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(54) MATERIAL DELIVERY SYSTEM USING DECOUPLING ACCUMULATOR

MATERIALBEREITSTELLUNGSSYSTEM UNTER VERWENDUNG EINES
ENTKOPPLUNGSAKKUMULATORS

SYSTEME D'ALIMENTATION EN MATERIAU METTANT EN APPLICATION UN ACCUMULATEUR
DE DECOUPLAGE

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Description

FIELD

[0001] This application relates to material delivery and extrusion systems, including systems configured to deliver and extrude cementitious material.

Description of Related Art

[0002] Structures, such as buildings, may be built up, layer by layer, by extruding cementitious or other unhardened material from a nozzle moving in a controlled pattern. Examples of apparatuses and processes that may be used are set forth in the patent applications that have been incorporated by reference in the Cross-Reference to Related Applications section of this application.

[0003] The quality of the result may depend upon being able to accurately control the rate at which the cementitious or other material is extruded from the nozzle. Controlling the pressure or rate at which the material is delivered from a remote pump, however, may not be sufficient. Intervening hoses may expand or contract and gas bubbles in the material itself may compress or expand. Changes in pressure at the output of the pump, therefore, may not be immediately reflected at the nozzle.

DE 20 52 583 A1 discloses a device for conveying cementitious material with a member that maintains the pressure of cementitious material that is delivered into a delivery line through a chamber by pump cylinders and a screw conveyor, wherein said member includes a cylindrical jacket and an accumulator piston creating a chamber that accumulates cementitious material when the delivery pressure from the chamber is high and pushes the accumulated cementitious material back into the flow when the pressure from the chamber is low, so that pressure fluctuations in the delivery line are reduced.

US 2005/196484 A1 discloses a robotic system including a movable gantry robot, and a nozzle assembly movably coupled to the overhead beam of the gantry robot. The gantry robot includes an overhead beam extending between, and supported by, at least two side members slidably mounted on a pair of rails. The nozzle assembly is coupled to the overhead beam of the gantry robot, and may be configured to extrude material through an outlet. The robotic system further includes a position controller configured to control position and movement of the gantry robot and the nozzle assembly.

US 4 919 597 A discloses a pump assembly for pumping one or more fluids, including a drive piston pump which reciprocates to drive proportion pumps. Fluid to the drive piston pump is controlled through a pair of two-position, three-port valves which communicate pressurized fluid sequentially above and below the drive pump piston to reciprocate the piston. While applying fluid pressure to one face of the piston, the opposite face is vented to tank such that no back pressure exists in the system. A proportion pump is provided for each fluid pumped by the

system and is designed to pump upon movement in either direction. A check valve is fitted on the outlet of the proportion pump to maintain constant pressure in the hose attached to the proportion pump and to prevent back flow of fluid from the hose into the system. The hose is of sufficient length so as to modulate any variations in the pumping pressure.

SUMMARY

[0004] A cementitious material delivery system may include a pump configured to pump cementitious material and an accumulator. The accumulator may be a decoupling accumulator and may contain a reservoir configured to store cementitious material, an accumulator inlet to the reservoir configured to receive cementitious material pumped by the pump, an accumulator outlet configured to deliver cementitious material from the reservoir, and a pressure applicator configured to apply pressure to the cementitious material that is delivered from the accumulator outlet.

[0005] The decoupling accumulator is configured to pass cementitious material that sequentially enters the accumulator inlet in substantially the same sequence through the accumulator outlet.

[0006] The decoupling accumulator includes a cylinder and a piston within the cylinder.

[0007] A volume defined by the piston and the cylinder functions as the reservoir.

[0008] The decoupling accumulator includes a hollow shaft connected to the piston. The hollow shaft has an end connected to the piston and an opposite end that functions as the accumulator inlet.

[0009] The piston may have a pushing surface and an opening within the pushing surface. The hollow shaft may be attached to the piston such that cementitious material may flow from the accumulator inlet through the opening in the pushing surface of the piston.

[0010] The cylinder may include an opening there through that is sized and positioned to allow cementitious material to escape from the cylinder only when the cylinder has been filled beyond a threshold amount.

[0011] The pressure applicator may be configured to apply a substantially constant pressure to the cementitious material.

[0012] The pressure applicator may include a pneumatic actuator.

[0013] The pressure applicator may include a bladder.

[0014] The decoupling accumulator may include a detection system configured to detect when the amount of cementitious material in the reservoir reaches a first amount and a second amount. The pump may be configured to be activated when the detection system detects that the amount of cementitious material in the reservoir has reached the first amount and to be deactivated when the detection system detects that the amount of cementitious material in the reservoir has reached the second amount. The detection system may include a first and

second level sensor.

[0015] The cementitious material delivery system may include a nozzle configured to extrude the cementitious material delivered from the accumulator outlet.

[0016] The cementitious material delivery system may include a flow divider configured to divide the cementitious material delivered from the accumulator outlet of the reservoir into a first stream of cementitious material and a second stream of cementitious material that is separate from the first stream.

[0017] The cementitious material delivery system may include a first mixer configured to mix a first chemical agent with the first stream of cementitious material and a second mixer configured to mix a second chemical agent with the second stream of cementitious material.

[0018] The first and the second chemical agents may have different compositions that cause the first and the second streams to cure at substantially different rates. Nozzle may be configured to extrude the first stream of cementitious material and the second stream of cementitious material separately from the first stream.

[0019] These, as well as other components, steps, features, objects, benefits, and advantages, will now become clear from a review of the following detailed description of illustrative embodiments, the accompanying drawings, and the claims.

BRIEF DESCRIPTION OF DRAWINGS

[0020] The drawings disclose illustrative embodiments. They do not set forth all embodiments. Other embodiments may be used in addition or instead. Details that may be apparent or that are unnecessary are also often omitted to save space or for more effective illustration. When the same numeral appears in different drawings, it is intended to refer to the same or like components or steps.

[0021] FIG. 1 illustrates a material delivery system using a decoupling accumulator.

[0022] FIG. 2 is a cross-section of a flow-through, decoupling accumulator that uses a bladder.

[0023] FIG. 3 is a cut-away view of a flow-through, decoupling accumulator that uses a piston shown in a raised position.

[0024] FIG. 4 is a cut-away view of the flow-through, decoupling accumulator in FIG. 3 with the piston in a lowered position position.

[0025] FIG. 5 illustrates the upper portion of a flow-through, decoupling accumulator of the type shown in FIGS. 3 and 4 with a detection system and overflow protection.

[0026] FIG. 6 is a cut-away underneath view of the flow-through, decoupling accumulator that in FIG. 3.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0027] Illustrative embodiments are now discussed.

Other embodiments may be used in addition or instead. Details that may be apparent or that are unnecessary are also often omitted to save space or for more effective presentation.

[0028] Fig. 1 illustrates a material delivery system using a decoupling accumulator. As shown in Fig. 1, the material delivery system may include a reservoir 101. The reservoir may contain a mixture of unhardened material, such as unhardened cementitious material. The unhardened material may be treated with one or more retardant chemicals that may cause the material to cure slowly.

[0029] The reservoir 101 may be of any type. It may be of any shape, of any size, and made from any type of material. The reservoir 101 may include an internal mixer.

[0030] Material may be pumped from the reservoir 101 by a pump 103. The pump 103 may be external to the reservoir 101, as shown in Fig. 1, or may be within the reservoir 101. When outside, a tube 105, such as a flexible hose, may be connected between the reservoir 101 and the pump 103.

[0031] The operation of the pump 103 may be controlled by a control signal that may be delivered to the pump 103 over a control channel 107 or through other means. Under the control of the control signal, the pump may be configured to turn on, to turn off, and/or to operate at a controllable speed, flow rate or pressure.

[0032] Material that is pumped by the pump 103 may be delivered at an outlet 104 on the pump through a tube 109, such as a flexible hose, to an inlet 111 of a decoupling accumulator 113.

[0033] The decoupling accumulator 113 may include a reservoir 115, a pressure-applicator 117, and an outlet 119.

[0034] The reservoir 115 may be configured to store material that is delivered through the inlet 111 and to deliver stored material through the outlet 119. The pressure-applicator 117 may be configured to assert pressure on the material that is stored in the reservoir 115 and, in turn, the material that is delivered through the outlet 119.

[0035] The reservoir 115 may be of any type. It may be of any shape, of any size, and made from any type of material. It may include an internal mixer.

[0036] The pressure-applicator 117 may similarly be of any type. It may be of any shape, of any size, and made from any type of material.

[0037] The pressure-applicator 117 may include a piston 121 within the reservoir 115 that is configured to create a seal between the perimeter of the piston 121 and the wall of the reservoir 115. The piston 121 may be driven downwardly by any means, such as by the weight of the piston, a weight that is placed on top of the piston, a spring, by pressure from gas such as air, or by pressure from liquid such as water. The pressure-applicator may be configured to apply a constant pressure to the material in the reservoir 115, notwithstanding changes in the amount of the material within the reservoir 115.

[0038] A detection system may be employed in con-

nection with the decoupling accumulator 113. The detection system may be configured to detect the amount of material that is within the reservoir 115 and to generate a control signal based on this amount. This control signal may be delivered to the pump 103 over the control channel 107. The detection system may be configured to deliver a control signal to the pump 103 that turns the pump on when the level of material within the reservoir 115 is below a first threshold amount, and that turns the pump 103 off when the level of material within the reservoir 115 is above a second, larger threshold amount. One or more level-sensing switches may be used to detect the level of the material within the reservoir 115 as part of the detection system.

[0039] Material from the outlet 119 of the decoupling accumulator 113 may be channeled by a tube 123, such as a flexible hose, to a flow divider 125. The flow divider may be configured to divide the flow of material from the tube 123 into two or more separated paths. Material from a first path may be directed by a tube 127, such as a flexible hose, to a first metering device 129. Material from a second path may be directed by a tube 131, such as a flexible hose, to a second metering device 133.

[0040] The metering devices 129 and 133 may be configured to regulate the amount of material that flows through the path in which it is interposed. Examples of such metering devices and apparatuses and processes that may be employed in connection with them are set forth in US Provisional Application 60/864,060, entitled "Metering and Pumping Devices," Attorney Docket No. 28080-251, filed November 2, 2006; and U.S. Provisional Application Serial No. 60/864,291, entitled "Metering and Pumping Devices," Attorney Docket No. 28080-252, filed November 3, 2006.

[0041] A chemical agent, which may or may not be a hardening agent, may be injected in the first path of the material at a first injection point 135. Similarly, a chemical agent which may or may not be a hardening agent may be injected into the second path of material at a second injection point 137. The chemical agents that are injected into the first injection point 135 and the second injection point 137 may be different. One chemical agent may be selected to cause the material in one path to cure quickly. This quick-curing material may be extruded by a nozzle (discussed below) to quickly form two, spaced apart, outer shell walls. The other chemical agent may be selected to cause the material in another path to cure slowly and be self-leveling. The slow-curing material may be extruded by the nozzle into the space between the two, spaced apart, outer shell walls.

[0042] A mixer 141 may be used to mix the chemical agent that is injected at the first injection point 135 with the material in the first pathway. Similarly, a mixer 143 may be used to mix the chemical agent that is injected at the second injection point 137 with the material in the second pathway. The mixers may share a common drive shaft 144.

[0043] The mixed material in the first pathway and the

mixed material in the second pathway may be separately delivered to a nozzle 145. The nozzle 145 may include outlets 147 and 148 from which quick-curing mixed material may be extruded to quickly create the inner and outer shell walls. The nozzle 145 may include an outlet 149 between the outlets 147 and 148 from which slow-curing mixed material may be extruded to create a self-leveling core. Examples of nozzles and processes for using them are set forth in the patent applications that are incorporated by reference in the Cross-Reference to Related Applications section of this patent application.

[0044] Although two paths and three extrusion outlets are illustrated in Fig. 1, a different number may be used instead. For example, there may be only a single path of mixed material or there may be three paths. The nozzle may have only a single outlet or it may have two or more outlets.

[0045] A computer system may be used to partially or fully automate the operation of the pump 103, the metering devices 129 and 133, the injection of curing agents at the injection points 135 and 137, the mixers 141 and 143, the movement of the nozzle 145, and/or the extrusion of materials from the nozzle 145. In the partially automated mode, the control of one or more of these devices may be done manually. In the fully automated mode, all these devices may be controlled and operated by the computer system under the control of one or more computer programs. The same computer system, or a different computer system, may also operate a gantry system that may be used to position the nozzle and/or a deployable machine that may be used to transport the nozzle, along with the gantry system, to a construction site. Examples of apparatuses and processes that may be used in association with the apparatuses and processes described in this application are set forth in the patent applications that are incorporated by reference in the Cross-Reference to Related Applications section of this patent application.

[0046] The embodiment of the decoupling accumulator 113 that is illustrated in Fig. 1 may result in some material remaining longer in the reservoir 115 than other material. For example, material at the top of the reservoir 115 may remain within the reservoir 115 longer than material at the bottom. Some material may remain within the reservoir for so long that it begins to cure.

[0047] The decoupling accumulator 113 may be configured differently to be of a flow-through type so as to pass the material that sequentially enters the accumulator inlet in substantially the same sequence through the accumulator outlet.

[0048] Fig. 2 is a cross-section of a flow-through, accumulator that uses a bladder. As shown in Fig. 2, a decoupling accumulator 201 may include a material inlet 203, a material outlet 205, a compressible tube 207, such as a rubber tube, a sealed pressure chamber 209, and a control inlet 211.

[0049] In this embodiment, the interior wall of the compressible tube 207 may serve as a reservoir. The exterior

wall of the compressible tube 207, the sealed pressure chamber 209, and the control inlet 211 may serve as a pressure-applicator. The amount of pressure on the material within the compressible tube 207 may be controlled by varying the amount of gas, such as air, or fluid, such as water, that is delivered through the control inlet 211. A pressure gauge 213 may be included to indicate the pressure within the sealed pressure chamber 209 and, in turn, that is applied through the compressible tube 207 to the material within it.

[0050] A detection system may be used in connection with the decoupling accumulator 201 so as to generate an on and off control signal for the pump 103. For this purpose, one or more sensors may be used to detect the amount of material within the compressible tube 207. The sensors may sense the diameter of the compressible tube 207, the air pressure in the sealed pressure chamber 209, and/or the weight of the decoupling accumulator. One or more of these measurements may be compared to a pre-determined maximum and a pre-determined minimum. When the amount goes below the minimum, the detection system may send a control signal to the pump 103 to turn on. When the amount reaches the maximum, the detection system may send a control signal to the pump 103 to turn off.

[0051] The decoupling accumulator 201 may be used in lieu of the decoupling accumulator 113 in Fig. 1.

[0052] Fig. 3 is a cut-away view of a flow-through decoupling accumulator that uses a piston shown in a raised position. As shown in Fig. 3, a decoupling accumulator 301 may include a piston 305 having an under-side pushing surface 333 configured to snugly traverse the interior of a cylinder 307. The piston may be driven by a hollow drive shaft 309. Pneumatic cylinders 311 and 313 may be configured to apply downward pressure on the hollow drive shaft 309 and, in turn, the piston 305 through linkages 315, 317, 319 and 321.

[0053] In operation, material from the pump 103 may be delivered to the decoupling accumulator 301 at an inlet 331 which may be the upper end of the hollow drive shaft 309. The material may flow through the hollow drive shaft 309 and through an opening in the under-side, pushing surface 333 of the piston 305. FIG. 6 is a cut-away underneath view of the flow-through, decoupling accumulator that in FIG. 3. It illustrates the opening 334 in the piston 305.

[0054] The material may fill the reservoir defined by the inner wall of the cylinder 307, the under side pushing surface 333 of the piston 305, and a rim 335 of an outlet 337. As the material fills the reservoir, the piston may rise. However, the pneumatic cylinders 311 and 313, the linkages 315, 317, 319 and 321, the hollow drive shaft 309, and the piston 305 may cooperate to function as a pressure-applicator, applying pressure to the material within the reservoir, thus urging the material out of the outlet 337.

[0055] Fig. 4 is a cut-away view of the flow-through decoupling accumulator in Fig. 3 with the piston in a low-

ered position. As shown in Fig. 4, the piston 305 is at the bottom of the cylinder 307.

[0056] Fig. 5 illustrates the upper portion of a flow-through decoupling accumulator of the type shown in Figs. 3 and 4 with a detection system and overflow protection. As shown in Fig. 5, the decoupling accumulator may have the same components as shown in Figs. 3 and 4, except for the addition of an overflow outlet 401 near the upper end of the cylinder 307, a cylinder-empty sense switch 403, and a cylinder-full sense switch 405.

[0057] In this embodiment, the cylinder-empty sense switch 403 may have an actuation member 407 sized and positioned to contact a lower surface 409 of the linkage 319 when the piston 305 is almost at the bottom of the cylinder 307. A control signal generated by the empty sense switch 403 may be delivered to the pump 103 and cause the pump 103 to turn on, thus pumping material which will fill the reservoir within the cylinder 307.

[0058] When the piston 305 is almost at the top of the cylinder 307, but beneath the overflow outlet 401, an actuation member 411 on the cylinder-full sense switch 405 may be actuated by an upper surface of the piston 305. A control signal generated by the cylinder-full sense switch 405 may be delivered to the pump 103 and cause the pump 103 to turn off, thus stopping the reservoir within the cylinder 307 from continuing to fill.

[0059] If for any reason (such as sensor failure) the pump fails to shut off at this point, the piston 305 may continue to rise until the level of material within the cylinder 307 rises to the level of the overflow outlet 401. At this point, the material may exit from the overflow outlet 401, thus preventing the piston 305 from separating from the cylinder 307.

[0060] The decoupling accumulator 301 may be used in lieu of the decoupling accumulator 113 shown in Fig. 1.

[0061] The components, steps, features, objects, benefits and advantages that have been discussed are merely illustrative. None of them, nor the discussions relating to them, are intended to limit the scope of protection in any way. Numerous other embodiments are also contemplated, including embodiments that have fewer, additional, and/or different components, steps, features, objects, benefits and advantages. The components and steps may also be arranged and ordered differently.

[0062] The phrase "means for" when used in a claim embraces the corresponding structures and materials that have been described and their equivalents. Similarly, the phrase "step for" when used in a claim embraces the corresponding acts that have been described and their equivalents. The absence of these phrases means that the claim is not limited to any of the corresponding structures, materials, or acts or to their equivalents.

[0063] Nothing that has been stated or illustrated is intended to cause a dedication of any component, step, feature, object, benefit, advantage, or equivalent to the public, regardless of whether it is recited in the claims.

[0064] In short, the scope of protection is limited solely by the claims that now follow. That scope is intended to

be as broad as is reasonably consistent with the language that is used in the claims and to encompass all structural and functional equivalents.

Claims

1. A cementitious material delivery system comprising:

a pump (103) configured to pump cementitious material; and

a decoupling accumulator (301) containing a reservoir configured to store cementitious material, an accumulator inlet (331) to the reservoir configured to receive cementitious material pumped by the pump, an accumulator outlet (337) configured to deliver cementitious material from the reservoir, and a pressure applicator (333) configured to apply pressure to the cementitious material that is delivered from the accumulator outlet, wherein the decoupling accumulator includes a cylinder and a piston within the cylinder, wherein a volume defined by the piston and the cylinder functions as the reservoir, **characterized in that**

the decoupling accumulator is configured to pass cementitious material that sequentially enters the accumulator inlet in the same sequence through the accumulator outlet, the decoupling accumulator includes a hollow shaft connected to the piston, and the hollow shaft has an end connected to the piston and an opposite end that functions as the accumulator inlet.

2. The cementitious material delivery system of claim 1 wherein the piston has a pushing surface (333) and an opening (334) within the pushing surface that has an area less than the area of the surface outlined by the pushing surface.

3. The cementitious material delivery system of claim 2 wherein the hollow shaft is attached to the piston such that cementitious material may flow from the accumulator inlet through the opening in the pushing surface of the piston.

4. The cementitious material delivery system of claim 1 wherein the pressure applicator is configured to apply a constant pressure to the cementitious material.

5. The cementitious material delivery system of claim 1 wherein the pressure applicator includes a pneumatic actuator (311).

6. The cementitious material delivery system of claim 1 wherein the decoupling accumulator includes a de-

tection system (403, 405) configured to detect when the amount of cementitious material in the reservoir reaches a first amount and a second amount.

7. The cementitious material delivery system of claim 6 wherein the pump is configured to be activated when the detection system detects that the amount of cementitious material in the reservoir has reached the first amount and to be deactivated when the detection system detects that the amount of cementitious material in the reservoir has reached the second amount.

8. The cementitious material delivery system of claim 7 wherein the detection system includes a first and second level sensor (403, 405).

9. The cementitious material delivery system of claim 1 further comprising a flow divider (125) configured to divide the cementitious material delivered from the accumulator outlet of the reservoir into a first stream of cementitious material and a second stream of cementitious material that is separate from the first stream.

10. The cementitious material delivery system of claim 9 further comprising a first mixer (141) configured to mix a first chemical agent with the first stream of cementitious material and a second mixer (143) configured to mix a second chemical agent with the second stream of cementitious material.

11. The cementitious material delivery system of claim 10 further comprising the first and the second chemical agents and wherein the first and the second chemical agents have different compositions that cause the first and the second streams to cure at substantially different rates.

12. The cementitious material delivery system of claim 10 further comprising a nozzle (145) configured to extrude the first stream of cementitious material and the second stream of cementitious material separately from the first stream.

13. The cementitious material delivery system of claim 1 further comprising a nozzle (145) configured to extrude the cementitious material delivered from the accumulator outlet.

14. The cementitious material delivery system of claim 1 comprising:

a nozzle (145) having a nozzle inlet configured to receive the cementitious material and a nozzle outlet configured to extrude cementitious material received at the nozzle inlet; and
a tube (109) configured to be at least part of a

cementitious delivery pathway between the accumulator outlet and the nozzle inlet.

Patentansprüche

1. Bereitstellungssystem für zementartiges Material, umfassend:

eine Pumpe (103), die ausgestaltet ist, zementartiges Material zu pumpen; und
einen Entkopplungsakkumulator (301), der ein Reservoir enthält, das ausgestaltet ist, das zementartige Material zu speichern, einen Akkumulatoreintritt (331) zu dem Reservoir, der ausgestaltet ist, zementartiges Material aufzunehmen, das von der Pumpe gepumpt wird, einen Akkumulatoraustritt (337), der ausgestaltet ist, zementartiges Material aus dem Reservoir auszugeben, und einen Druckapplikator (333), der ausgestaltet ist, Druck auf das zementartige Material auszuüben, das aus dem Akkumulatoraustritt ausgegeben wird,
wobei der Entkopplungsakkumulator einen Zylinder und einen Kolben in dem Zylinder umfasst,
wobei ein Volumen, das von dem Kolben und dem Zylinder bestimmt wird, als Reservoir dient, **dadurch gekennzeichnet, dass**
der Entkopplungsakkumulator ausgestaltet ist, zementartiges Material, das aufeinander folgend in den Akkumulatoreintritt eintritt, in derselben Reihenfolge durch den Akkumulatoraustritt geleitet wird,
der Entkopplungsakkumulator eine Hohlwelle umfasst, die mit dem Kolben verbunden ist, und die Hohlwelle ein Ende aufweist, das mit dem Kolben verbunden ist, sowie ein gegenüberliegendes Ende, das als Akkumulatoreintritt dient.

2. Bereitstellungssystem für zementartiges Material nach Anspruch 1, wobei der Kolben eine Druckfläche (333) und eine Öffnung (334) in der Druckfläche aufweist, die eine Fläche kleiner als die Fläche der Oberfläche aufweist, die von der Druckfläche dargestellt wird.
3. Bereitstellungssystem für zementartiges Material nach Anspruch 2, wobei die Hohlwelle mit dem Kolben verbunden ist, sodass zementartiges Material von dem Akkumulatoreintritt durch die Öffnung in der Druckfläche des Kolbens fließen kann.
4. Bereitstellungssystem für zementartiges Material nach Anspruch 1, wobei der Druckapplikator ausgestaltet ist, einen konstanten Druck auf das zementartige Material auszuüben.

5. Bereitstellungssystem für zementartiges Material nach Anspruch 1, wobei der Druckapplikator ein pneumatisches Stellglied (311) umfasst.

6. Bereitstellungssystem für zementartiges Material nach Anspruch 1, wobei der Entkopplungsakkumulator ein Erfassungssystem (403, 405) umfasst, das ausgestaltet ist, zu erfassen, wenn die Menge an zementartigem Material in dem Reservoir eine erste Menge und eine zweite Menge erreicht.

7. Bereitstellungssystem für zementartiges Material nach Anspruch 6, wobei die Pumpe ausgestaltet ist, aktiviert zu werden, wenn das Erfassungssystem erfasst, dass die Menge an zementartigem Material in dem Reservoir die erste Menge erreicht hat, und deaktiviert zu werden, wenn das Erfassungssystem erfasst, dass die Menge an zementartigem Material in dem Reservoir die zweite Menge erreicht hat.

8. Bereitstellungssystem für zementartiges Material nach Anspruch 7, wobei das Erfassungssystem einen ersten und zweiten Füllstandssensor (403, 405) umfasst.

9. Bereitstellungssystem für zementartiges Material nach Anspruch 1, überdies umfassend einen Stromteiler (125), der ausgestaltet ist, das zementartige Material, das aus dem Akkumulatoraustritt des Reservoirs ausgegeben wird, in einen ersten Strom zementartigen Materials und einen zweiten Strom zementartigen Materials zu teilen, der von dem ersten Strom getrennt ist.

10. Bereitstellungssystem für zementartiges Material nach Anspruch 9, überdies umfassend einen ersten Mischer (141), der ausgestaltet ist, einen ersten chemischen Wirkstoff mit dem ersten Strom zementartigen Materials zu mischen, und einen zweiten Mischer (143), der ausgestaltet ist, einen zweiten chemischen Wirkstoff mit dem zweiten Strom zementartigen Materials zu mischen.

11. Bereitstellungssystem für zementartiges Material nach Anspruch 10, überdies umfassend den ersten und den zweiten chemischen Wirkstoff und wobei der erste und der zweite chemische Wirkstoff verschiedene Zusammensetzungen aufweisen, die bewirken, dass der erste und der zweite Strom mit im Wesentlichen unterschiedlichen Geschwindigkeiten aushärten.

12. Bereitstellungssystem für zementartiges Material nach Anspruch 10, überdies umfassend eine Düse (145), die ausgestaltet ist, den ersten Strom zementartigen Materials und den zweiten Strom zementartigen Materials getrennt von dem ersten Strom zu extrudieren.

13. Bereitstellungssystem für zementartiges Material nach Anspruch 1, überdies umfassend eine Düse (145), die ausgestaltet ist, das zementartige Material, das aus dem Akkumulatoraustritt ausgegeben wird, zu extrudieren.

14. Bereitstellungssystem für zementartiges Material nach Anspruch 1, umfassend:

eine Düse (145), die einen Düseneintritt aufweist, der ausgestaltet ist, das zementartige Material aufzunehmen, und einen Düsenaustritt, der ausgestaltet ist, das zementartige Material, das am Düseneintritt aufgenommen wurde, zu extrudieren; und ein Rohr (109), das ausgestaltet ist, zumindest Teil eines Zementförderwegs zwischen dem Akkumulatoraustritt und dem Düseneintritt zu sein.

Revendications

1. Système d'alimentation en matériau à base de ciment, comprenant :

une pompe (103) configurée pour pomper le matériau à base de ciment ; et un accumulateur de découplage (301) contenant un réservoir configuré pour stocker le matériau à base de ciment, une entrée d'accumulateur (331) vers le réservoir, configurée pour recevoir le matériau à base de ciment pompé par la pompe, une sortie d'accumulateur (337) configurée pour délivrer le matériau à base de ciment à partir du réservoir, et un applicateur de pression (333) configuré pour appliquer une pression sur le matériau à base de ciment délivré par la sortie d'accumulateur, dans lequel l'accumulateur de découplage comprend un cylindre et un piston à l'intérieur du cylindre, dans lequel un volume défini par le piston et le cylindre sert de réservoir,

caractérisé en ce que

l'accumulateur de découplage est configuré pour faire passer le matériau à base de ciment entrant de façon séquentielle par l'entrée d'accumulateur dans la même séquence par la sortie d'accumulateur, l'accumulateur de découplage comprend un arbre creux relié au piston, et l'arbre creux possède une extrémité reliée au piston et une extrémité opposée servant d'entrée d'accumulateur.

2. Système d'alimentation en matériau à base de ciment selon la revendication 1, dans lequel le piston possède une surface de poussée (333) et une ouver-

ture (334) à l'intérieur de la surface de poussée, dont l'aire est inférieure à l'aire de la surface définie par la surface de poussée.

3. Système d'alimentation en matériau à base de ciment selon la revendication 2, dans lequel l'arbre creux est relié au piston de manière à ce que le matériau à base de ciment puisse s'écouler à travers l'ouverture dans la surface de poussée du piston à partir de l'entrée d'accumulateur.

4. Système d'alimentation en matériau à base de ciment selon la revendication 1, dans lequel l'applicateur de pression est configuré pour appliquer une pression constante sur le matériau à base de ciment.

5. Système d'alimentation en matériau à base de ciment selon la revendication 1, dans lequel l'applicateur de pression comprend un actionneur pneumatique (311).

6. Système d'alimentation en matériau à base de ciment selon la revendication 1, dans lequel l'accumulateur de découplage comprend un système de détection (403, 405) configuré pour détecter si une quantité de matériau à base de ciment dans le réservoir atteint une première quantité et une deuxième quantité.

7. Système d'alimentation en matériau à base de ciment selon la revendication 6, dans lequel la pompe est configurée pour être activée lorsque le système de détection détecte que la quantité de matériau à base de ciment dans le réservoir a atteint la première quantité, et pour être désactivée lorsque le système de détection détecte que la quantité de matériau à base de ciment dans le réservoir a atteint la deuxième quantité.

8. Système d'alimentation en matériau à base de ciment selon la revendication 7, dans lequel le système de détection comprend un premier et un deuxième capteur de niveau (403, 405).

9. Système d'alimentation en matériau à base de ciment selon la revendication 1, comprenant en outre un diviseur de flux (125) configuré pour diviser le matériau à base de ciment délivré par la sortie d'accumulateur du réservoir en un premier flux de matériau à base de ciment et un deuxième flux de matériau à base de ciment séparé du premier flux.

10. Système d'alimentation en matériau à base de ciment selon la revendication 9, comprenant en outre un premier mélangeur (141) configuré pour mélanger un premier agent chimique avec le premier flux de matériau à base de ciment, et un deuxième mélangeur (143) configuré pour mélanger un deuxième

agent chimique avec le deuxième flux de matériau à base de ciment.

11. Système d'alimentation en matériau à base de ciment selon la revendication 10, comprenant en outre les premier et deuxième agents chimiques, et dans lequel les premier et deuxième agents chimiques présentent des compositions différentes en raison desquelles les premier et deuxième flux durcissent à des vitesses substantiellement différentes. 5
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12. Système d'alimentation en matériau à base de ciment selon la revendication 10, comprenant en outre une buse (145) configurée pour extruder le premier flux de matériau à base de ciment et le deuxième flux de matériau à base de ciment séparément du premier flux. 15
13. Système d'alimentation en matériau à base de ciment selon la revendication 1, comprenant en outre une buse (145) configurée pour extruder le matériau à base de ciment délivré par la sortie d'accumulateur. 20
14. Système d'alimentation en matériau à base de ciment selon la revendication 1, comprenant : 25
 - une buse (145) possédant une entrée de buse configurée pour recevoir le matériau à base de ciment et une sortie de buse configurée pour extruder le matériau à base de ciment reçu par l'entrée de buse ; et 30
 - un tube (109) configuré pour former au moins une partie d'un trajet d'acheminement de matériau à base de ciment entre la sortie d'accumulateur et l'entrée de buse. 35

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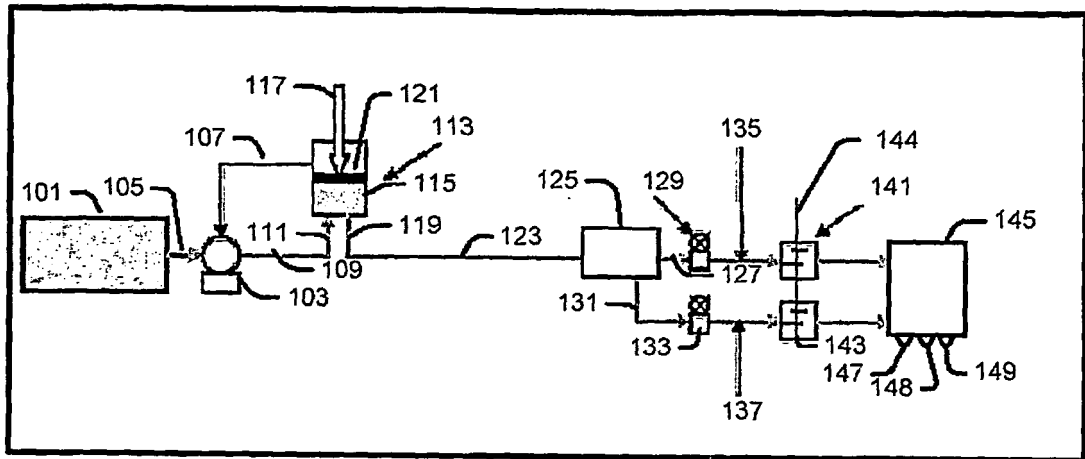


FIG. 1

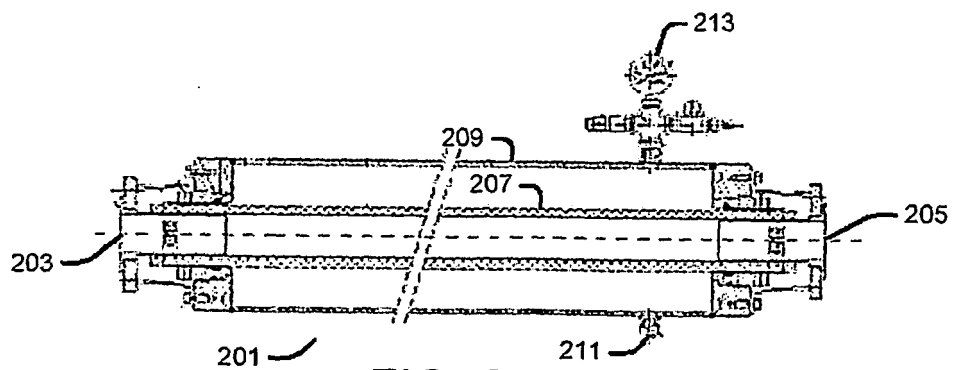


FIG. 2

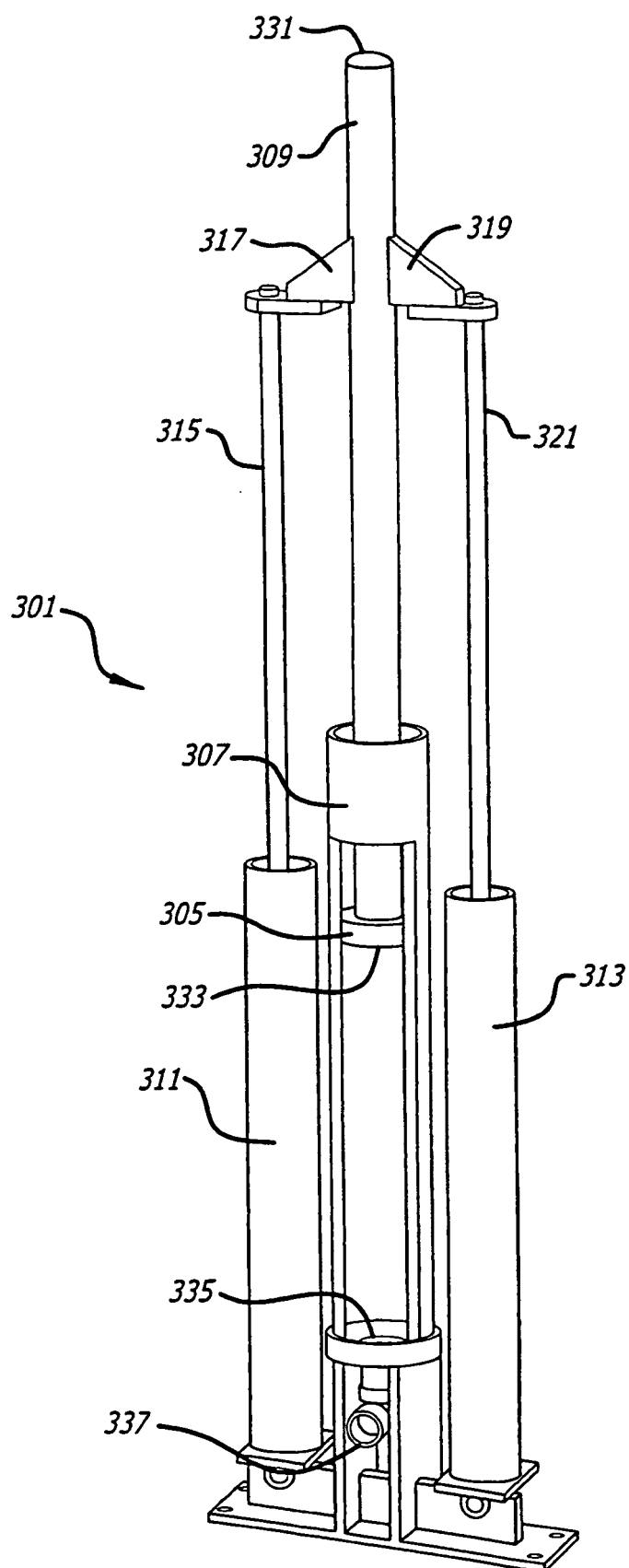


FIG. 3

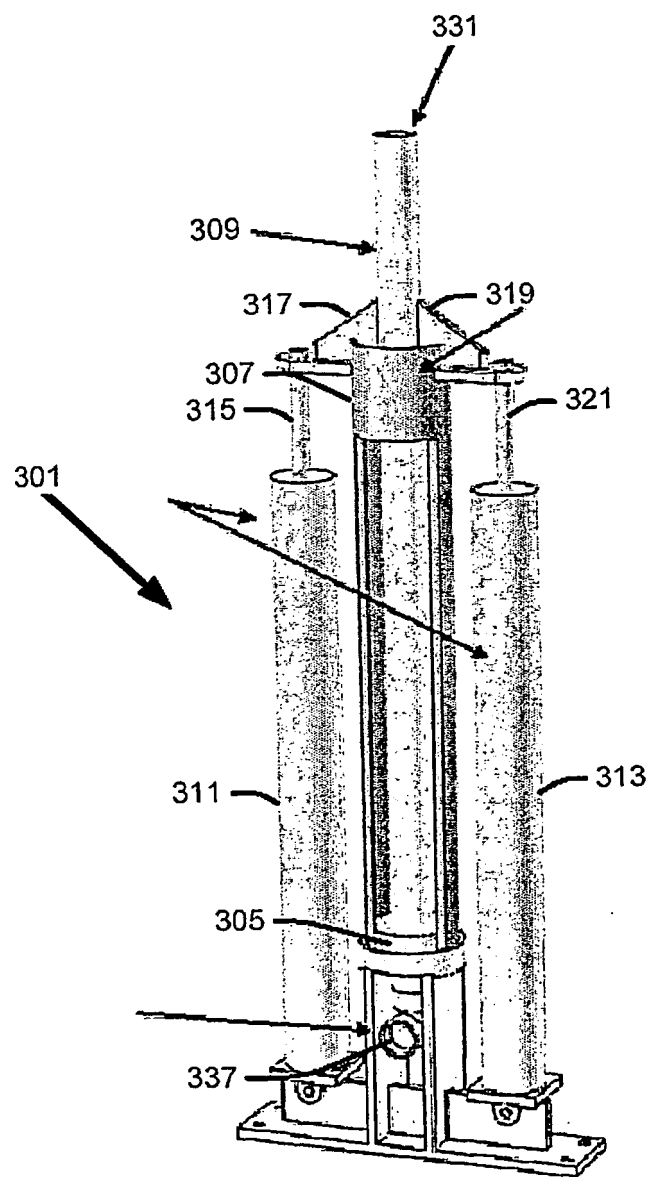


FIG. 4

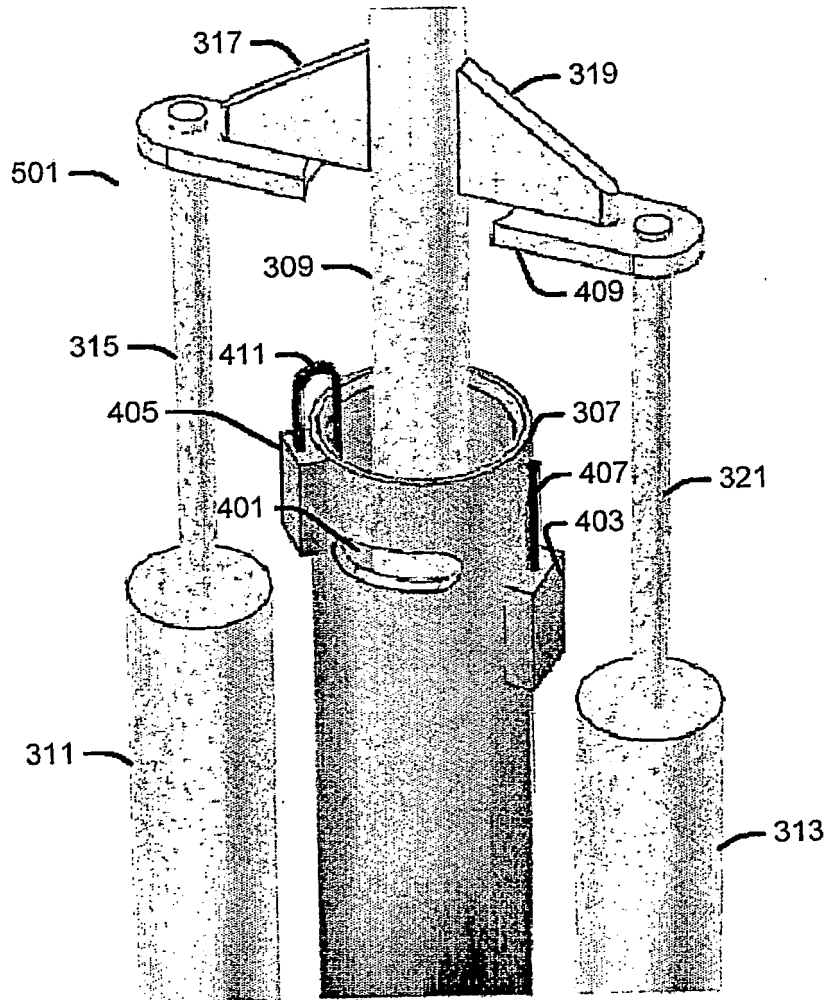


FIG. 5

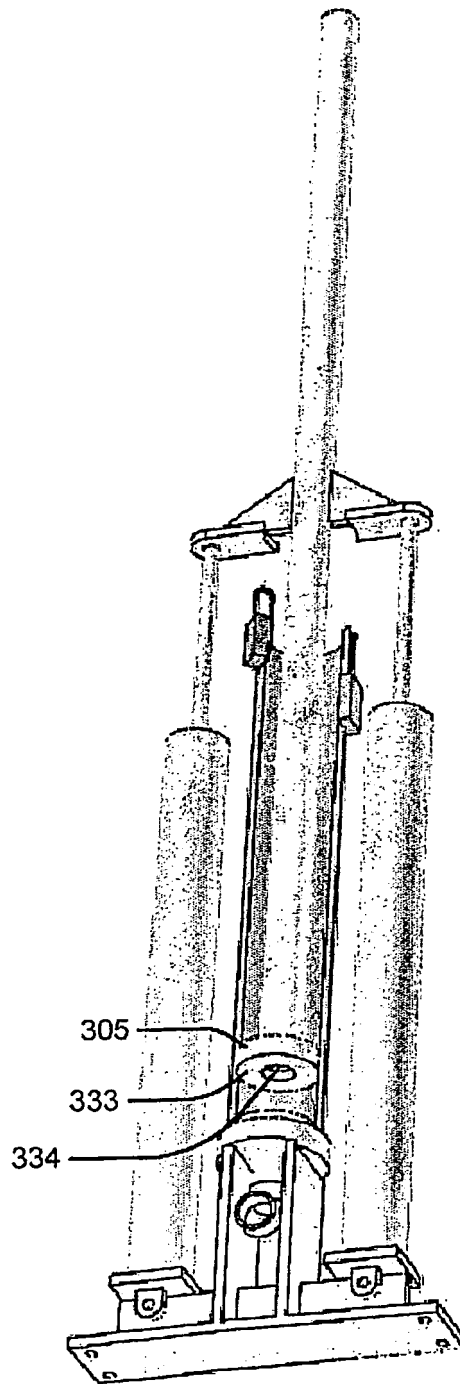


FIG. 6

REFERENCES CITED IN THE DESCRIPTION

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