump. Other methods of cleaning the fluid shaker will be understood by one skilled in the art.

[0023] Once the one or more offline fluid shakers 121, 122, 123, 124 are cleaned, in this case fluid shaker 124, and drilling operations are completed, and completions operations may commence. Drilling fluid is displaced with a completions fluid in accordance with one or more of the wellbore fluid displacement methods previously described. However, before the completions operations commence, valve 114 in main fluid return line is closed, which isolates the remaining fluid shakers 121, 122, 123. Further, isolation valve 112 in auxiliary flow line 108 is opened so that completions fluid now returning from the wellbore may be processed through cleaned fluid shaker 124 and isolated from the remaining “dirty” shakers (*i.e.*, shakers 121, 122, and 123 in Figure 1). Thus, fluid flow through cleaned fluid shaker 124 processes the completions fluid and routes the

completions fluid to desired cleaned mud pits or directly to completions filtration systems.

[0024] While fluid shaker 124 processes completion fluid, isolated fluid shakers 121, 122, 123 may be cleaned. As the remaining fluid shakers are cleaned, these fluid shakers may also be brought back online to process completions fluid as fluid returns from the wellbore. For example, in certain embodiments, fluid shakers 121, 122, 123 may be cleaned and isolation valve 114 in main fluid return line 110 may be opened to bring the fluid shakers back online. In other embodiments, fluid shakers 121, 122, 123 may have individual auxiliary lines (not shown) connected thereto, and as each fluid shaker is cleaned, the fluid shaker may be brought back online by opening valve(s) in the auxiliary line(s). Thus, in certain embodiments, the remaining fluid shakers may be brought back online simultaneously. In other embodiments, fluid shakers may be brought back online individually when cleaned. The remaining dirty fluid shakers may be cleaned and brought back online to process completions fluid until each fluid shaker is in operation.

[0025] Embodiments of the present disclosure provide a completions system that may reduce non-productive time that may occur when switching from drilling operations to completions operations. For example, as previously described, cleaning of the fluid shakers and other surface fluid handling equipment before commencing with completions operations may take several hours, which is costly given expensive rig and crew time. Therefore, by isolating one or more fluid shakers and cleaning the fluid shakers while completing drilling operations, the downtime for cleaning fluid equipment prior to commencing completions operations may be greatly reduced.

[0026] In one aspect, embodiments disclosed herein relate to a method of handling return fluid from a wellbore. The method includes isolating a fluid shaker from return fluid flowing through a main fluid return line, cleaning the fluid shaker, and rerouting the return fluid through an auxiliary flow line to the fluid shaker.

[0027] In another aspect, embodiments disclosed herein relate to a fluid handling system including a main fluid return line, a plurality of fluid shakers to receive return fluid

through the main fluid return line, and an auxiliary flow line connected between the main fluid return line and at least one of the plurality of fluid shakers.

[0028] In yet another aspect, embodiments disclosed herein relate to a method of handling return fluid from a wellbore. The method includes directing return fluid through a main fluid return line to a first fluid separatory device and a second fluid separatory device, isolating the second fluid separatory device from the return fluid in the main fluid return line, cleaning the second fluid separatory device, isolating the first fluid separatory device from the return fluid in the main fluid return line, and reconnecting the second fluid separatory device to the main fluid return line through an auxiliary flow line.

[0029] Although the preceding description has been described herein with reference to particular means, materials and embodiments, it is not intended to be limited to the particulars disclosed herein. Rather, it extends to all functionally equivalent structures, methods and uses, such as are within the scope of the appended claims.

CLAIMS

What is claimed is:

1. A method of handling return fluid from a wellbore, the method comprising:
isolating a fluid shaker from return fluid flowing through a main fluid return line;
cleaning the fluid shaker; and
rerouting the return fluid through an auxiliary flow line to the fluid shaker.
2. The method of claim 1, wherein the fluid shaker is isolated prior to reaching a wellbore target depth.
3. The method of claim 1, wherein isolating the fluid shaker comprises:
closing a valve between the main fluid return line and the fluid shaker.
4. The method of claim 1, wherein rerouting the return fluid comprises:
closing a main fluid return line valve; and
opening an auxiliary flow line valve.
5. The method of claim 1, wherein the return fluid comprises a first fluid and a second fluid, the method further comprising:
displacing the first fluid in the wellbore with the second fluid.
6. The method of claim 5, wherein the first fluid is isolated from the fluid shaker and the second fluid is rerouted to the fluid shaker.
7. The method of claim 5, wherein the first fluid comprises a drilling fluid and the second fluid comprises a completions fluid.
8. The method of claim 1, further comprising:
processing the return fluid returning through the main fluid return line with a non-isolated fluid shaker while cleaning the fluid shaker.
9. The method of claim 1, wherein the fluid shaker comprises a plurality of fluid shakers.

10. A fluid handling system comprising:
 - a main fluid return line;
 - a plurality of fluid shakers to receive return fluid through the main fluid return line; and
 - an auxiliary flow line connected between the main fluid return line and at least one of the plurality of fluid shakers.
11. The fluid handling system of claim 10, wherein the main fluid return line comprises a main fluid return line valve.
12. The fluid handling system of claim 11, wherein the auxiliary flow line is connected to the main fluid return line upstream of the main fluid return line valve.
13. The fluid handling system of claim 10, wherein the auxiliary flow line comprises an auxiliary flow line valve.
14. The fluid handling system of claim 10, further comprising:
 - a fluid distribution box that distributes the return fluid through a plurality of fluid distribution lines to the plurality of fluid shakers.
15. The fluid handling system of claim 14, wherein at least one of the plurality of fluid distribution lines comprises a fluid distribution line valve.
16. The fluid handling system of claim 10, wherein one of the plurality of fluid shakers is isolated from the return fluid in the main fluid return line.
17. The fluid handling system of claim 10, wherein the main fluid return line is in fluid communication with a wellbore.

18. A method of handling return fluid from a wellbore, the method comprising:
directing return fluid through a main fluid return line to a first fluid separatory device and
a second fluid separatory device;
isolating the second fluid separatory device from the return fluid in the main fluid return
line;
cleaning the second fluid separatory device;
isolating the first fluid separatory device from the return fluid in the main fluid return
line; and
reconnecting the second fluid separatory device to the main fluid return line through an
auxiliary flow line.
19. The method of claim 18, wherein at least one of the first fluid separatory device and the
second fluid separatory device comprises a fluid shaker, a centrifuge, a hydrocyclone, and a
thermal desorption unit.
20. The method of claim 18, wherein the return fluid comprises a drilling fluid and a
completions fluid, wherein the drilling fluid is isolated from the second fluid separatory device,
the method further comprising:
directing the completions fluid through the auxiliary flow line to the second fluid
separatory device.

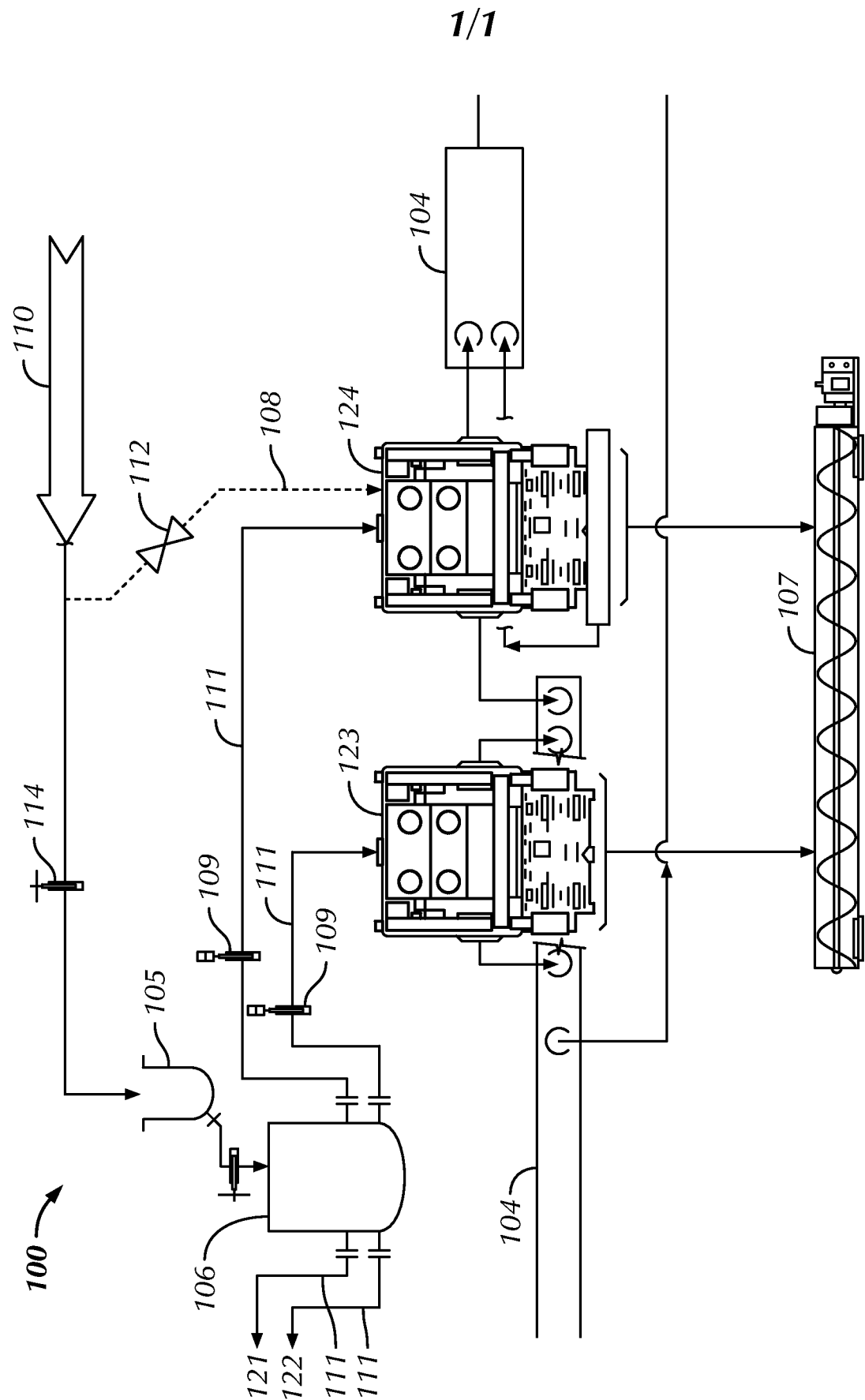


FIG. 1

A. CLASSIFICATION OF SUBJECT MATTER**E21B 21/06(2006.01)i, E21B 21/01(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E21B 21/06; C09K 8/02; E21B 7/12; B09B 5/00; E21B 21/08; E21B 21/01

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: shaker, screen, clean and auxiliary line

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009-0145664 A1 (LARSON, THOMAS ROBERT et al.) 11 June 2009 See paragraphs [0038]-[0044] and figure 3.	10-17
A		1-9, 18-20
A	US 2009-0227477 A1 (BURNETT, GEORGE ALEXANDER) 10 September 2009 See paragraphs [0030]-[0050] and figures 1-4.	1-20
A	US 6854532 B2 (FINCHER, ROGER W. et al.) 15 February 2005 See column 4, line 33-column 9, line 9 and figures 1-3.	1-20
A	US 2003-0217866 A1 (DEBOER, LUC) 27 November 2003 See paragraphs [0047]-[0090] and figures 1-9.	1-20
A	US 5109933 A (JACKSON, JAMES E.) 05 May 1992 See column 2, line 30-column 4, line 61 and figures 1-2.	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"E" earlier application or patent but published on or after the international filing date

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search

23 June 2014 (23.06.2014)

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24 June 2014 (24.06.2014)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2014/022361

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