A pump apparatus for transporting at least one fluid, comprising a shaft, wherein the shaft has a longitudinal axis; a motor, wherein the motor is adapted to rotate the shaft about the longitudinal axis; and, a plurality of gerotors, wherein the gerotors are attached to the shaft along the longitudinal axis and wherein the shaft rotation actuates the plurality of gerotor rotation, causing pumping of the at least one fluid.
1. PUMP MOTOR STARTED

2. FLUID FLOW FROM AT LEAST ONE RESERVOIR

3. VOLUME OF FLUID CALCULATED

4. FLUID PUMPED BY PLURALITY OF GEROTORS

5. PUMP MOTOR STOPPED

6. FLUID CEASES FLOW

FIG. 4
Pump started

Chemicals drawn to pump

Pumping chemicals

Pumped volume measurement

Sustained pumping

Pump stopped

Chemical flow stopped

Repeat

FIG. 5
PUMP APPARATUS AND METHODS FOR USING SAME

RELATED APPLICATIONS

[0001] This application claims the benefit under 35 USC §119(e) of U.S. Application Ser. No. 60/736,801 filed on Nov. 15, 2005 and U.S. Application Ser. No. 60/754,101 filed on Dec. 27, 2005. This application relates to US Patent Application, Docket No. 408/05557, entitled “Pump Apparatus and Methods for Using Same”, and PCT Application, Docket No. 408/05553, entitled “Substance Injecting Apparatuses and Methods for Using Same”, both filed on even date as this application. The disclosures of these applications are incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to fluid transportation, for example pump apparatuses used in the packing material manufacturing industry.

BACKGROUND OF THE INVENTION

[0003] In the packing material manufacturing industry, various component materials are often combined to create a final product packing material. Often this component material mixing occurs at the actual site where the packing material is to be used for packing. In order to conduct this mixing, component materials are pumped from reservoirs and then the various components are added to each other in a mixing chamber. Sometimes the container where the packing material is to be ultimately used acts as the mixing chamber. Many systems in use today use individual pumps, typically pneumatic pumps, for each of a plurality of components.

[0004] Each of these pumps is often mounted in each reservoir being pumped which require time and effort to move around and mount every time a reservoir is expended. Furthermore, these require complicated control systems to maintain a preset ratio of fluids necessary for manufacturing a packing material with specific desired properties. Other systems require adjustable ratio mixtures to compensate for chemical inlet ports that are partially blocked due to inadequate cleaning of the ports between operations of the mixing head. One solution to a few of these problems is to use gerotor based pumps because gerotor pumps are fixed displacement pumps and supply a defined volume of fluid per revolution within a reasonable range of viscosities and back pressures. Gerotor elements utilize a drive shaft with an inner and outer rotor. As the inner rotor rotates, a volume is created within the element. This volume creates a partial vacuum between the inner and outer rotor and fluid is drawn in through the port plates on the inlet side of the element. As the inner rotor continues to rotate, the volume is progressively reduced in size and the fluid is discharged through the port plates on the outlet side of the element. While gerotors help to solve the component ratio problem, gerotors can be ill-advised for use when components that are being used cause partial or complete blockage of the delivery nozzles which introduce them to the mixing chamber.

SUMMARY OF THE INVENTION

[0005] An aspect of some exemplary embodiments of the invention relates to a single motor pump apparatus provided with a plurality of pumps operated by the single motor. Optionally, the motor is AC. Optionally, the motor is DC, if for example highly responsive motor control is important. In some exemplary embodiments of the invention, a single motor driven shaft operates a plurality of gerotors for fluid transportation. In some exemplary embodiments of the invention, the motor driven shaft passes through the motor for operating at least one gerotor on each side of the motor. In some exemplary embodiments of the invention, gears are not used to achieve pumping. Optionally, operation of the plurality of gerotors is simultaneous. Optionally, the single shaft operates two gerotors. In some exemplary embodiments of the invention, the pump apparatus transports a predetermined volume of fluid through the gerotors. Optionally, the volume of fluid transported through a gerotor by each rotation of the shaft is predetermined. In some exemplary embodiments of the invention, the pump apparatus is used with fluids of varying viscosity. In some exemplary embodiments of the invention, fluids enter the pump via fluid conveying tubes at room temperature. Optionally, the tubes are heated, up to 60° C. Optionally, the tubes are heated, more than 60° C. Optionally, fluids exit the pump at a mixing chamber at room temperature. In an exemplary embodiment of the invention, a shaft rotation counter is provided to the pump apparatus. In some exemplary embodiments, the pump apparatus transports fluids to a plurality of recipient apparatuses. In some exemplary embodiments of the invention, more than one type of fluid is transported by the pump apparatus. Optionally, each gerotor transports one type of fluid. Optionally, gerotors of varied size are used simultaneously. In some exemplary embodiments of the invention, the pump apparatus is used in conjunction with a bagging apparatus which provides bags which serve as a receptacle, and/or mixing chamber, for the chemical mix.

[0006] An aspect of some exemplary embodiments of the invention relates to providing a bypass valve system within the pump apparatus. In some exemplary embodiments of the invention, the bypass valve system is used for recycling fluids being transported through the pump apparatus. In some exemplary embodiments of the invention, the bypass valve system activates in order to preserve predetermined pressure levels within the pump apparatus. Optionally, the bypass valve system activates upon the attainment of 250 psi of a fluid pressure in the pump apparatus. Optionally, the bypass valve system activates upon the attainment of 300 psi of a fluid pressure in the pump apparatus. In some exemplary embodiments of the invention, a plurality of gerotors is used to provide pumping of a plurality of materials. Optionally, the plurality of materials subsequently mix together to form a combination of materials. Optionally, a bypass valve system is used with each gerotor in the pump apparatus. Optionally, the bypass valve system is spring actuated. Optionally, the bypass valve system is pneumatic, optionally making the pressure relief lever remotely adjustable. Optionally, the bypass valve system is constructed within the same piece as the gerotor, reducing the likelihood of leakage and system failure.

[0007] An aspect of some exemplary embodiments of the invention relates to a method of using a pump with a bypass valve system and plurality of gerotors therein. In an exemplary embodiment of the invention, fluid pressure and volume output regulation is automatically controlled by a gerotor based pump provided with a bypass valve system. Optionally, fluid pressure is automatically regulated by the bypass valve system wherein upon the attainment of certain pressure lev-
els, for example if there is a nozzle blockage, fluids are automatically recycled in the pump and/or are outlet, relieving pressure. Optionally, the volume of fluid output by the pump is automatically regulated as a function of the size of the gerotor being used. In some exemplary embodiments of the invention, fluid viscosity is modified by controllably heating the tubes feeding the fluids through the pump and/or out of the pump, thereby heating and/or cooling the fluids and altering their viscosity. Optionally, fluids viscosities are decreased in order to save wear and tear on system components, such as seals. In some exemplary embodiments of the invention, viscosities are altered to adjust the component ratio of a mix. Optionally, the pump apparatus itself is heated to modify the viscosities of the fluids pumped thereupon. Optionally, viscosities are altered to normalize the component ratio, for example due to a partial blockage that doesn’t equally affect the flow of all of the components. Optionally, viscosities are altered to increase and/or decrease the ratio of one component to another.

[0008] There is thus provided, in accordance with an exemplary embodiment of the invention, a pump apparatus for transporting at least one fluid, comprising: a shaft, wherein the shaft has a longitudinal axis; a motor, wherein the motor is adapted to rotate the shaft about the longitudinal axis; and, a plurality of gerotors, wherein the gerotors are attached to the shaft along the longitudinal axis and wherein the shaft rotation actuates the plurality of gerotors rotation, causing pumping of the at least one fluid. Optionally, the apparatus further comprises a shaft revolution counter. Optionally, the shaft further comprises at least one protrusion extending radially outward from the longitudinal axis. Optionally, the shaft revolution counter is an optical encoder. Optionally, the shaft revolution counter is a photo-sensor. Optionally, the apparatus further comprises at least one inlet port and at least one outlet port for each of the plurality of gerotors. In some exemplary embodiments of the invention, the apparatus further comprises a bypass valve system adapted for selective release of the at least one fluid between the at least one inlet port and the at least one outlet port. Optionally, the bypass valve system activates release at 250 psi of pressure. Optionally, the bypass valve system activates release at greater than 300 psi of pressure. In some exemplary embodiments of the invention, the bypass valve system is comprised of a spring and a ball. Optionally, the plurality of gerotors is varied in size. Optionally, the apparatus further comprises an additional port positioned proximal to the outlet port. Optionally, the additional port is adapted for bleeding air from the outlet port. Optionally, the additional port is adapted for permitting diagnostic measurements to be taken of the outlet port. Optionally, the apparatus further comprises fluid conveying tubes which are controllably heated. Optionally, at least one of the plurality of gerotors is mounted on the shaft opposite the motor from at least one other of the plurality of gerotors.

[0009] There is thus provided in accordance with an exemplary embodiment of the invention, a bypass valve system for use in a fluid pumping apparatus comprising a pump, at least one inlet and at least one outlet, comprising: a valve closer, wherein the valve closer maintains bypass valve in a closed state until the bypass valve system is activated; and, a valve plug, wherein when the bypass valve is closed, the valve plug substantially prohibits fluid flow between the inlet and outlet. Optionally, the valve closer is a spring. Optionally, the valve plug is a ball. In some exemplary embodiments of the invention, when the bypass valve system is activated, the valve closer and the valve plug permit fluid flow between the inlet and outlet. Optionally, the system is activated upon the attainment of 250 psi of pressure. Optionally, the system is activated upon the attainment of 300 psi of pressure. Optionally, the system is activated upon the attainment of greater than 300 psi of pressure. Optionally, the fluid pumping apparatus further comprises at least one gerotor.

[0010] There is thus provided in accordance with an exemplary embodiment of the invention, a method of using a fluid pumping apparatus comprised of a plurality of gerotors and at least one outlet, comprising: commencing rotation of a shaft, wherein the shaft is connected to the plurality of gerotors; and, measuring at least one fluid through the pumping apparatus using the plurality of gerotors. Optionally, the method further comprises counting the rotations of the shaft in order to measure the volume of at least one fluid being pumped. Optionally, the method further comprises stopping rotation of the shaft upon the attainment of a predetermined measured volume of the at least one fluid. Optionally, the method further comprises activating a bypass valve system if pressure in the at least one outlet exceeds a predetermined threshold.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Exemplary non-limiting embodiments of the invention are described in the following description, read with reference to the figures attached hereto. In the figures, identical and similar structures, elements or parts thereof that appear in more than one figure are generally labeled with the same or similar references in the figures in which they appear. Dimensions of components and features shown in the figures are chosen primarily for convenience and clarity of presentation and are not necessarily to scale. The attached figures are:

[0012] FIG. 1 is a perspective view of a pump apparatus, in accordance with an exemplary embodiment of the invention;

[0013] FIG. 2 is a cross-sectional view of a pump apparatus, in accordance with an exemplary embodiment of the invention;

[0014] FIGS. 3A-B are detailed, cross-sectional views of a bypass valve system in a closed position, in accordance with an exemplary embodiment of the invention;

[0015] FIGS. 3C-D are detailed, cross-sectional views of a bypass valve system in an open position, in accordance with an exemplary embodiment of the invention;

[0016] FIG. 4 is a flowchart of a method for using a pump apparatus, in accordance with an exemplary embodiment of the invention;

[0017] FIG. 5 is a flowchart of a method of using a pump apparatus for packing material creation, in accordance with an exemplary embodiment of the invention; and,

[0018] FIG. 6 is a side view of a pump apparatus with a through-shaft, in accordance with an exemplary embodiment of the invention.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

Exemplary Pump Apparatus

[0019] Referring to FIG. 1, a perspective view of a pump apparatus 100 is shown, in accordance with an exemplary embodiment of the invention. A motor 102 is provided to pump apparatus 100 for providing motive force to apparatus 100. In some exemplary embodiments of the invention, motor
102 is AC. Optionally, motor 102 is DC. For example, applications that require a variable mixing rate, not ratio, optionally would use a DC motor which is easily speed controlled. Motor 102 is operationally connected to a propulsion shaft 116 that extends along a longitudinal axis 120 of pump apparatus 100, in an exemplary embodiment of the invention. In some exemplary embodiments, propulsion shaft 116 runs the length of longitudinal axis 120 of pump apparatus 100. Optionally, propulsion shaft 116 is positioned centrally along longitudinal axis 120.

[0020] In an exemplary embodiment of the invention, a revolution counter section 118 is positioned abutting motor 102 along longitudinal axis 120. Revolution counter section 118 is optionally comprised of a shaft revolution counter 210, shown in FIG. 2, which is used to help measure a predetermined amount of fluid to be pumped by pump apparatus 100. In some exemplary embodiments of the invention, revolution counter section 118 allows passage of shaft 116 therethrough. Optionally, control electronics (not shown) are used to commence and/or halt operation of pump apparatus 100. In some exemplary embodiments of the invention, control electronics are operationally connected to revolution counter section 118 to process measurements made therein and/or to issue control commands to pump apparatus 100 based on the measurements.

[0021] Along longitudinal axis 120, away from motor 102, a first gerotor pump 106 abuts revolution counter section 118, in an exemplary embodiment of the invention. First gerotor pump 106 is provided with a first gerotor inlet 104 and a first gerotor outlet 108. In an exemplary embodiment of the invention, fluids being pumped enter first gerotor pump 106 via first gerotor inlet 104 and exit via first gerotor outlet 108. Optionally, abutting first gerotor pump 106 extending outwards along longitudinal axis 120 from motor 102 is a second gerotor pump 112, in an exemplary embodiment of the invention. Second gerotor pump 112 is provided with a second gerotor inlet 110 and a second gerotor outlet 114. In an exemplary embodiment of the invention, fluids are introduced to pump apparatus 100 via first gerotor inlet 104 and second gerotor inlet 110 and are optionally drawn from fluid reservoirs 122, 124. Optionally, fluid reservoirs 122, 124 provide different fluids to pump apparatus 100 via fluid conveying tubes. Optionally, fluid reservoirs provide the same fluid to pump apparatus 100. In some exemplary embodiments of the invention, more than one fluid reservoir is associated with a single gerotor. Optionally, more than one inlet is associated with a single reservoir. In an exemplary embodiment of the invention, first gerotor pump 106 and second gerotor pump 112 allow passage of shaft 116 therethrough so that shaft 116 can impart motion to the gerotor pumps. Optionally, more than two gerotor pumps are used with a single motor. In some exemplary embodiments of the invention, gerotor outlets distribute fluid to a plurality of recipient locations. For example, a first pump optionally delivers fluid to a first machine, while a second pump delivers fluid to a second machine. In an exemplary embodiment of the invention, motor 102 runs continuously and a valve optionally opens and closes on a recipient machine to admit the proper amount of fluid at any time. Amount of fluid is optionally determined by counting the pump cycles once the valve has opened at the recipient machine. In some exemplary embodiments of the invention, the bypass valve system, described below, assists with this procedure by allowing pressure regulation and continuous pump operation.

[0022] The spatial and operational relationship of these various components, in an exemplary embodiment of the invention, is described in more detail in the context of FIG. 2 below.

[0023] Referring now to FIG. 2, a cross-sectional view of a pump apparatus 100 is shown in accordance with an exemplary embodiment of the invention. Shaft 116 is shown attached to motor 102, wherein shaft 116 passes through revolution counter section 118, first gerotor pump 106 and second gerotor pump 112 in accordance with an exemplary embodiment of the invention. In some exemplary embodiments of the invention, revolution counter section 118 includes a shaft revolution counter 210. Shaft revolution counter 210 counts the number of rotations shaft 116 makes during pump apparatus 100 operation. As described above, gerotors are designed to create a volume during rotation which draws in fluid and then discharges it via an outlet. By knowing the volume created by the gerotor in motion, and therefore the volume of fluid pumped, and calculating a volume of fluid pumped per rotation of the shaft, it can be known how much volume of liquid corresponds to a specific number of shaft rotations. Therefore, in an exemplary embodiment of the invention, predetermined volumes of fluid are pumped by counting the number of revolutions made by shaft 116 and then ceasing pumping upon the attainment of the predetermined volume. Optionally, measurement of volume is made as fluid is delivered by pump without the object of attaining a specific, predetermined amount. Optionally, shaft revolution counter 210 is comprised of an optical encoder which counts the passage of at least one protrusion 212 extending radially outwards from shaft 116 and which passes past shaft revolution counter 210 for counting. In some exemplary embodiments of the invention, shaft 116 is provided with an encoder disk, a circular array of notches, which passes through a photo-sensor which counts the notches as they pass by, in order to gain precise control of the number of rotations shaft 116 performs. Optionally, the sensor is a magnetic Hall Effect sensor. Optionally, the sensor is an inductive probe. Optionally, the sensor is a capacitive probe.

[0024] In an exemplary embodiment of the invention, shaft 116 is operationally connected to gerotors located in first gerotor pump 106 and second gerotor pump 112. Rotation of shaft 116 creates movement of internal rotors 216 relative to outer rotors 218 of the gerotor pumps 106, 112. As described above, this movement initially creates a volume which is filled with fluid from inlets 104, 110 and then diminishes the volume, thereby expelling fluids out of gerotor pumps 106, 112 via outlets 108, 114, in an exemplary embodiment of the invention. In some exemplary embodiments of the invention, fluids are drawn by pump apparatus 100 from a plurality of reservoirs at the same rate. Optionally, a first fluid is selectively drawn prior to the drawing of an additional fluid from a reservoir. Optionally, fluids are selectively drawn from reservoirs depending on the application of pump apparatus 100. For example, if in a pumping application more of one type of fluid is desired over another, fluid pumping from a first reservoir optionally commences before pumping of another fluid from another reservoir. Optionally, the bypass valve system allows for this type of operation by permitting the non-flowing pumps to recycle fluids as they pump. In some exemplary embodiments of the invention, different sized gerotors are used depending on the desired volume of fluid which is to be pumped. For example, if one fluid is needed in higher volume than another fluid which is being pumped, a larger and/or
thicker gerotor pump is optionally used to deliver a higher volume of that fluid. Optionally, an additional port 214, normally plugged off, is connected to the outlet 108, 114 side in order to allow air bleeding, technician measurements and diagnostics, and/or adding a pressure sensor.

[0025] In some exemplary embodiments of the invention, a bypass valve 308, shown in FIG. 3, is used to balance pressure and/or to recycle fluids within pump apparatus 100.

Exemplary Through-Shaft Pump Apparatus

[0026] Referring to FIG. 6, a through-shaft pump apparatus 600 is shown, in accordance with an exemplary embodiment of the invention. Through-shaft pump apparatus 600 is provided with a shaft 602 which projects from each side of through-shaft pump apparatus 600 allowing for a first gerotor pump 604 and a second gerotor pump 606 to be mounted on each side of a motor 608. In some embodiments of the invention, shaft 602 extends towards either side of motor 608 and is projected towards the other side using a device which extends shaft 608.

[0027] In the packing material manufacturing industry, component chemicals are optionally passed through pumps 604, 606 which react in combination form a packing material. However, any inadvertent mixing of these chemicals, for example in pump apparatus 600, could lead to reacted chemical build-up and possible pump malfunction. Therefore, in an exemplary embodiment of the invention, first gerotor pump 604 and second gerotor pump 606 are separated by motor 608 to provide an additional safeguard against inadvertent mixing of the fluids in pumps 604, 606.

[0028] First and second gerotor pumps 604, 606 are optionally attached to motor using any manner known to those skilled in the art. For example, a gerotor pump (e.g. first gerotor pump 604) is affixed to motor 608 using a mounting block 610, in accordance with an exemplary embodiment of the invention. Optionally, shaft 602 is interfaced with a first gerotor pump shaft 614 using a coupling 612. The attachment of shaft 602, which is rotated by motor 608, to first gerotor pump shaft 614 provides rotation to the gerotor located in first gerotor pump 604. In some exemplary embodiments of the invention, a bypass valve 308, shown in FIG. 3, is used to balance pressure and/or to recycle fluids within pump apparatus 600.

[0029] Through-shaft pump apparatus 600 is optionally used in lieu of pump apparatus 100, described above. Therefore, description herein as it pertains to pump apparatus 100 is optionally applied to through-shaft pump apparatus 600 and vice versa.

Exemplary Bypass Valve System

[0030] In some exemplary embodiments of the invention, a bypass valve system 300 is provided to pump apparatus 100 or through-shaft pump apparatus 600 for pressure regulation and/or fluid recycling. Referring to FIGS. 3A and 3B, a cross-section and perspective cross-section of a gerotor pump is shown wherein a bypass valve system 300 is shown in a closed position, in an exemplary embodiment of the invention. Central opening 302 is where shaft 116 passes through the gerotor pump, in an exemplary embodiment of the invention. As described herein, shaft 116 is operationally connected as a central axis to a gerotor (not shown), within the gerotor pump. The gerotor pump includes an inlet 304 and an outlet 306 for fluid transfer by the pump. A bypass valve 308 is used to selectively relieve pressure in outlet 306 section and/or to recycle fluid from outlet 306 back to inlet 304, as described below. Optionally, bypass valve 308 is maintained in a closed position by a valve closer when bypass valve 308 is not active. Optionally, the valve closer is a spring. A valve plug is used in some exemplary embodiments of the invention, to substantially prevent flow of fluid between inlet and outlet when bypass valve 308 is not activated. Optionally, the valve plug is a ball. In operation, closed bypass valve 308 permits the one way flow 310 of fluid through gerotor pump from inlet 304 to outlet 306.

[0031] In an exemplary embodiment of the invention, bypass valve 308 is opened when a predetermined pressure threshold is reached in outlet 306 portion of the gerotor pump, as shown in FIGS. 3C and 3D. Optionally, bypass valve 308 is opened to maintain a maximum valve force pressure. For example, if the pressure in the outlet 306 rises to a predetermined level, bypass valve 308 opens to allow fluid from outlet 306 to flow 312 into inlet 304 to restore the desired pressure level. Optionally, bypass valve 308 is opened to allow flow 312 of fluid from inlet 304 to outlet 306. In some exemplary embodiments of the invention, activation of bypass valve system 300 allows for running pump apparatus 100 without necessitating output of fluids.

Exemplary Method of Using Pump Apparatus

[0032] Referring to FIG. 4, a flowchart of a method 400 for using pump apparatus 100 or through-shaft pump apparatus 600 is presented, in accordance with an exemplary embodiment of the invention. In operation, pump motor 102 is started (402) in order to commence the movement of fluid through the pump. As the gerators in the pump apparatus 100 begin to turn, suction is created within fluid conveying tubes, instigating fluid flow (404) from at least one fluid reservoir towards the gerators. As fluid reaches the gerators it is taken into the gerators via inlets, then pumped (406) out via outlets due to the decrease in volume within the gerators as the internal rotors turn. As described elsewhere herein, the volume of fluid pumped (406) by the gerators is optionally calculated (412) by monitoring the number of shaft 116 rotations. In an exemplary embodiment of the invention, pumping (406) starts before a fluid valve opens to allow time for the pressure to build in the system. Optionally, calculation (412) starts when the valve opens. In an exemplary embodiment of the invention, pump apparatus motor 102 is stopped (408) in order to cease (410) flow of fluid through pump apparatus 100. Optionally, motor 102 is stopped (408) upon the attainment of a predetermined volume of pumped fluid. In some exemplary embodiments of the invention, bypass valve system enables the maintenance of a preset pressure level within pump apparatus 100 and fluid conveying tubes as described herein.

Exemplary Application of Using Pump Apparatus for Manufacturing Packing Material

[0033] In some exemplary embodiments of the invention, fluids enter pump apparatus 100 or through-shaft pump apparatus 600 via fluid conveying tubes at room temperature. Optionally, the tubes are heated, up to 60°C. Optionally, the tubes are heated, more than 60°C. Optionally, fluids exit the pump via fluid conveying tubes at room temperature which transport the fluids to a mixing chamber. Optionally, the exit fluid conveying tubes are also heated. In some exemplary
embodiments of the invention, the fluids are delivered to the mixing chamber at about 50° C. to 60° C. In an exemplary embodiment of the invention, the raised temperature is to allow better flow through the small orifices of the mixing chamber and to promote a chemical reaction occurring at first in the mixing chamber and finally in a receptacle, such as a bag. Optionally, although the exit fluid conveying tubes are heated, the tube heating is adjusted to deliver the fluids to the mixing chamber at room temperature. Additionally or alternatively, pump apparatus 100 is heated to provide heating to at least one fluid being transported by pump apparatus 100. In an exemplary embodiment of the invention, heating is provided to at least one fluid in order to normalize the mix ratio between one component and another. Optionally, the mix ratio is purposely altered using heating to modify the viscosities, and thus the flow rates and/or fluid pressures, of the various component fluids. Optionally, fluid viscosities are altered to spare the pump system wear and tear, such as in the tubes, seals and gaskets. In some exemplary embodiments of the invention, the pump apparatus is used with fluids of varying viscosity. Optionally, fluids up to 400 cP at room temperature are used with the pump apparatus. Optionally, fluids up to 800 cP at room temperature are used with the pump apparatus. Optionally, fluids up to 1400 cP at room temperature are used with the pump apparatus.

[0034] Referring to FIG. 5, a flowchart of a method 500 for using a pump apparatus 100 or through-shaft pump apparatus 600 for manufacturing packing material is provided, in accordance with an exemplary embodiment of the invention. In an exemplary embodiment of the invention, the pump apparatus 100 is used to provide a plurality of component chemicals in measured amounts which, when mixed, react to form a material suitable for use as a packing material. Pump apparatus 100 motor 102 is started (502) causing shaft 116 to rotate. The rotation of shaft 116 creates revolutions of the gerotor located within the gerotor pumps of pump apparatus 100. As described above, the increase in volume within the gerotors serve to draw (504) component chemicals from their respective reservoirs and towards the gerotor pumps of pump apparatus 100. In an exemplary embodiment of the invention, as rotation of the gerotor components continues, the volume within the gerotor decreases, thereby pumping (506) the component chemicals out of pump apparatus 100 and towards a mixing chamber for component chemical mixing. In some exemplary embodiments of the invention, the mixed chemicals are then deposited in a final receptacle, such as a bag. Optionally, mixing is not performed in a mixing chamber prior to component chemical deposit in the final receptacle.

[0035] Pumping, as described above, is continued (508) until a desired amount of chemical components have been transported through pump apparatus 100, in an exemplary embodiment of the invention. In some exemplary embodiments of the invention, the amount of pumped chemical components is measured (514) by counting the rotations of shaft 116. Once a predetermined amount of chemical components has been pumped, motor 102 is stopped (510) to cease (512) chemical component flow through pump apparatus 100, in an exemplary embodiment of the invention. Optionally, the chemical flow is stopped (512) before motor 102 is stopped (510). In an exemplary embodiment of the invention, stopping the flow (512) and the count (514) before stopping the motor (510) gives a more accurate measurement as a result of constant flow rate before the pressure drops. Optionally, method 500 is repeated (520) for the filling of a subsequent receptacle. Optionally, motor 102 is not stopped (510) prior to filling of a subsequent receptacle, which starts an exemplary pumping cycle comprising (504)-(508), including (514).

[0036] In an exemplary embodiment of the invention, packing material is manufactured using a two component mixture. Component “A” is optionally isocyanate. Optionally, component “A” is from a family of substances similar to isocyanate. In some exemplary embodiments of the invention, component “A” is maintained at a viscosity between 300 cP and 400 cP. Component “B” is optionally polyol. Optionally, component “B” is from a family of substances similar to polyol. In some exemplary embodiments of the invention, component “B” is maintained at a viscosity between 700 cP and 800 cP. Optionally, component “B” exhibits a viscosity of up to 1400 cP during packing material manufacture. Following the method described herein, the components are taken from separate reservoirs and ejected into a mix chamber using pump apparatus 100 as a motive force. Upon mixture in the mix chamber, the components react chemically creating the packing material sought.

[0037] In some exemplary embodiments of the invention, a component spraying nozzle is used downstream of the pump which is flushed with solvent between operations to avoid downstream partial blockage. Blockage avoidance measures used in conjunction with gerotors provide pump apparatus 100 with reliability and the capability to be accurately controlled in terms of volume of fluid delivered.

[0038] The present invention has been described using non-limiting detailed descriptions of embodiments thereof that are provided by way of example and are not intended to limit the scope of the invention. It should be understood that features and/or steps described with respect to one embodiment may be used with other embodiments and that not all embodiments of the invention have all of the features and/or steps shown in a particular figure or described with respect to one of the embodiments. For example, description pertaining to pump apparatus 100 can optionally be applied to through-shaft pump apparatus 600 even if not specifically noted. Variations of embodiments described will occur to persons of the art. Furthermore, the terms “comprise,” “include,” “have” and their conjugates, shall mean, when used in the disclosure and/or claims, “including but not necessarily limited to.”

[0039] It is noted that some of the above described embodiments may describe the best mode contemplated by the inventors and therefore may include structure, acts or details of structures and acts that may not be essential to the invention and which are described as examples. Structure and acts described herein are replaceable by equivalents, which perform the same function, even if the structure or acts are different, as known in the art. Therefore, the scope of the invention is limited only by the elements and limitations as used in the claims.

1. A pump apparatus for transporting at least one fluid, comprising:
   a. a shaft, wherein said shaft has a longitudinal axis;
   b. a motor, wherein said motor is adapted to rotate said shaft about said longitudinal axis; and,
   c. a plurality of gerotors, wherein said gerotors are attached to said shaft along said longitudinal axis and wherein said shaft rotation actuates said plurality of gerotors rotation, causing pumping of said at least one fluid.

2. A pump apparatus according to claim 1, further comprising a shaft revolution counter.
3. A pump apparatus according to claim 1, wherein said shaft further comprises at least one protrusion extending radially outward from said longitudinal axis.

4. A pump apparatus according to claim 3, wherein said shaft revolution counter is an optical encoder.

5. A pump apparatus according to claim 3, wherein said shaft revolution counter is a photo-sensor.

6. A pump apparatus according to claim 1, further comprising at least one inlet port and at least one outlet port for each of said plurality of gerotors.

7. A pump apparatus according to claim 6, further comprising a bypass valve system adapted for selective release of said at least one fluid between said at least one inlet port and said at least one outlet port.

8. A pump apparatus according to claim 7, wherein said bypass valve system activates release at 250 psi of pressure.

9. A pump apparatus according to claim 7, wherein said bypass valve system activates release at 300 psi of pressure.

10. A pump apparatus according to claim 7, wherein said bypass valve system activates release at greater than 300 psi of pressure.

11. A pump apparatus according to claim 7, wherein said bypass valve system is comprised of a spring and ball.

12. A pump apparatus according to claim 1, wherein said plurality of gerotors are varied in size.

13. A pump apparatus according to claim 6, further comprising an additional port positioned proximal to said outlet port.

14. A pump apparatus according to claim 13, wherein said additional port is adapted for bleeding air from said outlet port.

15. A pump apparatus according to claim 13, wherein said additional port is adapted for permitting diagnostic measurements to be taken of said outlet port.

16. A pump apparatus according to claim 1, further comprising fluid conveying tubes which are controllably heated.

17. A pump apparatus according to claim 1, wherein at least one of said plurality of gerotors is mounted on said shaft opposite said motor from at least one other of said plurality of gerotors.

18. A bypass valve system for use in a fluid pumping apparatus comprising a pump, at least one inlet and at least one outlet, comprising:

   a valve closer, wherein said valve closer maintains bypass valve in a closed state until said bypass valve system is activated; and,

   a valve plug, wherein when said bypass valve is closed, said valve plug substantially prohibits fluid flow between said inlet and outlet.

19. A bypass valve system according to claim 18, wherein said valve closer is a spring.

20. A bypass valve system according to claim 18, wherein said valve plug is a ball.

21. A bypass valve system according to claim 18, wherein when said bypass valve system is activated, said valve closer and said valve plug permit fluid flow between said inlet and outlet.

22. A bypass valve system according to claim 21, wherein said system is activated upon the attainment of 250 psi of pressure.

23. A bypass valve system according to claim 21, wherein said system is activated upon the attainment of 300 psi of pressure.

24. A bypass valve system according to claim 21, wherein said system is activated upon the attainment of greater than 300 psi of pressure.

25. A bypass valve system according to claim 18, wherein said fluid pumping apparatus further comprises at least one gerotor.

26. A method of using a fluid pumping apparatus comprised of a plurality of gerotors and at least one outlet, comprising:

   commencing rotation of a shaft, wherein said shaft is connected to said plurality of gerotors; and,

   drawing at least one fluid through said pumping apparatus using said plurality of gerotors.

27. A method according to claim 26, further comprising counting said rotations of said shaft in order to measure the volume of said at least one fluid being pumped.

28. A method according to claim 26, further comprising stopping rotation of said shaft upon the attainment of a predetermined measured volume of said at least one fluid.

29. A method according to claim 26, further comprising activating a bypass valve system if pressure in said at least one outlet exceeds a predetermined threshold.

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