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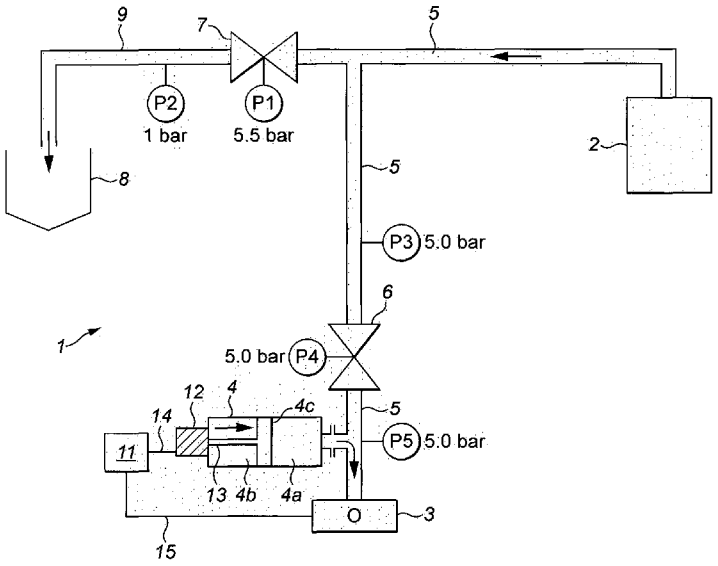


FIG. 1

(57) Abstract: A dispensing apparatus for dispensing a pressurised fluid product (5) has a supply part (2) for supplying the pressurised fluid product, a depositor part (3) selectively to adopt an open state for fluid communication with the supply part to receive a charge of fluid product from the supply part and to adopt a closed state to isolate the charge of fluid product from the supply part to dispense the charge of fluid product from the depositor part. A buffer reservoir (4) is connected between the supply part and the depositor part for fluid communication therewith. The buffer reservoir has a volume capacity which is variable so as to expand if the depositor part is closed to admit pressurised fluid product from the supply part and to contract if the depositor part is open to eject previously admitted pressurised fluid product to the depositor for dispensing, thereby to tranquilise pressure variations within the pressurised fluid product.

WO 2014/147465 A1

DISPENSING APPARATUS, AND METHODS FOR DISPENSING A PRESSURISED FLUID PRODUCT

The invention relates to the dispensing of fluid products and particularly, though not exclusively, fluid food items such as chocolate, confection, fats or the like.

In the manufacture of food products, it is often required to dispense food items or edible items in a fluid form into receptacles such as moulds, or onto component parts of the ultimate food product – e.g. when dispensing fillings/coverings for a food product. The pressure at which a food item is held within, and dispensed from, a dispensing apparatus can often be critical to the quality of the food product ultimately produced, and the efficiency of the overall dispensing process.

For example, in the manufacture of chocolate, it is necessary to temper the chocolate when in fluid form. This involves controlling the temperature of the chocolate so as to control the crystallisation of the cocoa butter to ensure the appropriate type of crystals. Failure to appropriately temper chocolate can result in the chocolate forming a "bloom" in which it will appear matt in complexion and covered with pale or white patches. The chocolate will also tend to crumble unpleasantly rather than "snap" when bitten. Tempering the chocolate avoids these undesirable outcomes. The tempering controls the crystals so that only crystals of the desired type are produced resulting in a better quality chocolate. This is just one example of how it can be important to control the temperature of fluid food products during a dispensing operation.

Mechanised dispensing typically requires the delivery of a fluid food product from a pressurised supply system. Appropriate control of the pressure, and therefore temperature, within the system critically affects the quality of the dispensed products and the efficiency of the dispensing system. Excessive fluctuations of pressure within such a system may not only damage the food product but may also undesirably change the viscosity and rheology of the fluid to reduce the efficiency and uniformity with which product is dispensed. This can be critical in an automated system, particularly a batch-dispensing system in which food product is intermittently and periodically dispensed. This may be particularly the case when the food product being dispensed is an aerated product, such as a cream or an aerated chocolate. Unsuitable pressure reductions may cause de-gassing from the aerated product undesirably.

An example of a batch dispensing operation is the dispensing of liquid chocolate into separate moulds in succession so as to produce batches of chocolate tablets or bars. The dispensing of the chocolate is co-ordinated with the positioning of moulds suitably adjacent a dispensing outlet, and dispensing chocolate from the outlet only when alignment is achieved. This requires the dispensing system to dispense the food product intermittently when required.

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This intermittent form of dispensing can impose pressure fluctuations within the dispensing system which may damage the food product being dispensed, and reduce dispensing efficiency and accuracy.

The present invention aims to provide an improved method and apparatus for dispensing a pressurised fluid product, particularly (though not exclusively) a pressurised fluid food product.

According to the present invention there is provided an apparatus and method as set forth in the appended claims. Other features of the invention will be apparent from the dependent claims, and the description which follows.

In a first aspect, the invention may provide a dispensing apparatus for dispensing a pressurised fluid product comprising:

a supply part (e.g. vessel) for supplying the pressurised fluid product;

a depositor part adapted and arranged selectively to adopt an open state for fluid communication with the supply part to receive a charge of said fluid product from the supply part and to adopt a closed state to isolate the charge of fluid product from the supply part to dispense the charge of fluid product from the depositor part;

a buffer reservoir connected between the supply part and the depositor part for fluid communication therewith;

wherein the buffer reservoir has a volume capacity which is variable so as to expand if said depositor part is in said closed state thereby to admit pressurised fluid product from the supply vessel and to contract if said depositor part is in said open state so as to eject previously admitted pressurised fluid product to the depositor part for dispensing, thereby to tranquilise pressure variations within the pressurised fluid product. In this way, the buffer reservoir is able to accommodate fluid product unable to exit the dispensing system when the depositor part is closed yet return that fluid at an appropriate pressure when the depositor part re-opens. The supply part may include a fluid pump arranged to pump the fluid product from the supply part (e.g. a vessel) to the depositor part and thereby induce fluid pressure within the fluid. The supply part may comprise a pressure vessel for containing fluid product at a desired supply pressure.

The fluid product may be a structured fluid in which gas is dispersed in the form of single bubbles and/or dissolved within the fluid, which may be dissolved in the fat phase of the fluid. Such a structured fluid may be sensitive to variations in pressure, temperature and shear. The

invention enables gentle pressure compensation substantially without large pressure drops in the fluid, additional shear or substantial temperature variations. The fluid may be a foam, and may be a food-grade product. The term "structured fluid" may include a reference to a fluid containing a thermodynamically stable water, surfactant, co-surfactant and a non-aqueous component. Surfactants may be used comprising saturated or unsaturated fatty acids, while co-surfactants may comprise naturally occurring acids such as citric or the like. The water may be not "free", but "entrapped" in a thermodynamically and kinetically stable state. This may lead to beneficial properties such as little or no agglomeration when incorporating the structured liquid into chocolate-type products. The term "non-aqueous component" or "fat-phase" may be understood as including any solids and/or liquid ingredient mixable with oil or fat, or that has the capacity to dissolve in oil or fat at ambient temperature. An "aqueous phase" may refer to any solid or liquid ingredient mixable with water, or that has the capacity to dissolve in water at ambient temperature.

The invention enables adjustable bubble formation within the fluid product during the period when the depositor part is in the open state. This is because a variable volume of the buffer reservoir is able to reduce pressure variations at the fluid product being supplied to the depositor part as the depositor part opens and closes in use.

The depositor part may comprise a depositor chamber for receiving the charge of fluid product and a depositor output port from which the depositor part is operable and arranged to dispense the charge of fluid product from the depositor chamber. The depositor part may include an ejector part(s), apparatus or assembly for forcing the charge of fluid product from the depositor chamber and out through the output port. The depositor part may be moveable, or include elements moveable (e.g. include a closure part moveable) between a first position which places the depositor chamber in the open state in fluid communication with the buffer reservoir and the supply of fluid product, and a second position which places it in the closed state which isolates the depositor chamber from the buffer reservoir and the supply of fluid product. In the first position, a charge of fluid product may be received by the depositor chamber while in the second position, the received charge may be ejected from the depositor chamber as the dispensing apparatus dispenses the charge. The depositor chamber may be moveable by a rotation of the depositor chamber to the first position to place an inlet of the depositor chamber in communication with the buffer reservoir and the fluid supply, and may be moveable by a further rotation into the second position which moves the inlet of the chamber out of such communication (e.g. blocks/closes it). In an embodiment, when the depositor chamber is in the first position the outlet port of the depositor chamber is closed to prevent output of the charge of fluid product as the chamber is being charged.

The dispensing apparatus may include a chamber defining an inner volume partitioned into a first volume part defining said buffer reservoir for fluid communication with the supply part and the depositor part for said admitting and ejecting of pressurised fluid product, and a second volume part isolated from the first volume part by a moveable partition part, and a drive part coupled to the partition part and arranged selectively to move the partition part in a direction towards or away from the first volume part to selectively vary the volume capacity thereof.

In an embodiment, the drive part is operable and arranged to move the partition part towards first volume part when the state of the depositor changes from said closed state to said open state, and to move the partition part away from first volume part when the state of the depositor changes from said open state to said closed state.

The drive part may be operable and arranged to move partition part at substantially a constant speed thereby to change volume capacity of the buffer reservoir at a substantially constant rate.

The drive part may be operable and arranged to move the partition part towards the first volume part at a first speed and to move the partition part towards the second volume part at a second speed which is substantially half the first speed.

The drive part may comprise an actuator and the partition part may comprise a piston to which the actuator is coupled.

The buffer reservoir may have a volume capacity which is variable, in use, according to a pressure of the pressurised fluid so as to expand if said pressure exceeds a predetermined pressure value thereby to admit pressurised fluid product from the supply part and to contract if said pressure is less than the predetermined pressure value so as to eject previously admitted pressurised fluid product to the depositor part for dispensing, thereby to tranquilise pressure variations within the pressurised fluid product.

The depositor part may be arranged to intermittently change from a closed state which prevents the release thereto of the fluid product, to an open state which permits the release thereto of fluid product from the supply part, wherein the supply vessel is arranged to supply the pressurised fluid product:

at a first supply pressure less than said predetermined pressure value when the depositor part is in the open state; and,

at a second supply pressure exceeding the predetermined pressure value when the depositor part is in the closed state. By constraining the predetermined pressure to fall within

these two operating/supply pressures, the buffer reservoir is able to respond to the two states of the depositor part appropriately.

The dispensing apparatus may include a chamber defining an inner volume partitioned into a first volume part for fluid communication with the supply part and the depositor part defining the buffer reservoir for said admitting and ejecting of pressurised fluid product, and a second volume part isolated from the first volume part by a moveable partition part urged from within the second volume part in a direction towards the first volume part and moveable, in use, according to a pressure of the pressurised fluid product within the first volume part.

The second volume part may contain a pressurised fluid arranged to urge the moveable partition part in a direction towards the first volume part such that the partition part is moveable in response to a pressure difference between a pressure within the second volume part and a pressure of said pressurised fluid product within the first volume part.

The dispensing apparatus may be arranged to maintain the pressure of the pressurised fluid at a substantially constant fluid pressure corresponding to the predetermined pressure. This enables a passive system to be employed. The apparatus may comprise a pressure control unit arranged to monitor and maintain the predetermined pressure. Alternatively, the pressurised fluid may be controlled to have a variable pressure, controlled to change the volume of the buffer reservoir actively.

The partition part may comprise a sliding piston and the chamber may comprise a piston chamber within which the piston is slidable to render the volume capacity of the buffer reservoir variable. Other forms of buffer reservoir may be employed, such as a volume containing (e.g. partitioned by) a flexible diaphragm(s) arranged to deform to change the volume of the buffer reservoir according to the fluid pressure of the fluid product.

The dispensing apparatus may include a piping system connecting the supply part for fluid communication with the depositor part wherein the buffer reservoir is connected in fluid communication with the piping system between the supply part and the depositor part.

The dispensing apparatus may include a first pressure valve located in the fluid communication path between the supply part and the depositor part and arranged to permit a flow of pressurised fluid product therethrough when at a fluid pressure is equal to or greater than said first supply pressure.

The dispensing apparatus may include an overflow tank connected to the supply part via a pressure valve in communication with the fluid communication path between the supply part

and the depositor part and arranged to permit a flow of pressurised fluid product therethrough to the overflow tank when at or exceeding a predetermined fluid supply pressure.

The overflow tank may be connected to the supply part via a second pressure valve for communication with the fluid communication path between the supply part and the depositor part and arranged to permit a flow of pressurised fluid product therethrough to the overflow tank when at a fluid pressure equal to or greater than said second supply pressure.

In an embodiment, the predetermined pressure is greater than said first supply pressure and less than said second supply pressure. In an embodiment, the overflow tank is arranged to maintain or operate at a fluid pressure therein which is less than any supply pressure of the supply part (e.g. atmospheric pressure).

In a second aspect, the invention may provide a food dispensing apparatus for dispensing a food item comprising a dispensing apparatus as described above according to the first aspect of the invention, wherein the pressurised fluid product is a food item.

In a third aspect, the invention may provide a method of dispensing for supplying a pressurised fluid product for dispensing comprising:

providing a supply part containing a supply of the pressurised fluid product for fluid communication with a depositor part adapted and arranged selectively to adopt an open state for fluid communication with the supply part to receive a charge of said fluid product from the supply part and to adopt a closed state to isolate the charge of fluid product from the supply part to dispense the charge of fluid product therefrom;

providing a buffer reservoir connected between the supply part and the depositor part for fluid communication therewith wherein the buffer reservoir has a volume capacity which is variable, in use, according to a pressure of the pressurised fluid;

supplying said pressurised fluid product to the depositor part at said pressure, for dispensing;

expanding the volume capacity of the buffer reservoir if the depositor part is in said closed state thereby to admit pressurised fluid product from the supply part and contracting the volume capacity of the buffer reservoir if the depositor part is in said open state so as to eject previously admitted pressurised fluid product to the depositor part for dispensing, thereby to tranquilise pressure variations within the pressurised fluid product.

The method may include providing a chamber defining an inner volume partitioned into a first volume part defining said buffer reservoir in fluid communication with the supply part and the depositor part for said admitting and ejecting of pressurised fluid product, and a second volume part isolated from the first volume part by a moveable partition part and, providing a drive part coupled to the partition part and, selectively moving the partition part in a direction towards or away from the first volume part to selectively vary the volume capacity thereof.

The method may include operating the drive part to move the partition part towards first volume part when the state of the depositor changes from said closed state to said open state, and to move the partition part away from first volume part when the state of the depositor changes from said open state to said closed state.

The method may include operating the drive part to move partition part at substantially a constant speed thereby to change volume capacity of the buffer reservoir at a substantially constant rate.

The method may include operating the drive part to move the partition part towards the first volume part at a first speed and to move the partition part towards the second volume part at a second speed which is substantially half the first speed.

The drive part may comprise an actuator or a servo motor and the partition part may comprise a piston to which the actuator or servo motor is coupled.

The method may include expanding the volume capacity of the buffer reservoir if said pressure exceeds a predetermined pressure value thereby to admit pressurised fluid product from the supply vessel and contracting the volume capacity of the buffer reservoir if said pressure is less than the predetermined pressure value so as to eject previously admitted pressurised fluid product to the output port for dispensing, thereby to tranquilise pressure variations within the pressurised fluid product.

The method may include intermittently changing the state of the depositor part from a closed state which prevents the release thereto of the fluid product, to an open which permits the release thereto of fluid product from the supply part; and supplying said pressurised fluid product from the supply part:

at a first supply pressure less than said predetermined pressure value when said depositor part is in said open state; and,

at a second supply pressure exceeding said predetermined pressure value when said depositor part is in said closed state.

The method may include providing a chamber defining an inner volume partitioned into a first volume part connected for fluid communication with the supply part and the depositor part defining said buffer reservoir, and a second volume part isolated from the first volume part by a moveable partition part; and urging the partition part from within the second volume part in a direction towards the first volume part to move according to a pressure of the pressurised fluid product within the first volume part.

In an embodiment, the second volume part contains a pressurised fluid, and the method includes therewith urging the moveable partition part in a direction towards the first volume part such that the partition part moves in response to a pressure difference between a pressure within the second volume part and a pressure of said pressurised fluid product within the first volume part.

The method may include maintaining the pressure of said pressurised fluid at a substantially constant fluid pressure corresponding to said predetermined pressure.

The method may include supplying said depositor part with said pressurised fluid product from the supply part via a piping system connecting the supply part for fluid communication with the depositor part in which the buffer reservoir is connected in fluid communication with the piping system between the supply part and the depositor part.

The method may include providing first pressure valve located in the fluid communication path between the supply part and the depositor part and therewith permitting a flow of pressurised fluid product therethrough when at a fluid pressure equal to or greater than said first supply pressure.

The method may include providing an overflow tank connected to the supply part via a second pressure valve for communication with the fluid communication path between the supply part and the depositor part and therewith permitting a flow of pressurised fluid product therethrough to the overflow tank when at a fluid pressure equal to or greater than said second supply pressure.

The method may include controlling said predetermined pressure to be greater than said first supply pressure and less than said second supply pressure.

The method may include operating or maintaining at the overflow tank a fluid pressure therein which is less than any supply pressure of the supply part (e.g. at ambient/atmospheric pressure).

In a fourth aspect, the invention may provide a method for dispensing a food item comprising a method according to the third aspect of the invention described above, wherein the pressurised fluid product is a food item.

The pressurised fluid product may be a liquid product (e.g. molten chocolate, confection, fat etc) or may be a fluidly flowable granular, particulate or powdered product (e.g. food product).

Examples of preferred embodiments of the invention will now be described with reference to the following drawings of which:

Figure 1 schematically illustrates a dispensing apparatus for supplying a pressurised aerated chocolate fluid in a batch dispensing system with the depositor outlet open (O);

Figure 2 schematically illustrates the dispensing apparatus illustrated in Figure 1 in which the depositor outlet of the apparatus is closed temporarily in-between successive chocolate dispensing phases;

Figure 3 schematically illustrates a dispensing apparatus according to an alternative embodiment for supplying a pressurised aerated chocolate fluid in a batch dispensing system;

Figure 4 schematically illustrates the dispensing apparatus illustrated in Figure 3 in which the depositor outlet of the apparatus is closed temporarily in-between successive chocolate dispensing phases;

Figures 5A and 5B show a depositor part in cross-section in an open state and a closed state, respectively;

Figure 6 illustrates graphically the reduction in variation of the liquid chocolate pressure within the dispensing system of Figures 1 to 4 achieved by use of the buffer reservoir apparatus thereof.

Referring to Figures 1 to 4, there is schematically illustrated a dispensing apparatus for supplying a pressurised aerated fluid chocolate to a depositor (3) for dispensing to a mould for a chocolate bar, or the like (not shown). In Figures 1 and 3 the depositor (3) is open (O) to the chocolate supply and the dispensing of fluid chocolate is temporarily stopped while the depositor is charged with fluid chocolate for dispensing, whereas in Figures 2 and 4 the depositor (3) is closed (C) to the chocolate supply and is dispensing the charge of chocolate.

The dispensing apparatus comprises a supply vessel (2) from which pressurised and aerated fluid chocolate is supplied. A fluid feeding pump may feed or supply the fluid in to the supply vessel at a desired and controllable pressure for maintaining fluid pressure within the vessel and the piping system (5) of the apparatus. The supply vessel is connected for fluid communication to a depositor (3) of the dispensing apparatus via a closed intermediate piping system (5) defining a fluid flow path for conveying the pressurised fluid chocolate from the supply vessel to the depositor for dispensing. A buffer reservoir (4) is connected in fluid communication with the piping system (5) between the supply vessel and the depositor for fluid communication with both. The supply vessel is shown schematically and may contain pressurised fluid chocolate, or may contain unpressurised (or relatively low pressure) fluid chocolate which is pumped into the intermediate piping system to generate a desired higher pressure within the piping system than is the pressure within the supply vessel. The supply vessel may comprise a pressure/pressurised vessel, of an unpressurised (or lower pressure) vessel in combination with a fluid pump as described above. The term "vessel" is intended to include (alone or in combination) cylinders, chambers, tanks, hoppers, piping and fluid conduits, fluid pumps and the like forming a means of fluid supply.

The depositor (3) is arranged and controllable to intermittently change between an open state in fluid communication with the supply part to receive a charge of fluid chocolate from the piping system and a closed state which isolates the charge of chocolate from the piping system to dispense the charge from the output port of the dispenser. In the open state the pressurised fluid chocolate within the dispensing apparatus is prevented from exiting the apparatus while the depositor receives the charge of chocolate. In the closed state the pressurised fluid chocolate may exit the output port of the depositor and be dispensed thereby while remaining isolated from the fluid chocolate within the piping system and the supply vessel.

A first valve unit (6) is connected to the intermediate piping system (5) of the apparatus between the supply vessel and the depositor and is arranged in the fluid flow path defined by the piping system to selectively permit the flow of fluid chocolate therethrough when the fluid pressure exceeds 5.0 bar and to prevent such flow otherwise. This valve may optionally be dispensed with. A second valve unit (7), in this embodiment a membrane counter-pressure valve, is connected to the intermediate piping system (5) of the apparatus between the supply vessel and the first valve and is arranged in an overflow piping branch in fluid communication with the fluid flow path defined by the piping system between the supply vessel and the first valve unit. The second valve unit is arranged to selectively permit the flow of fluid chocolate therethrough and along the overflow branch when the fluid pressure in the fluid flow path exceeds a pressure P1, 5.5 bar, and to prevent such flow otherwise. An overflow tank (8) is arranged at an internal fluid pressure of 1 bar (e.g. open to ambient pressure), in fluid

communication with the outlet of the second valve unit so as to receive fluid chocolate passed through the second valve unit. Hence the pressure meter P2 is at 1 bar . The first and second valve units comprise valves (e.g. membrane valves or otherwise) which serve as counter-pressure valves in this way such that the supplied fluid chocolate from the supply vessel is permitted to build-up a pressure of between 5.0 bar and 5.5 bar within the intermediate piping system prior to the depositor (as measured at pressure meters P3 P4 and P5). When the depositor (3) of the dispensing apparatus (1) is open, as shown in Figure 1, the first valve unit maintains the operating pressure of the fluid chocolate within the system at 5.0 bar. However, when the depositor is closed, as shown in Figure 2, the second valve unit operates to maintain the operating pressure at 5.5 bar. In the embodiment shown, P4 is 5.0 bar with P3 and P5 at 5.5 bar. In other embodiments, the first valve unit may be dispensed with or may be arranged to permit fluid flow through it at a threshold pressure of 5.5 bar, rather than 5.0 bar.

A buffer reservoir (4) is connected to the intermediate piping system in fluid communication therewith between the first valve unit (6) and the depositor (3). The buffer reservoir comprises a cylindrical chamber comprising an inner cylinder volume partitioned into a first volume part (4a) in fluid communication with the intermediate piping system (5) and the depositor which defines a variable-capacity buffer volume for admitting and ejecting pressurised fluid chocolate from/to the piping system. The cylindrical chamber also defines a second volume part (4b) isolated from the first volume part by a moveable piston head (4c) which partitions the first and second volume part in fluid isolation.

In a first embodiment illustrated in Figures 1 and 2, the piston head (4c) is connected to an actuator rod (13) which is driven by an actuator drive unit (12). The actuator drive apparatus is arranged to selectively extend and retract the actuator rod (13) therefrom at a selected speed (e.g. uniform speed) and at a selected time, in order to move the piston head (4c) to or fro along the internal bore of the buffer reservoir chamber in a selected direction. The actuator drive apparatus may be a pneumatic, hydraulic or electro-mechanical actuator whereby the extension/retraction of the actuator rod is actively controlled pneumatically, hydraulically or electro-mechanically. A servo motor may be arranged and operable to control the extension/retraction of the actuator rod. In this way, the volume capacity of the first volume part of the buffer reservoir maybe actively controlled.

A buffer control unit (11) is connected to the actuator drive unit via a control signal line (14) and is arranged to issue drive control signals to the actuator drive unit to control the direction of movement of the actuator rod (extension/retraction), its speed of movement and the time at which a particular movement commences. The buffer control unit is also connected to the depositor part (3) via a sensing signal line (15) along which is transmitted a sensing signal which emanates from a depositor sensor (not shown) arranged within the depositor part to

sense when the depositor part begins to change from an open state (Figure 5A) to a closed state (Figure 5B) and vice versa.

The depositor sensor is arranged to issue such a signal to the buffer control unit via the sensing signal line. The buffer control unit is responsive to a depositor sensor signal which indicates a transition from an open state to a closed state, by controlling the actuator drive unit (12) to retract the actuator rod (Figure 2) thereby to expand the volume capacity of the first volume part of the buffer reservoir to permit liquid chocolate to enter the buffer reservoir as soon as, and while, that chocolate is unable to enter the (closed) depositor part. The actuator drive unit controls the actuator rod so that the piston head moves at a uniform first speed thereby to increase the volume capacity of the first volume part at a rate which matches the volumetric rate at which the chocolate would otherwise enter the depositor part.

The buffer control unit is responsive to a depositor sensor signal which indicates a transition from a closed state to an open state, by controlling the actuator drive unit (12) to extend the actuator rod (Figure 1) thereby to reduce the volume capacity of the first volume part of the buffer reservoir to force liquid chocolate from the buffer reservoir as soon as, and while, that chocolate is able to enter the (open) depositor part. The actuator drive unit controls the actuator rod so that the piston head moves at a uniform second speed thereby to reduce the volume capacity of the first volume part at a rate which substantially twice the first speed.

Typically, about 1 second of time is required to fill the depositor part under typical operating conditions. The depositor part may deposit at a rate of about 100 Kg of chocolate per hour, for example. About one third of that time would be spent ejecting chocolate from the buffer reservoir for depositing chocolate from the depositor part, and about two thirds of the time would be spent entering/buffering chocolate within the buffer reservoir.

In an alternative embodiment illustrated in figures 3 and 4, the second volume part contains a gas (e.g. air) maintained at a substantially constant pressure of 5.25 bar by a pressure monitoring and control unit (110). The result is that the pneumatic pressure exerted upon the surface of the piston head within the second volume part of the cylindrical chamber, urges the piston head from within the second volume part in a direction towards the first volume part with a substantially constant urging force. The piston head is thereby moveable, in use, according to a pressure difference between the constant pressure in the second volume part and a (variable) pressurised of fluid chocolate within the first volume part and within the intermediate piping system from whence the fluid chocolate came.

This difference is positive (chocolate pressure exceeds pneumatic pressure) when the depositor is closed and the fluid pressure within the intermediate piping system rises to 5.5 bar

as determined by the second valve unit (7). This is shown in Figure 4. In this circumstance, the force exerted upon the piston head by the fluid chocolate within the first volume part exceeds the substantially constant urging force exerted upon it from within the second volume part, and the piston head moves along the cylindrical chamber of the buffer reservoir in a direction which expands the volume capacity of the first volume part, thereby permitting more fluid chocolate to be admitted into the second volume part. This has the effect of reducing, stabilising or subduing increases in the fluid pressure of the fluid chocolate within the intermediate piping system which are otherwise common when the depositor switches from the open state to the closed state for dispensing chocolate as shown in Figure 4.

Conversely, the pressure difference is negative (chocolate pressure less than pneumatic pressure) when the depositor is open and the fluid pressure within the intermediate piping system falls to 5.0 bar as determined by the first valve unit (6). This is shown in Figure 3. In this circumstance, conversely, the force exerted upon the piston head by the fluid chocolate within the first volume part is less than the substantially constant urging force exerted upon it from within the second volume part, and the piston head moves along the cylindrical chamber of the buffer reservoir in a direction which reduces the volume capacity of the first volume part, thereby ejecting fluid chocolate from the first volume part and back into the intermediate piping system. This also has the effect of reducing, stabilising or subduing falls in the fluid pressure of the fluid chocolate within the intermediate piping system which are otherwise common when the depositor switches from the closed state to the open state to halt the dispensing of chocolate (10) so as to receive a new charge of liquid chocolate for subsequent dispensing as shown in Figure 3.

By controlling the pneumatic pressure to be less than the operating/supply pressure of the chocolate in the piping system when the depositor is closed, yet greater than the operating/supply pressure when the depositor is open, the aforementioned pressure difference can change sign according to the state (open/closed) of the depositor and thereby the piston can act in opposite directions (to admit/eject chocolate) accordingly. Thus, the buffer reservoir is arranged to tranquilise variations in pressure, and therefore in temperature and flow rate, within the fluid chocolate which arise due to the otherwise sudden chances in those parameters caused by the repetitive and intermittent opening and closing of the depositor (3) during successive re-charging cycles. This is particularly is when the dispensing is done in "batch" mode, rather than continuously, and also when the dispensing apparatus comprises a closed piping system such as in the present embodiment.

Figures 5A and 5B show a depositor part in cross-section. Figure 5A shows the depositor part in the open state and receiving a charge of liquid chocolate from the piping system (5) of the dispensing apparatus. Figure 5B shows the depositor part in the closed state isolated from the

piping system and arranged for depositing/outputting (10) the received charge of liquid chocolate from dispensing apparatus.

The depositor part is structured in the manner of a plug valve and includes a valve input cavity (20) connected in fluid communication with the piping system of the dispenser apparatus. A depositor chamber (24) is formed within a plug part (21) of the valve which is rotatingly housed within the valve input cavity and is rotatable by rotation of the plug part to change the state of the depositor part from an open state to a closed state. The valve input cavity comprises a tapering input bore part leading, at its wider end, from the piping system to a circular cylindrical valve cavity part at its narrower end. The cylindrical valve cavity houses within it a semi-circular cylindrical plug part (21) having a diameter matching the diameter of the circular cylindrical bore within which it snugly fits. The depositor chamber is defined by a through-bore which extends through the plug part from a first curved (circular) outer surface part of the plug part to a separate second curved (circular) outer surface part tangentially oriented at the outer surface of the plug part in an orientation perpendicular to that of the first surface part. In this way the ends of the through-bore are separated by a quarter segment section of the plug part and face in mutually perpendicular directions.

A collector (22, 23) extends from an inner wall surface of the circular cylindrical cavity part of the valve input cavity and includes a charge collector bore (22) in fluid communication with the valve input cavity which contains a collector piston (23) moveable along the charge collector bore selectively either away from the valve input cavity to suck a charge of chocolate into the charge collector bore to charge the depositor (3) with chocolate (Figure 5A), or towards the valve input cavity to eject the charge of chocolate from the charge collector bore for dispensing (Figure 5B).

The plug part is rotatable to a first position (Figure 5A, Figure 1) which opens the depositor part in which one end of the through-bore (24) is in communication with an outlet nozzle (25) of the depositor while the other end is blocked by the internal surface of the valve input cavity (20). In this position, the semi-circular shape of the plug part (21) does not occupy the portions of the valve input cavity between the piping system and the charge collector (22, 23) thereby placing the two in fluid communication and permitting a charge of fluid chocolate to be drawn into the charge collector bore by retraction of the collector piston (23) to suck chocolate into the charge collector bore to charge the depositor (3) with a charge of chocolate for subsequent dispensing, as shown in Figure 5A.

The plug part is rotatable to a second position (Figure 5A, Figure 2) which closes the depositor part in which one end of the through-bore is in communication with an outlet nozzle (25) of the depositor while the other end is in communication with the (charged) collector bore (22). In

this position, the semi-circular shape of the plug part (21) does occupy the portions of the valve input cavity between the piping system and the charge collector (22, 23) thereby placing the two in fluid isolation and permitting a charge of fluid chocolate to be ejected from the charge collector bore by extension of the collector piston (23) to push chocolate from the charge collector bore to discharge the depositor (3) and dispense the charge of, as shown in Figure 5B.

Figure 6 graphically shows an example of the range of variation of the pressure fluctuations in the fluid chocolate within the intermediate piping system (5) both when the buffer reservoir is not operational (or not present) – here the pressure variations amount to a 2 bar fluctuation as shown in region A – and also when the buffer reservoir is present and operational as shown in region B – the pressure variations amount to a 1 bar fluctuation. This is according to the first embodiment. A similar improvement occurs according to the second embodiment. In the graph P is pressure and T time with the pressure fluctuating rapidly (not shown) between the upper and lower lines.

Although a few preferred embodiments have been shown and described, it will be appreciated by those skilled in the art that various changes and modifications might be made without departing from the scope of the invention, as defined in the appended claims.

In summary, the invention provides a dispensing apparatus for dispensing a pressurised fluid product having a supply part for supplying the pressurised fluid product, a depositor part selectively to adopt an open state for fluid communication with the supply part to receive a charge of fluid product from the supply part and to adopt a closed state to isolate the charge of fluid product from the supply part to dispense the charge of fluid product from the depositor part. A buffer reservoir is connected between the supply part and the depositor part for fluid communication therewith. The buffer reservoir has a volume capacity which is variable so as to expand if the depositor part is closed to admit pressurised fluid product from the supply part and to contract if the depositor part is open to eject previously admitted pressurised fluid product to the depositor for dispensing, thereby to tranquilise pressure variations within the pressurised fluid product.

Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, and drawings), and/or all of the steps of any method or process so disclosed, may be combined in

any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS

1. A dispensing apparatus for dispensing a pressurised fluid product comprising:

a supply part for supplying the pressurised fluid product;

a depositor part adapted and arranged selectively to adopt an open state for fluid communication with the supply part to receive a charge of said fluid product from the supply part and to adopt a closed state to isolate the charge of fluid product from the supply part to dispense the charge of fluid product from the depositor part;

a buffer reservoir connected between the supply part and the depositor part for fluid communication therewith;

wherein the buffer reservoir has a volume capacity which is variable so as to expand if the depositor part is in said closed state thereby to admit pressurised fluid product from the supply part and to contract if said depositor part is in said open state so as to eject previously admitted pressurised fluid product to the depositor for dispensing, thereby to tranquilise pressure variations within the pressurised fluid product.

2. A dispensing apparatus according to claim 1 including:

a chamber defining an inner volume partitioned into a first volume part defining said buffer reservoir for fluid communication with the supply part and the depositor part for said admitting and ejecting of pressurised fluid product, and a second volume part isolated from the first volume part by a moveable partition part; and,

a drive part coupled to the partition part and arranged selectively to move the partition part in a direction towards or away from the first volume part to selectively vary the volume capacity thereof.

3. A dispensing apparatus according to claim 2 in which the drive part is operable and arranged to move the partition part towards first volume part when the state of the depositor changes from said closed state to said open state, and to move the partition part away from first volume part when the state of the depositor changes from said open state to said closed state.

4. A dispensing apparatus according to any of claims 2 and 3 wherein the drive part is operable and arranged to move partition part at substantially a constant speed thereby to change volume capacity of the buffer reservoir at a substantially constant rate.

5. A dispensing apparatus according to any of claims 2 to 4 in which the drive part is operable and arranged to move the partition part towards the first volume part at a first speed and to move the partition part towards the second volume part at a second speed which is substantially half the first speed.

6. A dispensing apparatus according to any of claims 2 to 5 in which the drive part comprises an actuator and the partition part comprises a piston to which the actuator is coupled.

7. A dispensing apparatus according to any preceding claim in which the buffer reservoir has a volume capacity which is variable, in use, according to a pressure of the pressurised fluid so as to expand if said pressure exceeds a predetermined pressure value thereby to admit pressurised fluid product from the supply part and to contract if said pressure is less than the predetermined pressure value so as to eject previously admitted pressurised fluid product to the depositor part for dispensing, thereby to tranquilise pressure variations within the pressurised fluid product.

8. A dispensing apparatus according to any preceding claim in which the depositor part is arranged to intermittently change from said closed state which prevents the release thereto of the fluid product, to said open which permits the release thereto of fluid product from the supply vessel, wherein the supply vessel is arranged to supply said pressurised fluid product:

at a first supply pressure less than said predetermined pressure value when said depositor part is in said open state; and,

at a second supply pressure exceeding said predetermined pressure value when said depositor part is in said closed state.

9. A dispensing apparatus according to any of claims 7 to 8 including a chamber defining an inner volume partitioned into a first volume part for fluid communication with the supply part and the depositor part defining said buffer reservoir for said admitting and ejecting of pressurised fluid product, and a second volume part isolated from the first volume part by a moveable partition part urged from within the second volume part in a direction towards the first volume part and moveable, in use, according to a pressure of the pressurised fluid product within the first volume part.

10. A dispensing apparatus according to claim 9 in which the second volume part contains a pressurised fluid arranged to urge the moveable partition part in a direction towards the first volume part such that the partition part is moveable in response to a pressure difference

between a pressure within the second volume part and a pressure of said pressurised fluid product within the first volume part.

11. A dispensing apparatus according to claim 10 arranged to maintain the pressure of said pressurised fluid at a substantially constant fluid pressure corresponding to said predetermined pressure.

12. A dispensing apparatus according to any of claims 9 to 11 in which the partition part comprises a sliding piston and the chamber comprises a piston chamber within which said piston is slidable to render the volume capacity of the buffer reservoir variable.

13. A dispensing apparatus according to any preceding claim including a piping system connecting the supply part for fluid communication with the depositor part wherein the buffer reservoir is connected in fluid communication with the piping system between the supply part and the depositor part.

14. A dispensing apparatus according to any preceding claim including a first pressure valve located in the fluid communication path between the supply part and the depositor part and arranged to permit a flow of pressurised fluid product therethrough when at a fluid pressure equal to or greater than said first supply pressure.

15. A dispensing apparatus according to claim 14 including an overflow tank connected to the supply part via a second pressure valve for communication with the fluid communication path between the supply part and the depositor part and arranged to permit a flow of pressurised fluid product therethrough to the overflow tank when at a fluid pressure equal to or greater than said second supply pressure.

16. A dispensing apparatus according to any of claims 7 to 15 in which said predetermined pressure is greater than said first supply pressure and less than said second supply pressure.

17. A dispensing apparatus according to any preceding claim including an overflow tank connected to the supply part via a pressure valve for communication with the fluid communication path between the supply part and the depositor part and arranged to permit a flow of pressurised fluid product therethrough to the overflow tank when at or exceeding a predetermined fluid supply pressure.

18. A dispensing apparatus according to any of claims 9 and 10 in which the overflow tank is arranged to operate at a fluid pressure therein which is less than any supply pressure of the supply vessel.

19. A food dispensing apparatus for dispensing a food item comprising a dispensing apparatus according to any preceding claim, wherein the pressurised fluid product is a food item.

20. A method of dispensing for supplying a pressurised fluid product for dispensing comprising:

providing a supply part containing a supply of the pressurised fluid product in fluid communication with a depositor part adapted and arranged selectively to adopt an open state in fluid communication with the supply part to receive a charge of said fluid product from the supply part and to adopt a closed state to isolate the charge of fluid product from the supply part to dispense the charge of fluid product therefrom;

providing a buffer reservoir connected between the supply part and the depositor part in fluid communication therewith wherein the buffer reservoir has a volume capacity which is variable;

supplying said pressurised fluid product to the depositor part at said pressure, for dispensing;

expanding the volume capacity of the buffer reservoir if said depositor part is in said closed state thereby to admit pressurised fluid product from the supply part and contracting the volume capacity of the buffer reservoir if said depositor part is in said open state so as to eject previously admitted pressurised fluid product to the depositor part for dispensing, thereby to tranquilise pressure variations within the pressurised fluid product.

21. A method according to claim 20 including:

providing a chamber defining an inner volume partitioned into a first volume part defining said buffer reservoir for fluid communication with the supply part and the depositor part for said admitting and ejecting of pressurised fluid product, and a second volume part isolated from the first volume part by a moveable partition part; and,

providing a drive part coupled to the partition part; and,

selectively moving the partition part in a direction towards or away from the first volume part to selectively vary the volume capacity thereof.

22. A method according to claim 21 including operating said drive part to move the partition part towards first volume part when the state of the depositor changes from said closed state to said open state, and to move the partition part away from first volume part when the state of the depositor changes from said open state to said closed state.

23. A method according to any of claims 21 and 22 including operating the drive part to move partition part at substantially a constant speed thereby to change volume capacity of the buffer reservoir at a substantially constant rate.

24. A method according to any of claims 21 to 23 including operating the drive part to move the partition part towards the first volume part at a first speed and to move the partition part towards the second volume part at a second speed which is substantially half the first speed.

25. A method according to any of claims 21 to 24 in which the drive part comprises an actuator and the partition part comprises a piston to which the actuator is coupled.

26. A method according to claim 20 including expanding the volume capacity of the buffer reservoir if said pressure exceeds a predetermined pressure value thereby to admit pressurised fluid product from the supply vessel and contracting the volume capacity of the buffer reservoir if said pressure is less than the predetermined pressure value so as to eject previously admitted pressurised fluid product to the output port for dispensing, thereby to tranquilise pressure variations within the pressurised fluid product.

27. A method for dispensing according to claim 26 including intermittently changing the state of the depositor part from a closed state which prevents the release thereto of the fluid product, to an open which permits the release thereto of fluid product from the supply part; and supplying said pressurised fluid product from the supply part:

at a first supply pressure less than said predetermined pressure value when said depositor is in said open state; and,

at a second supply pressure exceeding said predetermined pressure value when said depositor part is in said closed state.

28. A method for dispensing according to any of claims 26 to 27 including providing a chamber defining an inner volume partitioned into a first volume part for fluid communication with the supply part and the depositor part defining said buffer reservoir, and a second volume part isolated from the first volume part by a moveable partition part; and urging the partition part from within the second volume part in a direction towards the first volume part to move according to a pressure of the pressurised fluid product within the first volume part.

29. A method for dispensing according to claim 28 in which the second volume part contains a pressurised fluid, and therewith urging the moveable partition part in a direction towards the first volume part such that the partition part moves in response to a pressure difference between a pressure within the second volume part and a pressure of said pressurised fluid product within the first volume part.

30. A method for dispensing according to claim 29 including maintaining the pressure of said pressurised fluid at a substantially constant fluid pressure corresponding to said predetermined pressure.

31. A method for dispensing according to any of claims 20 to 30 including supplying said depositor part with said pressurised fluid product from the supply part via a piping system connecting the supply part for fluid communication with the depositor part in which the buffer reservoir is connected in fluid communication with the piping system between the supply part and the depositor part.

32. A method for dispensing according to any of claims 20 to 31 including providing first pressure valve located in the fluid communication path between the supply part and the depositor part and therewith permitting a flow of pressurised fluid product therethrough when at a fluid pressure equal to or greater than said first supply pressure.

33. A method for dispensing according to any of claims 20 to 31 including providing an overflow tank connected to the supply vessel via a second pressure valve for communication with the fluid communication path between the supply part and the depositor part and therewith permitting a flow of pressurised fluid product therethrough to the overflow tank when at a fluid pressure equal to or greater than said second supply pressure.

34. A method for dispensing according to any of claims 26 to 33 including controlling said predetermined pressure to be greater than said first supply pressure and less than said second supply pressure.

35. A method for dispensing according to any of claims 33 and 34 including operating the overflow tank a fluid pressure therein which is less than any supply pressure of the supply part.

36. A method for dispensing a food item comprising a method according to any of claims 13 to 22, wherein the pressurised fluid product is a food item.

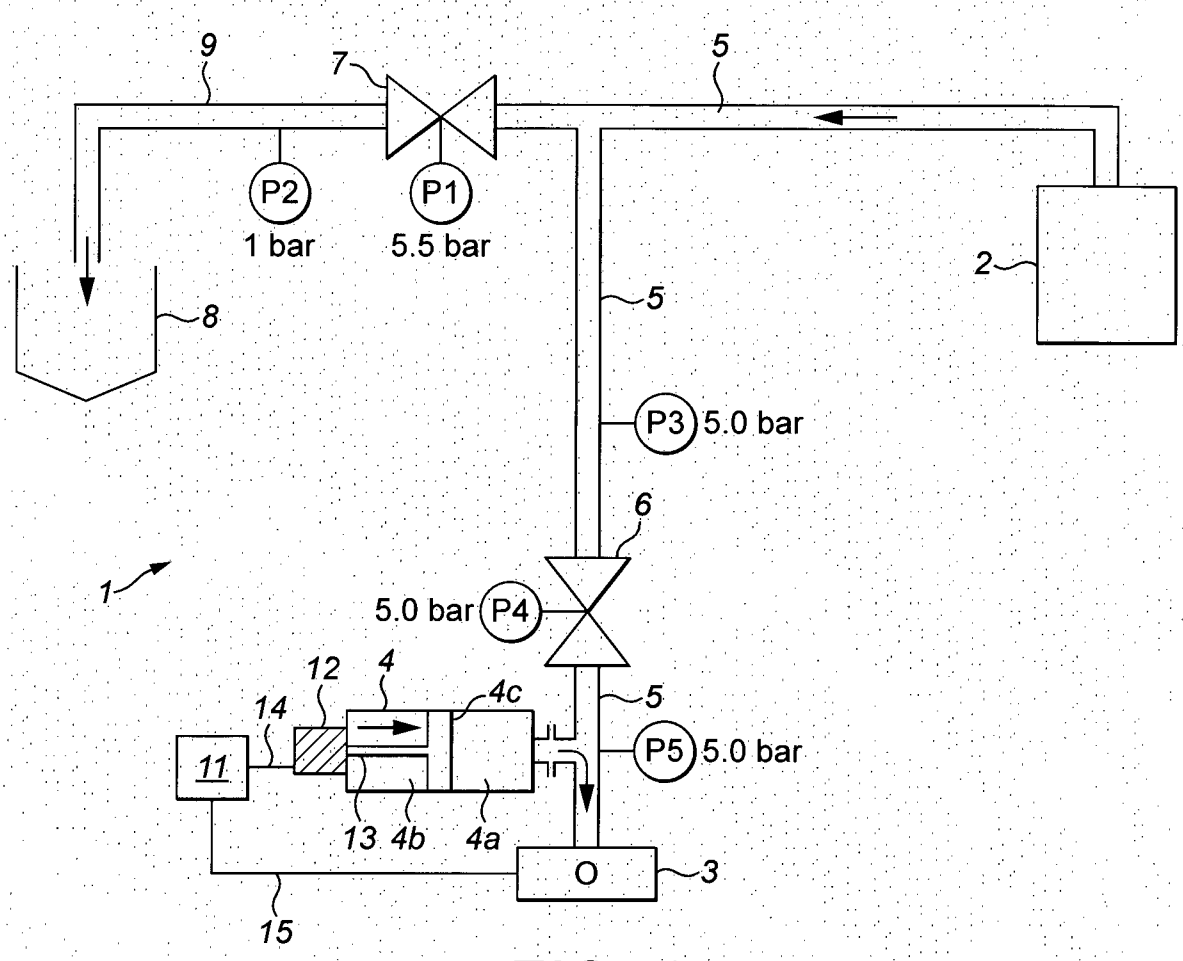

9
7
5
P2
1 bar
P1
5.5 bar
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8
5
P3 5.0 bar
6
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5.0 bar P4
12
4
4c
14
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11
P5 5.0 bar
13
4b
4a
O
3
15

FIG. 1

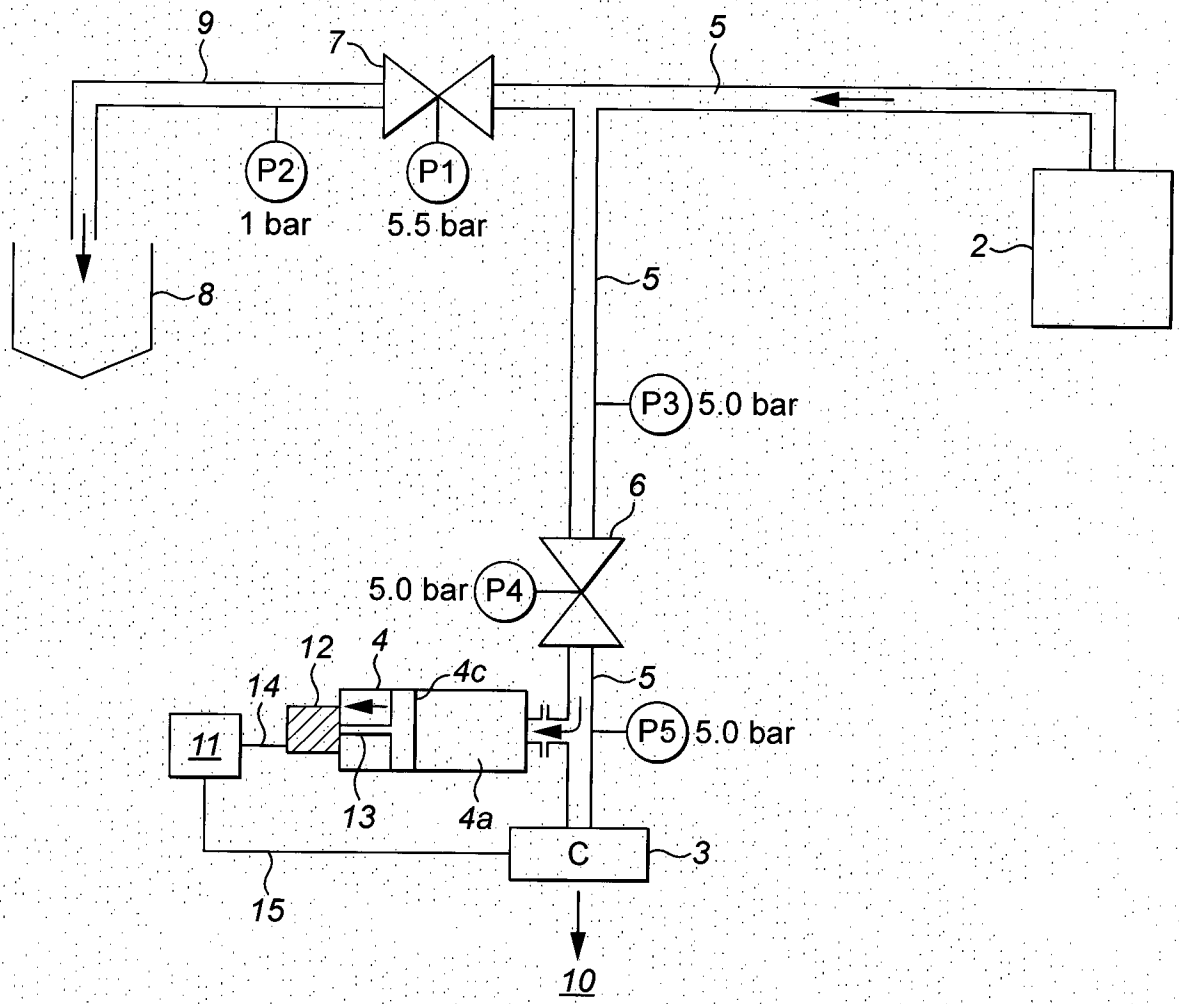

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P1
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P3 5.0 bar
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P5 5.0 bar
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15
10

FIG. 2

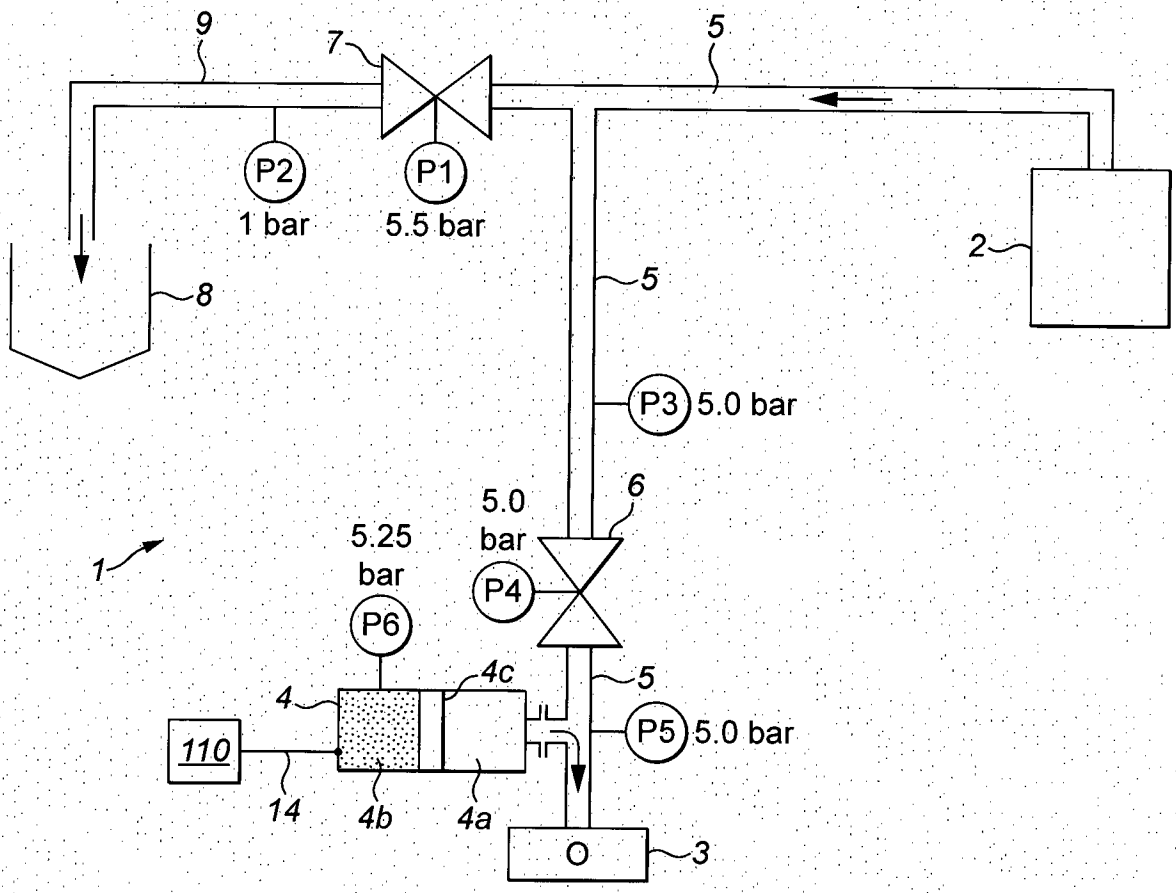

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P1
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8
5
P3
5.0 bar
6
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bar
5.25
bar
P4
P6
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4
P5
5.0 bar
110
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4b
4a
O
3

FIG. 3

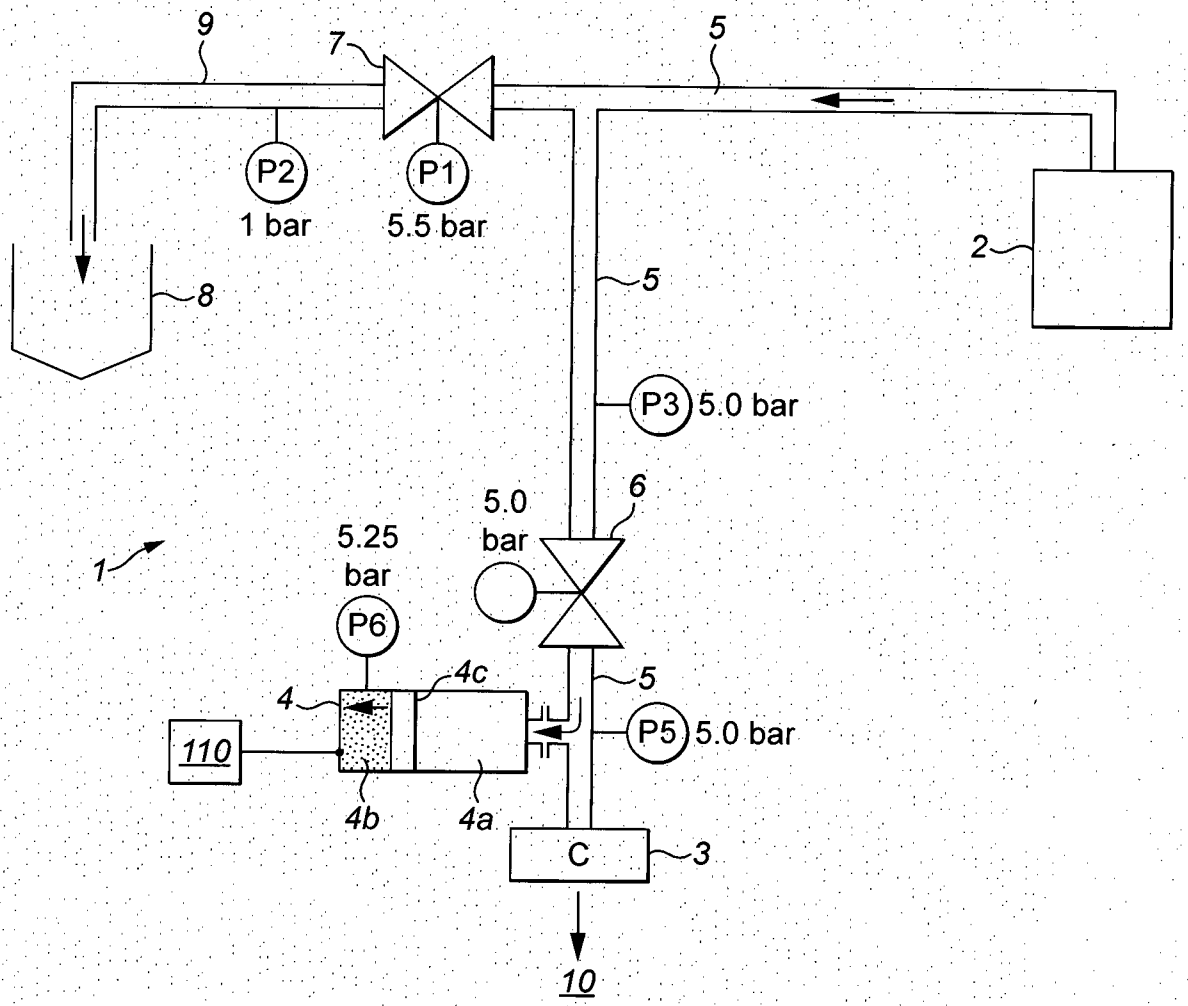

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P2
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P1
5.5 bar
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P3 5.0 bar
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6
1
5.25
bar
P6
4c
4
5
P5 5.0 bar
110
4b
4a
C
3
10

FIG. 4

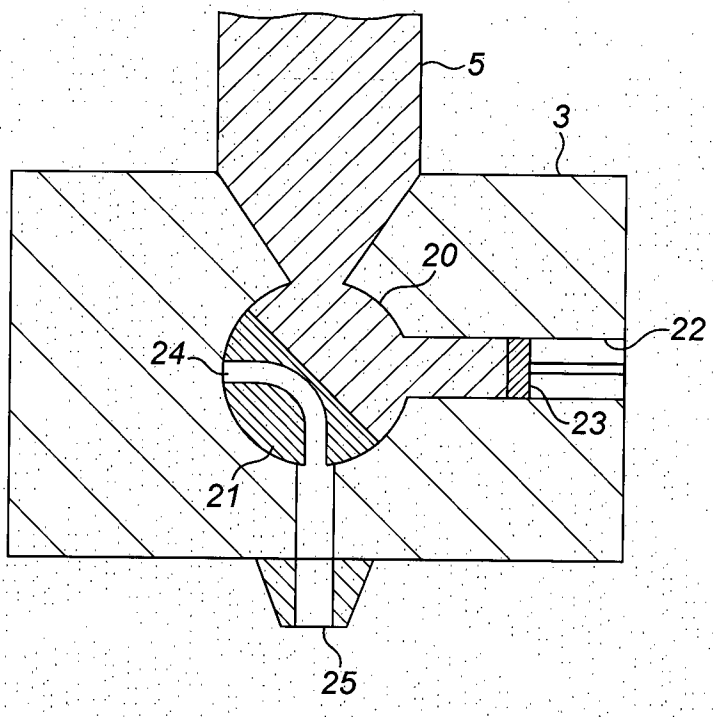


FIG. 5A

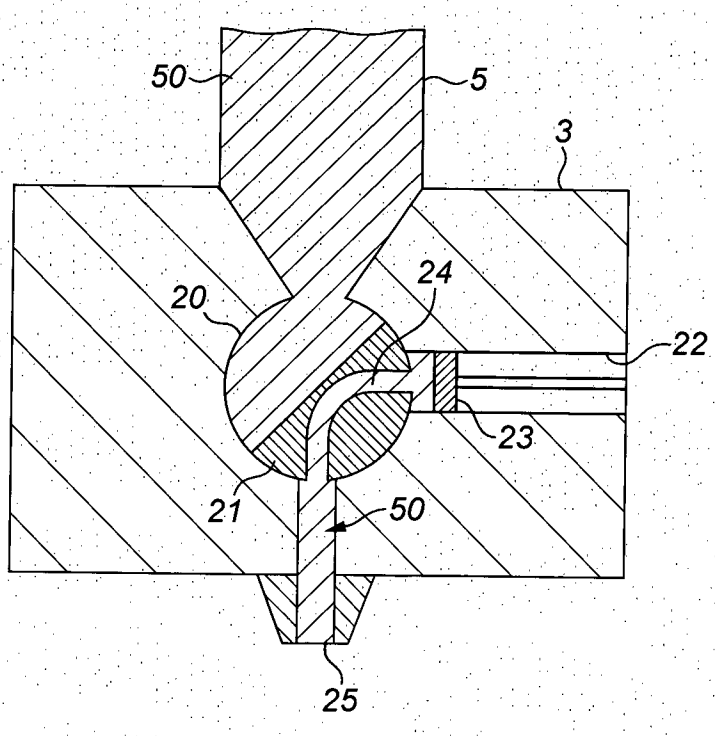


FIG. 5B

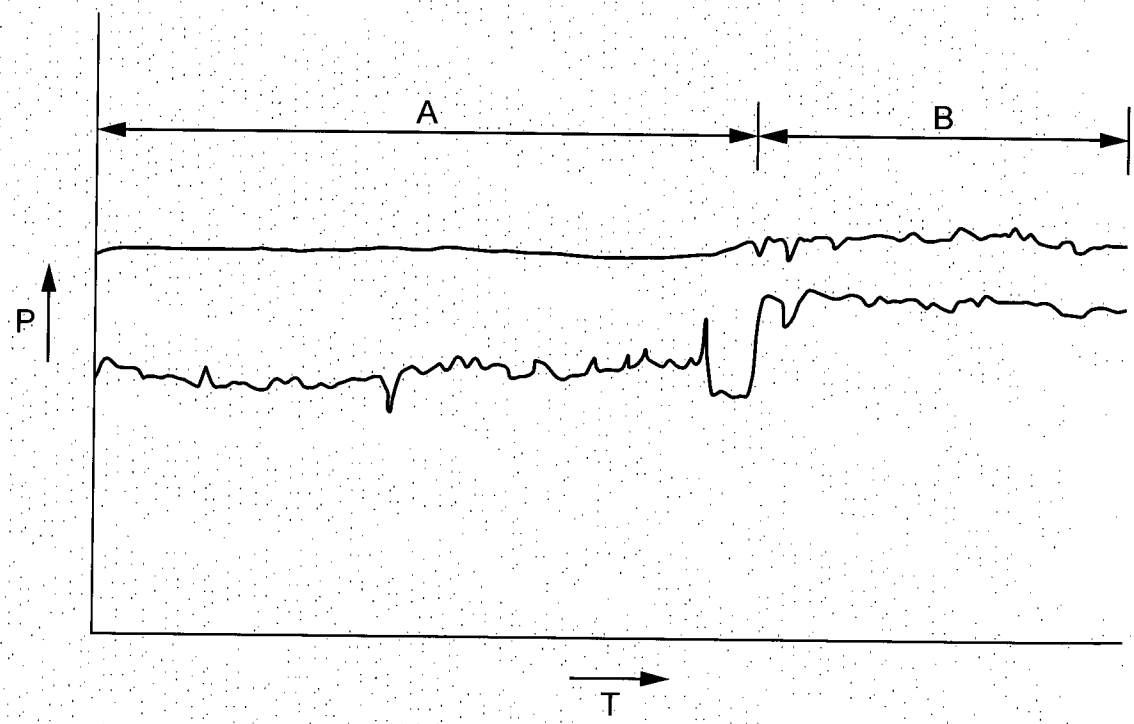


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/000387

A. CLASSIFICATION OF SUBJECT MATTER
INV. A23G1/20 A23G3/02 A23G3/20 A23G9/28 F04B11/00
F04B13/00
ADD.
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)
A23G F04B

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 758 056 B1 (CATHENAUT PHILIP IGOR [FR] ET AL) 6 July 2004 (2004-07-06) column 5, line 14 - column 6, line 42; figures 1-5	1,2,13, 19-21, 25,31,36

X	EP 1 547 469 A1 (NESTEC SA [CH]) 29 June 2005 (2005-06-29) paragraph [0017] - paragraph [0021]; figures 1,2 paragraph [0024] - paragraph [0026] paragraph [0030] - paragraph [0031]	1,13,19, 20,25,36

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 June 2014	16/06/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Gaiser, Markus

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/000387

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 566 612 A (VON KREUTER ALAN [US]) 28 January 1986 (1986-01-28) column 2, line 26 - column 4, line 8; figures 1-3	1,2,13, 19-21, 25,31,36
X	US 3 771 322 A (BETSCHART R) 13 November 1973 (1973-11-13) column 3, line 11 - line 39; figures 2,3,6	1,2,13, 19-21, 25,31,36
A	US 3 682 107 A (MACMANUS JOHN) 8 August 1972 (1972-08-08) column 3, line 36 - line 66; figures 4,5 column 4, line 51 - column 6, line 29	1,19,20, 36

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International application No
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