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(54) Multi-component dosing plant

(57) The present invention relates to a multi-component dosing plant for dosing a plurality of fluid components from their storage containers into a vessel for a mixture of said fluid components, said plant comprising a plurality of storage containers (1) for said plurality of fluid components, said storage containers (1) being in fluid communication, via connecting tubes (c 1), with a dosing head (3); said connecting tubes (c 1) being capable of feeding a respective fluid component from an outlet of the respective storage container (1) to said dosing head (3); said dosing head (3) having inlets corresponding to the connecting tubes (c 1) and having at least one dosing head exit (7) capable of releasing metered fluids, via the volume stream (c 2), to a fluid mixture container (4); a pressure source (2) capable of generating pressure and/or maintaining pressure in its inner volume; said pressure source (2) being in pressure communication, via a main pressure tube (b 1) and connecting pressure tubes (b 2), to a pressure inlet of each of the storage containers (1); and said pressure inlet of each of the storage containers (1) and/or said the fluid component outlets of each of the storage containers (1) and/or said inlet valves of the dosing head (3) being capable of being electronically controlled by an electronic control unit (6).

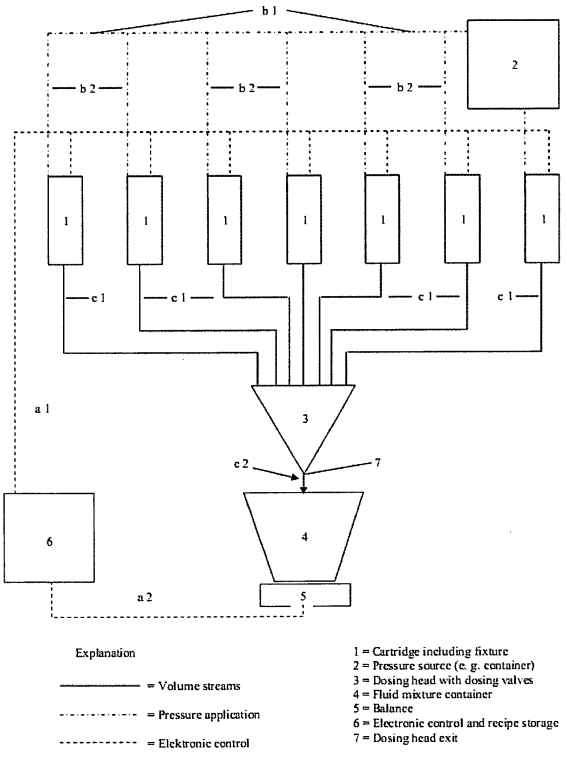

Figure 1

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Description

[0001] The present invention relates to a multi-component dosing plant for dosing a plurality of fluid components from storage containers thereof into a suitable mixing vessel. The invention also relates to a process for dosing a plurality of fluid components into a mixture of such components, or relates to a process for mixing a plurality of fluid components into a homogeneous mixture of such components including an exact dosing thereof.

[0002] Plants allowing an exact and - nevertheless - rapid dosing of several fluid or liquid components with the aim of obtaining final homogeneous mixtures of the components establishing the mixture are in operation in the chemical, printing ink, painting, adhesive, food and similar industries. Particularly, solutions were found for dosing highly viscous fluids so as to obtain viscous fluid mixtures having identical properties (colour tone, viscosity, stickiness) in each volume element thereof.

[0003] For example, the document DE-A 10 2004 041 365 (Title: Process and plant for manufacturing confectionery products) discloses a plant for manufacturing confectionery products, said plant comprising a dosing unit in fluid communication with a valve leading to a mixing vessel and with containers storing the components to be mixed for obtaining the confectionery products. The components may be, for example, chocolate mixtures of different composition, almond paste, icing sugar etc.. The dosing unit comprises a dosing piston/cylinder combination, the latter combination withdrawing, by rotating, shifting or combined shifting/rotating movement of the piston within the cylinder and, thereby, increasing the void volume of the cylinder, one of the sticky and/or highly viscous fluid components, e. g. the above-mentioned components for confectionery, from their storage containers in respective amounts predetermined by a recipe stored in a controlling unit. Then, the dosing unit shifts from the fluid-receiving mode to the fluid releasing mode, thereby dosing, by discharging, said component via said valve into the mixing vessel by a reverse movement of the piston/cylinder combination. The disadvantage of such a system is the use of multiple storage containers for the components which must be filled with the respective component to be processed to confectionery, and the relative inflexible dosing system comprising the piston/cylinder combination.

The document DE-U 20 2005 015 569 (Title: Additive dosing device for a polyurethane plant) discloses an additive dosing device for a polyurethane plant. Said additive dosing device comprises an exchangeable cartridge, a driving module capable of being connected to the cartridge, said cartridge comprising a void volume for the additive and a means for applying pressure onto the cartridge and being connected to a pressure source, with the aim of maintaining a constant pressure on the additive cartridge when emptying the cartridge in the course of the operation of the device by draining the additive. The additive is discharged from the cartridge via a duct connected to a piston/cylinder dosing device and then released, by a reverse movement of the piston in the cylinder, into a duct leading to a nozzle, from where the additive is injected into the polyurethane component mixing unit. One example of an additive addressed in said document is a dye for dying the polyurethane component mixture and obtaining a polyurethane product having a desired colour. In this case of prior art, there is achieved a dosing of one component, only, into the polymer component mixture, and again, the piston/cylinder combination is relatively inflexible in the dosing step.

[0004] The document DE-A 10 2007 011 736 (Title: Charging device for a powder) discloses a device for charging dye powder for a powder coating from a storage vessel into a powder application means. The charging device comprises a powder storage vessel in fluid communication with an inlet to a piston/cylinder combination. The outlet of the latter is in fluid communication with the fluid application device. The void volume of the cylinder is in fluid communication, via an air-permeable separation wall, with a charging air inlet. In operation, the piston is moved, thereby increasing the inner volume of the cylinder and charging powder via the inlet from the powder storage vessel and charging air via the air-permeable separation wall from the air inlet into the inner cylinder volume. As soon as the amount of powder to be used for the next step of powder-coating vehicle parts is loaded, the piston reverses the movement and expulses the powder air mixture via the outlet into the powder application means. Also in this case, the dosing of powder is achieved via the piston/cylinder combination, only, in a charge-wise (i. e. discontinuous) manner, thereby rendering the dosing step relatively inflexible and slow. A multi-component dosing cannot be achieved by said device.

[0005] Hence, it was an object of the present invention to provide a multi-component dosing plant allowing a reliably exact, rapid and versatile dosing of several or even a multiplicity of fluid, highly viscous and/or sticky components into a mixing plant.

[0006] It was another object of the present invention to provide a multi-component dosing plant useable with existing dosing systems and allowing the continuing use of existing parts of the overall plant in a new manner.

[0007] It was another object of the present invention to provide a multiple-component dosing plant wherein the storage vessels for the components to be dosed can be exchanged rapidly and remaining component amounts before changing the storage vessels can be reduced to a minimum amount.

[0008] It was a further object of the present invention to provide a multi-component dosing plant which can be used with the dosing of any desirable number of components having different physical properties (e. g. selected from, but not restricted to, the group consisting of high viscosity, paste-like character, stickiness) in a rapid, clean and reliably controllable manner.

[0009] The above (and further) objects were surpris-

ingly achieved by providing a multi-component dosing plant for dosing a plurality of fluid components from their storage containers into a vessel for a mixture of said fluid components, said plant comprising

- a plurality of storage containers for said plurality of fluid components, said storage containers being in fluid communication, via connecting tubes, with
- a dosing head;
- said connecting tubes being capable of feeding a respective fluid component from an outlet of the respective storage container to said dosing head;
- said dosing head having inlet valves corresponding to the connecting tubes and having a dosing head exit capable of releasing metered fluids, via the volume stream, to
- a fluid mixture container;
- a pressure source capable of generating pressure and/or maintaining pressure in its inner volume;
- said pressure source being in pressure communication, via a main pressure tube and connecting pressure tubes, to a pressure inlet of each of the storage containers; and
- said pressure inlet of each of the storage containers and/or said inlet valves of the dosing head being electronically controlled by an electronic control unit.

[0010] Preferred embodiments of the multi-component dosing plant of the invention are claimed in dependent claims 2 to 11.

[0011] The invention also relates to a process for dosing a plurality of fluid components into a mixture of such components, said process comprising providing a multi-component dosing plant according to the subsequent detailed description, providing said plurality of fluid components in the storage containers of said plant, applying a pressure to said storage containers allowing a feeding of said plurality of components from said containers to the dosing head and from the dosing head to the fluid mixture container of said plant, wherein the amount of feeding of each of said plurality of components of said mixture is electronically controlled by the electronic control unit.

[0012] Furthermore, the invention also relates to a process for mixing a plurality of fluid components into a homogeneous mixture of such components, said process comprising providing a multi-component dosing plant according to the subsequent detailed description, providing said plurality of fluid components in the storage containers of said plant, applying a pressure to said storage containers allowing a feeding of said plurality of components from said containers to the dosing head and from the dosing head to the fluid mixture container of said plant, and subjecting said mixture of the plurality of fluid components to a mixing step, wherein the amount of feeding of each of said plurality of components of said mixture is electronically controlled by the electronic control unit.

[0013] Preferred embodiments of these processes are claimed in the dependent claims 14 to 15.

[0014] The invention is now further in detail described by referring to its preferred embodiments, which, however, should not be construed to limit the invention, but only serve for a better exemplary description thereof. When describing the preferred embodiments of the invention, reference is made to the only Figure which shows a sketch of a preferred embodiment of the multi-component dosing for dosing a plurality of fluid components from suitable storage containers into a mixing vessel.

[0015] Reference is now made to the Figure. The multi-component dosing plant for dosing a plurality of fluid components is shown with several parts thereof.

[0016] The term "multi-component", as used in the present description and in the claims, is considered to mean that the plant of the present invention is capable of exactly dosing, rapidly dosing and cleanly dosing at least two components, preferably at least five components, more preferably more than ten components from their storage containers into a vessel suitable for mixing those components into a substantially homogeneous mixture. The above numbers of components given as examples only do not mean that in each or every dosing and mixing process, all the components available are dosed and subsequently mixed into a substantially homogeneous mixture: It may be possible that, in one case of dosing and mixing, only two of the components available are mixed, and in another case fifteen components are mixed, and in a third case seven components are mixed, to give only a few examples. The maximum number of components to be dosed and mixed may be selected by a skilled person in each case in accordance with the requirements of the specific case.

[0017] The term "dosing" and "dose", as used in the present description and in the claims, is considered to mean a process of metering an amount (or the metered amount of substance or matter itself) in the very general sense. In a particularly preferred embodiment of the invention, the above terms are considered to have the meaning of an exact metering of a substance (or the exactly metered amount) or of a rapid metering of a substance (or the rapidly metered amount) or even the combined exact and rapid metering of a substance (or the combined exactly and rapidly metered amount). It is one of the particular characteristics of the present invention that the dosing process can be planned, programmed, performed and concluded in a way allowing meeting all requirements of having the desired components of a mixture included into said mixture in exactly those amounts needed to obtain the desired result. Of course, the result

depends on the technical field and/or the components to be dosed and mixed, as will be described below with reference to respective technical fields.

[0018] The term "plant", as used in the present description and in the claims, is considered to mean that the parts of which the plant is consisting allow a dosing (and subsequent mixing) of the fluid components in a laboratory scale, in a pilot plant scale or even in a larger scale of an industrial plant. In preferred embodiments of the invention, plants are considered to allow a dosing and mixing of the fluid components in the pilot plant and industrial scales.

[0019] The term "fluid components" or "fluids", as used in the present description and in the claims, is considered to mean substances, (chemical) compounds or even mixtures of (chemical) compounds which, generally, are capable of flowing. In preferred embodiments of the invention, fluids or fluid components are substances, (chemical) compounds or mixtures of (chemical) compounds which are capable of flowing through lines, tubes or similar "fluid flow connections" on their own or under the influence of a power (for example under the influence of pressure applied thereon). Even more particularly, the term "fluids" comprises liquids (i. e. substances having a relatively low viscosity at ordinary working temperature, for example room temperature or a controlled elevated temperature), but also comprises substances having a higher viscosity under ordinary working temperature, for example room temperature or a controlled elevated temperature, for example a paste. In accordance with the present invention, the term "fluids" may also comprise suspensions (i. e. substance mixtures having one solid and one liquid or paste-like component) or may also comprise powders or powder mixtures. The above are only non-limiting examples of skilled person's understanding of the term fluids. "Fluid components" may be considered as single components of a fluid, which may be fluids itself (i. e. are capable of flowing) or which may have a physical condition different from a fluid, e. g. may be solid or gaseous.

[0020] Specific examples of "fluids", in accordance with the present invention, are - without restriction - polymer component fluids, chemical additive component fluids, dye component fluids, paint component fluids, ink component fluids, adhesive component fluids, agrochemical component fluids, food component fluids, pharmaceutical component fluids, cosmetic component fluids, petrochemical component fluids, flavour and fragrance component fluids and any liquid chemicals. In all the above exemplary cases, the single components may be solids, liquids (fluids) or gases. For example, ink component fluids may comprise a suitable dye or colorant, a solvent, a humectant, a viscosity-adjusting agent, a penetration agent and several other components; these components need to be exactly dosed, preferably dosed in accordance with a certain recipe the composition of which has to be maintained exactly during the whole manufacturing process in order to ensure the quality needed. The same would apply to a cosmetic composition which has to be mixed from several fluid components like, for example, a cream base fluid, a solvent, a solution containing an effective agent, a pH-adjusting agent, a humectant, an emulsifier, a surface-active agent, and optionally others.

[0021] The term "storage containers" for the fluid components, as used in the present description and in the claims, is considered to mean containers of a size adapted to the overall size of the plant, what concerns the amounts of the plurality of components needed for the specific task. In cases of laboratory scale or pilot plant scale plants, the storage containers may be of a relatively small size, since the amounts of fluid components needed are relatively small. Suitable storage containers may be small tanks or even cartridges containing the single fluid component. In cases of large pilot plant scale plants or even industrial scale plants, at least the fluid components needed in larger ratio amounts need larger tanks for their storage, while fluid components needed in relatively small amounts may still be provided in small tanks or even cartridges. Examples of the latter may be catalysts for polymer component fluids, which catalysts are needed usually in minor amounts only.

[0022] In accordance with the present invention, a multi-component dosing plant for dosing a plurality of fluid components from their storage containers into a mixing vessel for mixing said fluid components may comprise a plurality of storage containers 1, 1, 1, 1, ... for said plurality of fluid components. Such storage containers 1 may have a volume appropriate for dosing the necessary amount of the single components. This means that storage containers for fluid components needed in large amounts must be of larger volume, while storage containers for fluid components needed in smaller amounts may have a smaller volume. This does not mean that a certain storage contained may contain only one substance or fluid component. It may be advantageous for several reasons to store a mixture of components in one storage container while storing another single fluid component in another container. In either case, one multi-component dosing plant of the present invention may have a plurality of one type of storage containers 1, only (e. g. one size of storage containers 1 and/or one type of single-component or multiple-component storage containers 1), or may have different types of storage containers 1 (e. g. two or even several sizes of storage containers 1 and/or several types of single-component and/or multiple-component storage containers 1). In the most preferred embodiments of the invention, at least the size of storage containers 1 in one multi-component dosing plant of the invention is the same.

[0023] In a preferred embodiment of the invention, the storage containers 1, 1, 1, 1, ..., have an inlet, more preferred an inlet provided with a valve, even more preferred an inlet provided with a valve being capable to be controlled, mostly preferred an inlet with a valve being capable to be controlled electronically, said inlet allowing

the application of a pressure to the fluid component(s) contained in the container. Furthermore, the storage containers 1 have an outlet via which the content of fluid component(s) contained in the container may be released from the container. In a further preferred embodiment, the outlet of the storage container(s) 1 may be provided with an outlet valve, more preferred with an outlet valve being capable of being controlled, even more preferred with an outlet valve being capable of being controlled electronically. The outlet of the storage container 1 allows releasing the fluid components contained in the container 1 to the outside thereof, as may be described below.

[0024] In a preferred embodiment of the invention, particularly for smaller size plants or small pilot plants, the plurality of storage containers 1 may be a plurality of cartridges containing the desired components to be dosed and, later, optionally mixed. Using cartridges as storage containers 1 for the fluid components to be dosed and, optionally, mixed is advantageous, since cartridges are closed containers which may be easily stored in a large number before being mounted to the multi-component dosing plant of the invention, are standardized in size and may easily be exchanged, when empty, against the next filled cartridge. In addition, cartridges as the storage containers are common in known industrial plants. Hence, it may be relatively easy to reconstruct known plants to those in accordance with the present invention. Moreover, cartridges are not too heavy and, hence, may be handled easily. Finally, cartridges may be inserted into suitable broadly available fittings when connecting them to the multi-component dosing plant of the invention.

[0025] When using cartridges in preferred embodiments of the multi-component dosing plant of the present invention, such cartridges, as the storage containers 1 may contain one of the fluid components to be dosed so that each of said plurality of the fluid components to be dosed has one separate cartridge. In an alternative embodiment of the invention, one or several of the cartridges may contain one of the plurality of the fluid components, only, while one or several of the cartridges may contain two, three or even a plurality of the plurality of fluid components. This may depend on the system installed and on the nature of fluid components to be dosed and mixed. A skilled person may, in each single case, decide upon the content of the plurality of cartridges available in a certain multi-component dosing plant. In the most preferred embodiment of the invention, one, two or more, particularly a plurality of cartridges standardized in their size and containing said plurality of fluid components to be dosed and, optionally, later to be mixed are used in the multi-component dosing plant of the present invention.

[0026] In accordance with another preferred embodiment of the invention, the plurality of storage containers 1, 1, 1, 1, ..., are arranged adjacent, i. e. in close proximity, to each other. The term "in close proximity to each other", as used in the present description and in the claims, is considered to mean that the storage containers 1 used, due to their functional relationship in the multi-component dosing plant, are arranged as a group of storage means having substantially identical relationship to the other functional means of the multi-component dosing plant, e.g. substantially identical fluid communications, pressure communications, electronic control communications to the dosing head 3 (to be described later in detail), to the pressure source 2 (to be described later in detail) and to the electronic control unit 6 (to be described later in detail) and, optionally, also to other means in the multi-component dosing plant of the present invention. In an even more preferred embodiment of the invention, the storage containers 1, 1, 1, 1, ..., are arranged in a row of several containers or, alternatively, are arranged in a circular arrangement. The circular arrangement of the plurality of storage containers 1, 1, 1, 1, ..., is most preferred in the present invention. The reason is that the containers 1 arranged in a circle have an arrangement saving space and allowing an easy access for a replacement of one or several or all of the plurality of storage containers 1 in cases of (i) exchanging one or more empty containers 1 against one or more filled containers 1; (ii) exchanging one or more small or large containers 1 against one or more large or small containers 1; or (iii) exchanging one or more or all of containers 1 being filled with a certain type of fluid components to be dosed against one or more or all of containers being filled with a different type of fluid components to be dosed, when changing the dosing and optionally mixing tasks of the multi-component dosing plant of the present invention.

[0027] In a preferred embodiment of the invention, the storage containers 1 employed may be of a type where the inner compartment of the container is a void volume which is filled with one or several fluid component(s) to be dosed in the multi-component dosing plant of the present invention. In another preferred embodiment of the invention, particularly where the storage containers 1 are cartridges, more preferably are cylindrical cartridges, the storage container 1 may have an inner compartment which is divided, for example by a piston, into a void compartment filled with the fluid component to be dosed which will usually be located on the downstream side of the container 1 or cartridge and another part of the compartment which was emptied and is filled with air or another pressure gas. The former compartment of the container 1/cartridge will usually be in fluid communication to the exit side or outlet of the container 1/cartridge, while latter compartment will usually be in fluid communication to the entry side or inlet of the container 1/cartridge, particularly - in an even more preferred embodiment - to the pressure inlet of the container 1/cartridge.

[0028] In an even more preferred embodiment of the invention, said storage containers 1, 1, 1, 1, ..., via their respective pressure inlet, have a pressure applied directly to their content, particularly in cases where the inner

compartment of the container 1/cartridge is one void volume filled with a single fluid component or filled with a plurality of fluid components. In an alternative preferred embodiment, said storage containers 1, 1, 1, 1, ... , via their respective pressure inlet, have the pressure applied to the inside piston transferring the pressure to the content. Thereby, the fluid component(s) contained in the container 1/cartridge may be released smoothly from the container 1 or from the cartridge.

[0029] In accordance with the invention, the plurality of storage containers 1, 1, 1, 1, ..., for said plurality of fluid components are in fluid communication with a dosing head 3. In the present invention, the term "in fluid communication", as used in the present description and in the claims, is considered to mean that there is existing a connection between the storage containers 1, preferably between each of the storage containers 1, 1, 1, 1, ... , separately, even more preferred between each of the exits of the storage containers 1, 1, 1, 1, ... , and the dosing head 3 allowing a flow of a fluid component, or a flow of a plurality of fluid components (depending upon the content of the respective storage container(s)), from the respective storage container(s) to the dosing head. In a preferred embodiment of the multi-component dosing plant of the present invention, the fluid communication between the storage containers 1, e.g. between the cartridges of the preferred embodiment, and the dosing head 3 is effected by suitable connecting lines or connecting tubes c 1, c 1, c 1, c 1, ... which are capable of feeding a respective fluid component from an outlet of the respective storage container 1, 1, 1, 1, ..., to the dosing head 3, preferably to the inlet of the dosing head 3, so that a smooth flow of the respective component(s) from its/their storage container 1 to the dosing head 3 is possible. A suitable size/diameter of the line or tube can be selected by a skilled person by considering the type, amount, viscosity, feeding conditions (including speed of feeding) of fluid component to be fed from the storage container 1 to the dosing head 3. Preferably, usual standardized tubes of a quality allowing a maintenance of the fluid communication between the storage container, e. g. the cartridge, and the dosing head are used. They may have an inner diameter in the range of, exemplarily and without restriction, 2 to 200 mm, for example 25 mm.

[0030] The dosing head 3 used in the multi-component dosing plant of the present invention may be any known dosing head used in these (or similar) dosing plants. A skilled person may select such a dosing head in accordance with the typical requirements needed in each special case, depending upon a number of known parameters, as, for example, the number of fluid components to be dosed, the volume of the single fluid components and the overall volume of all fluid components passing the dosing head 3 in the process, the (chemical) nature (e. g. fluid food component dosing, fluid pharmaceutical component dosing, fluid cosmetic component dosing, etc.) and parameters (e.g. viscosity, acidity/basicity, etc.) of the fluid components to be dosed, the conditions of the dosing process (e.g. temperature, pressure etc.) and others. A typical dosing head 3 to be used in accordance with the present invention is the dosing head available from the company Fluid Solutions GmbH under the name Fluid Cartridge Dispenser, for example K18-DN7, K20-DN10, K24+4 or other.

[0031] In a preferred embodiment of the invention, the dosing head 3 has an inlet, more preferably an inlet provided with a valve, even more preferably an inlet provided with a valve being capable to be controlled, mostly preferred an inlet with a valve being capable to be controlled electronically, said inlet allowing feeding in a plurality of the fluid component(s) from their respective containers. Furthermore, the dosing head 3 has an outlet via which the content of fluid component(s) fed in from their containers may be released from the dosing head 3. In a further preferred embodiment, the outlet of the dosing head 3 may be provided with an outlet valve, more preferred with an outlet valve being capable of being controlled, even more preferred with an outlet valve being capable of being controlled electronically. The outlet of the dosing head 3 allows releasing the fluid components from the dosing head 3 to the outside thereof, as may be described below.

[0032] In accordance with the invention, the dosing head 3 has inlets, more preferably has inlets provided with valves, for example electronically controllable inlet valves, corresponding (e. g. in number, size, diameter, position etc.) to the connecting tubes c 1, c 1, c 1, c 1, ..., from which the fluid components are fed from their storage containers 1, 1, 1, 1, ... In addition, the dosing head 3 has at least one dosing head exit 7 which is capable of releasing metered fluids via the volume stream c 2 to a fluid mixture container 4. If desired, the dosing head exit 7 may also be provided, in a preferred embodiment of the invention, with a valve, more preferably with a controllable valve, most preferably with a valve which is controllable electronically.

[0033] In accordance with the invention, the multi-component dosing plant comprises a pressure source 2 which is capable of generating pressure and/or which is capable of maintaining a pressure in its inner volume. The term "pressure", as used in the present description and claims, is considered to mean a pressure above atmospheric pressure, in general. The specific pressure generated by and/or maintained in the pressure source is not restricted, as long as it is a pressure above atmospheric pressure. The pressure may depend upon parameters easily determined by a skilled person as, for example, the nature and physical properties (e. g. the viscosity) of the fluid component(s) to be dosed, the size of the container(s), the size (length and diameter) of the connecting tubes maintaining the fluid communication between the devices of the present multi-component dosing plant, to name only a few. Usually, the pressure selected may be within a range of from > 1 to 100 bar, for example within a range of from > 1 to 7 bar.

[0034] In preferred embodiments of the invention, the

pressure source 2 may be a pressure pump generating continuously or intermittently the pressure needed in the containers 1,1, 1, 1, ... In an alternative embodiment the pressure needed may be generated by a pump and may then be "applied" to a large pressure container which is connected, via a suitable pressure line or pressure tube b1, to the plurality of containers 1. The gas put under pressure may be any desirable and suitable gas. A skilled person may select the gas in accordance with usual requirements, as for example the nature or sensitivity of the fluid components to be put under pressure, or other parameters. In a more preferred embodiment, the gas put under pressure is air; similarly, inert gases (argon, nitrogen etc.) may be selected in accordance with the needs.

[0035] In accordance with the invention, the pressure source 2 is in pressure communication to a pressure inlet of each of the storage containers 1, 1, 1,1, ...,.Such a pressure communication may be effected via a main pressure line or pressure tube b1 and a plurality of connecting pressure lines or tubes b 2, b 2, b 2, b 2, ..., deriving from the main pressure line or tube b1 and connecting the latter to the respective pressure inlet or pressure inlet valve of the storage containers 1/ cartridges.

[0036] The application of pressure promoting the step of feeding the plurality of fluid components from their respective containers 1, 1, 1, 1, ..., to the dosing head 3, particularly from the respective container outlets to the dosing head inlets (wherein said container outlets and/or dosing head inlets may be provided with respective valves) may be controlled in accordance with the invention. In a preferred embodiment of the invention, the pressure inlet of each of the storage containers 1, 1, 1, 1, ..., and/or the fluid component outlets of each of the storage containers 1, 1, 1, 1, ..., and/or the inlets or inlet valves of the dosing head 3 are capable of being controlled, preferably capable of being controlled electronically, by an electronic control unit 6.

[0037] Said electronic control unit 6 may be any electronic control unit a skilled person knows for controlling the operation of a laboratory scale plant, pilot plant scale plant or industrial scale plant electronically. Examples of such electronic control units are usual computers which may be capable of storing all data needed for the control of the operation of the multi-component dosing plant and emit signals in accordance with such data which signals serve to actuate (e. g. open or close) valves, start volume flows of fluid components and control volume amounts, weight amounts drawn from storage containers 1 and dosed into the vessels provided for subsequent steps, for example mixing steps and application steps of the final mixture obtained.

[0038] In particularly preferred embodiments of the multi-component dosing plant of the invention, said electronic control unit 6 is capable of storing, and using for electronic control of the plant, stored data for the composition of a plurality of mixtures of fluid components. Such data may be useful for dosing repeatedly the same relative amounts of the fluid components available for a specific mixture or "recipe", and a storage thereof could contribute not only to a rapid, exact and reliable dosing of a plurality of fluid components, but could also make it possible to dose a plurality of fluid components for a specific mixture of said fluid components on demand or just in time. As an example, a paint composition for vehicles or vehicle parts could be prepared, in an amount needed for applying said paint on a predetermined amount of vehicle parts in the same quality and colour tone, at a time calculated previously for delivery to the place of application within a large vehicle manufacturing plant just in time when the parts to be painted arrive at the paint spray application chamber. In a similar way, powders (as the fluid components) for the application of a powder paint onto metallic parts could be dosed from a multiplicity of components and mixed so as to be prepared just in time for the application. In preferred embodiments of the present invention, said stored data for the composition of a plurality of mixtures of fluid components are recipe data of such mixtures, as explained above for the case of paints for vehicle parts.

[0039] The control of the overall multi-component dosing plant of the invention by said electronic control unit 6 may be performed at one of several points within the multi-component dosing plant or may be performed at more than one, e. g. two or even more of several points within the dosing plant. The control may be a continuous one at all points or may be a successive one at successive points within the multi-component dosing plant. Specific examples may be the following:

An electronic control may be performed (i) at the exit of the pressure source 2 or between the exit of the pressure source 2 and the inlet into the storage container 1 or at the inlet into the storage container. In such a case, the electronic control step may be a step of electronically controlling the application of pressure ("stored" within the pressure source 2 or generated by the pressure source 2), for example by actuating valves allowing an application of said pressure to a single one of, or to several of or to a plurality of, the fluid component storage containers 1, 1, 1, 1, ... The valves actuated may be valves at the pressure outlet of the pressure source 2 and/or may be valves within the main pressure tube b 1 and/or may be valves between the main and connecting pressure tubes b 1, b 2, b 2, ... and/or may be valves at the pressure inlet into the storage containers 1, 1, 1, ... As described above, the pressure applied to the storage containers 1, 1, 1, 1, ... under the control of the control unit 6 may be applied directly to the fluid component(s) stored within said container(s) 1, or may be applied to a piston separating the pressurized (gas) volume of the container (s) from the fluid component(s) itself/themselves contained in the containers.

[0040] In another preferred embodiment of the multi-component dosing plant of the invention, an electronic control, by the control unit, may be performed (ii) at the outlet side of the storage containers 1, 1, 1, 1, ..., or at the inlet side of the dosing head 3. In such a case, the electronic control step may be a step of electronically controlling the volume flow of a single fluid component or of two fluid components or of a plurality of fluid components by actuating, via the electronic control, the valve on the outlet side of the storage container(s) 1 and/or at the inlet side of the dosing head 3, thereby allowing a predetermined volume flow of one or several or a plurality of said fluid components from the storage containner(s) 1 to the dosing head 3. Particularly preferred is an electronic control of the valves provided at the dosing head 3. Such valves may be single-stage valves or multiple-stage valves. They may release the fluid component(s) in question (i. e. those the valves of which were actuated by the electronic control) through several different cross-sections, thus making a rapid, exact and reliable dosing via the dosing head 3 possible. Particularly, small amounts of fluid components can be dosed in an exact manner reliably. The control signal may be a signal from stored data (e. g. a certain recipe of a paint mixture, pharmaceutical mixture, cosmetic mixture etc.) or may be a signal resulting from a final control of the volume flow having passed the valve or arriving at the mixing vessel 4.

[0041] Other ways of electronically controlling the operation of the multi-component dosing plant of the invention may also be envisaged:

In a preferred embodiment, the plant further comprises a metering control means, and even more preferably comprises a volume metering control means and/or a weight measuring control means as the metering control means. Metering control means are considered to comprise all such control means wherein an amount of substance, e. g. an amount of the fluid components to be dosed, can be measured. The volume of such a substance or the weight of such a substance are only examples which do not restrict the invention; volumes may be measured by measuring the volume amount passing a certain section of a tube or line, while weight amounts may be measured by a balance (shown in the figure with the reference numeral 5). The weight change measured by means of the balance 5 may be communicated to the electronic control unit 6 and may actuate to stop the flow of the fluid component just dosed. A comparison between the actual and the theoretical weight values may serve to guarantee that the correct operation of the dosing step is maintained for the plurality of fluid components dosed.

In a further preferred embodiment, the metering control means is a means controlling the result of the process of mixing the plurality of components. The control (and the resulting comparison between actual and theoretical data) is made "after the event", i. e. indirectly derivable from data secondary to the primary addition of the fluid components. This may be advantageous and, hence, preferably in some cases due to its more reliable control of the result of the dosing step. Suitable examples (although not restricting) are those where the metering control means is a means controlling a physical parameter of the mixture of said plurality of components. Examples of such physical parameters may be the viscosity of a polymer resulting from the step of dosing the components of the polymer in a suitable ratio; the tone of dye, paint or ink resulting from the step of dosing the fluid components of the dye, paint or ink; the insoluble additive particle content in a heterogeneous mixture or suspension; the effective agent concentration in a pharmaceutical or cosmetic poly-component mixture; etc.). Also measurements of an increasing concentration of a component resulting from a chemical reaction of the fluid components appropriately dosed or measurements of a decreasing concentration of a fluid component educt employed at the starting point of a reaction may be suitable.

In all these preferred embodiments of the invention, the measurement result generated by the metering control means is capable of controlling the operation of the multi-component dosing plant.

[0042] As a result of the dosing step in accordance with the invention, the desired plurality of fluid components is fed from the dosing head 3, via the volume stream c 2, into a fluid mixture container 4.

[0043] In a further preferred embodiment of the invention, the fluid mixture container 4 is capable of providing, by a thorough mixing step, a mixture of said plurality of fluid components, more preferably provides a homogeneous mixture of said plurality of clued components. Such a mixture may be obtained by suitable mixing means which are known per se to a skilled person in this field, as for example, high-speed mixers, vortex mixers, etc..

[0044] The invention also relates to a process for dosing a plurality of fluid components into a mixture of such components, said process comprising providing a multi-component dosing plant according to the above detailed description, providing said plurality of fluid components in the storage containers of said plant, applying a pressure to said storage containers allowing a feeding of said plurality of components from said containers to the dosing head and from the dosing head to the fluid mixture container of said plant, wherein the amount of feeding of each of said plurality of components of said mixture is electronically controlled by the electronic control unit.

[0045] The invention also relates to a process for mixing a plurality of fluid components into a homogeneous mixture of such components, said process comprising

providing a multi-component dosing plant according to the above detailed description, providing said plurality of fluid components in the storage containers of said plant, applying a pressure to said storage containers allowing a feeding of said plurality of components from said containers to the dosing head and from the dosing head to the fluid mixture container of said plant, and subjecting said mixture of the plurality of fluid components to a mixing step, wherein the amount of feeding of each of said plurality of components of said mixture is electronically controlled by the electronic control unit.

[0046] In preferred embodiments of the invention, the electronic control is exerted on the basis of data stored in the electronic control unit. More preferably, the electronic control is exerted on the basis of recipe data of the mixture of said plurality of fluid components stored in the electronic control unit.

[0047] In accordance with another preferred embodiment of the invention, the electronic control is exerted on the basis of data obtainable from metering control means, preferably on the basis of data obtainable from a metering control means selected from the group consisting of a volume metering control means and/or a weight measuring control means; or wherein the electronic control is exerted on the basis of data obtainable from a means controlling the result of the process of mixing the plurality of components, preferably on the basis of data obtainable from a means controlling a physical parameter of the mixture of said plurality of components. Typical examples thereof are the viscosity of a polymer resulting from the step of dosing the components of the polymer in a suitable ratio; the tone of dye, paint or ink resulting from the step of dosing the fluid components of the dye, paint or ink; the insoluble additive particle content in a heterogeneous mixture or suspension; the effective agent concentration in a pharmaceutical or cosmetic poly-component mixture; etc.). Also measurements of an increasing concentration of a component resulting from a chemical reaction of the fluid components appropriately dosed or measurements of a decreasing concentration of an fluid component educt employed at the starting point of a reaction may be suitable.

[0048] At the end, it is possible that all dosing steps and amounts be recorded, reproduced, and finally stored in the database of the electronic control unit 6.

[0049] As obvious from the above description, the multi-component dosing plant for dosing a plurality of fluid components from their storage containers into a vessel for a mixture of said fluid components has the following advantages:

All the fluid components stored in the exchangeable storage containers 1 are sealed in the containers, for example in cartridges, not allowing air to access the containers and not allowing partial of said fluid components to be released to the environment. Thereby, a deterioration of said fluid components can be prevented, and any spilling thereof, for example into the environment, is also prevented reliably.

[0050] By using the preferred embodiments of cartridges as the storage containers 1, even highly viscous fluid components, e. g. paste-like or sticky substances may be dosed reliably and even in small amounts.

[0051] Air incorporated into the fluid components and remaining fluid component amounts in the containers are reduced to a minimum.

[0052] The storage containers 1, particular cartridges, may be changed easily, allowing a clean, reliable and standardized working with the storage containers 1.

[0053] The number of components (storage containers/cartridges) which may be included into the plant for the dosing step of said plurality of fluid components can be varied widely, thereby allowing a shaping of the plant in accordance to the requirements of the specific dosing task. Particularly, a dosing of fluid components of (substantially) all viscosities and broadly varying in their viscosities in one dosing operation may be performed.

[0054] Finally, the arrangement of the storage containers 1 /cartridges in a row or in a circular arrangement allows even a large number of contained to be combined in one multi-component dosing plant of the invention.

[0055] The invention is explained above by referring to its preferred embodiments. However, the preferred embodiments described should not be construed to restrict the invention in any way.

Claims

1. A multi-component dosing plant for dosing a plurality of fluid components from their storage containers into a vessel for a mixture of said fluid components, said plant comprising

- a plurality of storage containers (1, 1, 1, 1, ...) for said plurality of fluid components, said storage containers (1, 1, 1, 1, ...) being in fluid communication, via connecting tubes (c 1, c 1, c 1, c 1, ...), with
- a dosing head (3);
- said connecting tubes (c 1, c 1, c 1, c 1, ...) being capable of feeding a respective fluid component from an outlet of the respective storage container (1, 1, 1, 1, ...) to said dosing head (3);
- said dosing head (3) having inlets corresponding to the connecting tubes (c 1, c 1, c 1, c 1, ...) and having at least one dosing head exit (7) capable of releasing metered fluids, via the volume stream (c 2), to
- a fluid mixture container (4);
- a pressure source (2) capable of generating pressure and/or maintaining pressure in its inner volume;
- said pressure source (2) being in pressure

communication, via a main pressure tube (b 1) and connecting pressure tubes (b 2, b 2, b 2, b 2, ...), to a pressure inlet of each of the storage containers (1, 1, 1, 1, ...); and
- said pressure inlet of each of the storage containers (1, 1, 1, 1, ...) and/or said the fluid component outlets of each of the storage containers (1, 1, 1, 1, ...) and/or said inlet valves of the dosing head (3) being capable of being electronically controlled by an electronic control unit (6).

2. The multi-component dosing plant for dosing a plurality of fluid components according to claim 1, wherein said storage containers (1, 1, 1, 1, ...) for a plurality of fluid components are cartridges for each one of said plurality of fluid components and/or for two or more of said plurality of fluid components.

3. The multi-component dosing plant for dosing a plurality of fluid components according to claim 1 or claim 2, wherein said plurality of storage containers (1, 1, 1, 1, ...) are arranged in close proximity to each other, preferably are arranged in a row or are arranged in a circular arrangement.

4. The multi-component dosing plant for dosing a plurality of fluid components according to any of the claims 1 to 3, wherein said storage containers (1, 1, 1, 1, ...), via their respective pressure inlet, have the pressure applied directly to their content, or wherein said storage containers (1, 1, 1, 1, ...), via their respective pressure inlet, have the pressure applied to an inside piston transferring the pressure to the content.

5. The multi-component dosing plant for dosing a plurality of fluid components according to any of the claims 1 to 4, wherein said pressure source is a pressure pump or a large pressure container connected to a pressure-generating system or a pressure pump.

6. The multi-component dosing plant for dosing a plurality of fluid components according to any of the claims 1 to 5, wherein the fluid mixture container (4) is capable of providing, by a thorough mixing step, a homogeneous mixture of said plurality of fluid components.

7. The multi-component dosing plant for dosing a plurality of fluid components according to any of the claims 1 to 6, wherein said electronic control unit is capable of storing, and using for electronic control of the plant, stored data for the composition of a plurality of mixtures of fluid components, preferably wherein said stored data for the composition of a plurality of mixtures of fluid components are recipe data of such mixtures.

8. The multi-component dosing plant for dosing a plurality of fluid components according to any of the claims 1 to 7, said plant further comprising a metering control means, preferably said plant further comprising a volume metering control means and/or a weight measuring control means as the metering control means.

9. The multi-component dosing plant for dosing a plurality of fluid components according to claim 8, wherein the metering control means is a means controlling the result of the process of mixing the plurality of components, preferably wherein the metering control means is a means controlling a physical parameter of the mixture of said plurality of components. (viscosity of polymer; tone of dye, paint, ink; additive particle content in a heterogeneous mixture; effective agent concentration in a pharmaceutical or cosmetic poly-component mixture; etc.).

10. The multi-component dosing plant for dosing a plurality of fluid components according to any of the claims 1 to 9, wherein the measurement result generated by the metering control means is capable of controlling the operation of the multi-component dosing plant.

11. The multi-component dosing plant for dosing a plurality of fluid components according to any of the claims 1 to 10, wherein the fluid components are selected from polymer component fluids, chemical additive component fluids, dye component fluids, paint component fluids, ink component fluids, adhesive component fluids, agrochemical component fluids, food component fluids, pharmaceutical component fluids, cosmetic component fluids, petrochemical component fluids, flavour and fragrance component fluids and any liquid chemicals.

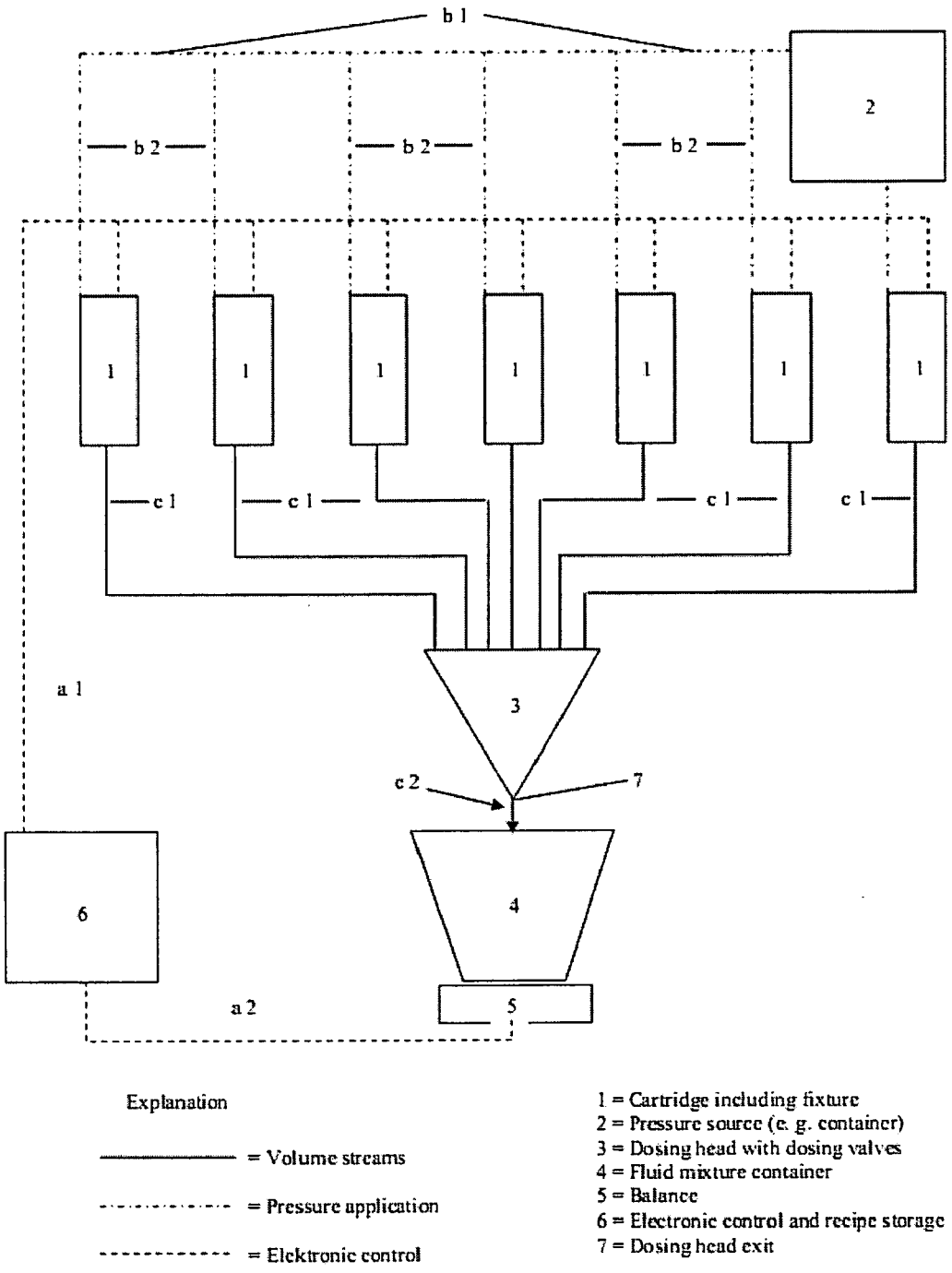
12. A process for dosing a plurality of fluid components into a mixture of such components, said process comprising providing a multi-component dosing plant according to any of the claims 1 to 11, providing said plurality of fluid components in the storage containers of said plant, applying a pressure to said storage containers allowing a feeding of said plurality of components from said containers to the dosing head and from the dosing head to the fluid mixture container of said plant, wherein the amount of feeding of each of said plurality of components of said mixture is electronically controlled by the electronic control unit.

13. A process for mixing a plurality of fluid components into a homogeneous mixture of such components, said process comprising providing a multi-component dosing plant according to any of the claims 1 to 11, providing said plurality of fluid components in the

storage containers of said plant, applying a pressure to said storage containers allowing a feeding of said plurality of components from said containers to the dosing head and from the dosing head to the fluid mixture container of said plant, and subjecting said mixture of the plurality of fluid components to a mixing step, wherein the amount of feeding of each of said plurality of components of said mixture is electronically controlled by the electronic control unit.

14. The process according to claim 12 or to claim 13, wherein the electronic control is exerted on the basis of data stored in the electronic control unit, preferably wherein the electronic control is exerted on the basis of recipe data of the mixture of said plurality of fluid components stored in the electronic control unit.

15. The process according to claim 12 or to claim 13, wherein the electronic control is exerted on the basis of data obtainable from metering control means, preferably on the basis of data obtainable from a metering control means selected from the group consisting of a volume metering control means and/or a weight measuring control means; or wherein the electronic control is exerted on the basis of data obtainable from a means controlling the result of the process of mixing the plurality of components, preferably on the basis of data obtainable from a means controlling a physical parameter of the mixture of said plurality of components. (viscosity of polymer; tone of dye, paint, ink; additive particle content in a heterogenous mixture; effective agent concentration in a pharmaceutical or cosmetic poly-component mixture; etc.)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Explanation
= Volume streams
= Pressure application
= Elektronic control
1 = Cartridge including fixture
2 = Pressure source (e. g. container)
3 = Dosing head with dosing valves
4 = Fluid mixture container
5 = Balance
6 = Electronic control and recipe storage
7 = Dosing head exit

Figure 1

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EUROPEAN SEARCH REPORT

Application Number
EP 09 00 4587

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 November 2009	Krasenbrink, B

CATEGORY OF CITED DOCUMENTS

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EUROPEAN SEARCH REPORT

Application Number
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