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(54) **Apparatus for the automatic preparation of a drug and respective method of preparation**

Vorrichtung für die automatische Zubereitung eines Arzneimittels und entsprechendes
Zubereitungsverfahren

Appareil pour la préparation automatique d'un médicament et procédé de préparation correspondant

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EP 1 997 471 B2

Description

FIELD OF THE INVENTION

[0001] The present invention concerns an apparatus for the automatic preparation of a drug and the relative method of preparation. In particular, the present invention is used for the preparation and dosage of liquid homogeneous solutions or dispersions of chemical products, of synthetic or natural origin, in order to prepare solutions for clinical use in the human and veterinary field or for industrial use.

BACKGROUND OF THE INVENTION

[0002] It is known that the preparation of a drug starting from two or more basic components contained in suitable containers, and the relative transfer to a container suitable for the intravenous administration of the drug itself are somewhat difficult, especially in the case of therapies in the oncological field which include the administration of chemotherapy drugs.

[0003] A first difficulty is connected to the fact that the prescription of a drug to a patient in chemotherapy occurs after his clinical state has been evaluated and the prescribed doses must be confirmed by a medical examination with every cycle. Consequently, the unit responsible for the preparation of the drug with the particular dosage must prepare solutions, which are always personalized and different each time, of the drug with the correct dosage. This has to be done very quickly, and often in great quantities, and so as to allow the nursing staff then to administer the therapies during working hours, often in a day hospital.

[0004] Another difficulty is connected to the variety of molecules used and the need to control the delivery of the preparations, according to how they will be used within the stability period that is characteristic of each preparation. The number of solutions prepared a year can be in the order of several tens of thousands, with some dozens of different molecules, of which a large part in everyday use. Another difficulty is the need to guarantee absolutely sterile conditions in every step of the preparation cycle.

[0005] The drugs, or their components, are supplied in containers with doses that vary between about 50% and 150% of the average individual daily dose. The complexity of the therapeutic protocols may even entail the use of five different active principles, distributed over several days.

[0006] Typically, the operation to prepare the drug consists in taking a solution containing the drug from a container located in an extractor hood, using a sterile syringe, and controlling visually, on the graduated scale of the syringe, the volume of the solution picked up.

[0007] The accuracy of the assessment depends on the optical aberrations due to the parallax error in the alignment between the operator's eye and the graduated

scale of the syringe. This mistake can be accentuated, if the interference of the glass of the extractor hood is taken into account.

[0008] Subsequently, the solution taken is further diluted and infused through an injection point into a sac or container made of deformable plastic material.

[0009] Since the compounds are often toxic, the dosage must be extremely accurate, according to the measuring instruments used, such as sterile syringes and connection sets between the syringe and the containers. Care must also be taken to keep the products sterile by means of methodical disinfection standards. For example, the work place is protected by adequate techniques to prevent the production of spray during the dilution, intake and preparation of the drug.

[0010] The use of extractor hoods and individual protection devices, such as gloves, work uniform and mask, allows to protect the operator and the work spaces but, at the same time, it limits spaces available for maneuver and makes the dosing operations not very easy, especially if we consider that these operations are repeated by the operator many times in the course of the working day. The repetitiveness of the operation and the familiarity acquired by the operator in handling the components of the drug also lead to a drop in attention of the operator, which increases the probability of mistakes. For example, the manual operation could be mistaken due to an exchange of the solutions used or to a mistake in the dosage. In fact, the solutions are mostly colorless or have similar colors and packaging. If a mistake is made, it would be impossible to detect it before the drug is administered.

[0011] Such mistakes can have very serious consequences, also considering the often critical clinical situation of the patient.

[0012] Furthermore, this type of manual preparation requires maximum precision in order to limit to a minimum the waste of the drug which is usually very expensive.

[0013] The international application WO-A-99/63547 discloses an apparatus for the preparation of radioactive solutions in which a computer controlled syringe pump is used to transfer the solution between reagent vials and to dispense the reagents.

[0014] Purpose of the present invention is to achieve an apparatus and perfect a relative method that allows to prepare a drug automatically, starting from several components, in an accurate and safe way, both for the patient and for the operator, which is totally sterile, quick and with repeatable results in an accurate manner.

[0015] The Applicant has devised, tested and embodied the present invention to overcome the shortcomings of the state of the art and to obtain these and other purposes and advantages.

SUMMARY OF THE INVENTION

[0016] The present invention is set forth and characterized in the independent claims, while the dependent

claims describe other characteristics of the invention or variants to the main inventive idea.

[0017] In accordance with the above purpose, an apparatus for the automatic preparation of a drug consisting of at least two components comprises a first container for a first component, a second container for a second component and a third container to receive the drug thus prepared.

[0018] According to a characteristic feature of the present invention, the apparatus also comprises an intermediate container for the preparation of the drug, connected both to the third container and also, by means of valve means selectively openable and closable, to the first and second containers; an intake/injection device, able to be activated in intake mode in order to take in dosed quantities of the first and second component inside the intermediate container, and able to be activated in injection mode in order to transfer the prepared drug from the intermediate container to the third container; and an electronic control unit suitable to manage automatically and in a coordinated manner the selective activation of the valve means and the intake/injection device.

[0019] According to an advantageous variant of the present invention, the electronic unit comprises, or is associated with, memorization means able to memorize data relating to predetermined doses of the drug. Advantageously, furthermore, the apparatus according to the present invention is provided with sensor means able to detect the values of said dosed quantities and to transmit them to the electronic control unit. In this way, from a comparison between the memorized data and the values detected, it is possible to control the correctness of the quantities of the components actually taken in, thus preventing any toxic effect for the patient.

[0020] Advantageously, the whole preparation operation is automated and does not involve the operator directly, except for the preparation of the containers that feed the components and except in the startup and control of the preparation procedure managed by the electronic control unit.

[0021] The present invention thus allows to prepare a drug automatically, starting from several components, in an accurate and safe way, both for the patient and for the operator, which is quick and with repeatable results in an accurate manner.

[0022] Advantageously, the exact quantity of the component taken in is controlled by calibrating the intake/injection device, the containers and the relative connection circuits. The calibration values are inserted into the electronic control unit by the operator responsible for starting each operation to prepare the drug or, preferably, memorized once only in the control unit.

[0023] Any change in the intake/injection device, the containers and the relative connection circuits is detected by said sensor means and signaled to the control unit which, by means of suitable alarm means, for example, acoustic and/or visual, obliges the operator to insert or recall from the memory the corresponding calibration val-

ues.

[0024] The accuracy of intake and dosage that is thus determined also allows to reduce waste in the components of the drug, allowing a considerable saving in costs.

[0025] An advantageous variant of the present invention provides to use a dosing syringe, of the sterile type, as an intake/injection device.

[0026] By using sterile containers, syringes and relative connection circuits, the apparatus in its entirety is rendered sterile and prevents contaminations of the drug prepared.

[0027] In an unclaimed example the apparatus can also be used as an injector-doser in the course of parenteral therapy according to a program controlled by the electronic control unit, by connecting the sterile syringe to an infusion line of suitable length.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] These and other characteristics of the present invention will become apparent from the following description of a preferential form of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a schematic representation of an apparatus for the automatic preparation of a drug according to the present invention;
- fig. 2 is a schematic representation of a method for the automatic preparation of a drug according to the present invention

DETAILED DESCRIPTION OF A PREFERENTIAL FORM OF EMBODIMENT

[0029] With reference to fig. 1, an apparatus 10 according to the present invention is used for the preparation of chemotherapy drugs formed by two or more components and used in oncological therapies.

[0030] The apparatus 10 comprises two containers 12 and 14, a first container 12 that contains a drug in solution, at a concentration such that it must be suitably diluted so as to be administered to the patient, and a second container 14 that contains a diluent for the drug in solution to be diluted.

[0031] The drug suitably prepared is sent, as shown hereafter, to a medical sac 16.

[0032] The containers 12 and 14 are of the sterile closing type, standard for medical applications, as is the medical sac 16.

[0033] The containers 12 and 14 and the medical sac 16 are put in communication with corresponding circuits 15, 17 and 19, of the sterile type, also standard for medical applications, which in turn converge into a hydraulic connection element 18, for example formed by a two-way Luer-Lock ramp.

[0034] Downstream of the connection element 18 a container 27 is provided, selectively connected with the

containers 12, 14 and 16, inside which, as will be shown hereafter, the drug is mixed and prepared.

[0035] Connected to the connection element 18 there are two taps 34 and 36, for example two-way or three-way, which are associated respectively with the circuits 15 and 17, in order to regulate the quantity of the stream of drug in solution and of diluent entering the connection element 18. The circuits 15 and 17 can consist of needles or ventilated needles which perforate the containers 12 and 14 and which are attached, screwed or inserted into the respective taps 34 and 36. The perforation of the containers 12 and 14 is guided by a slide or cradle or hopper on the bottom of which there are packings, either rigid or elastic, in such a number as to regulate the penetration of the points of the needles on the inner side of the containers 12 and 14, allowing maximum recoup of the content thereof.

[0036] The taps 34 and 36 are driven by relative independent motors 35 and 37, to operate in coordination with each other so as to determine all the possible combinations of quantities of drug in solution and diluent. The motors 35 and 37 move shaped guides, not shown in the drawings, to house the external wings of the taps 34 and 36.

[0037] The exact dosage quantities of the drug in solution and of diluent are selectively taken in by a dosing syringe 20, whose hollow cylinder 26 defines inside it the container 27. Inside the cylinder 26 the drug in solution and the diluent are mixed, and from here the prepared drug is injected, through the element 18, into the medical sac 16.

[0038] In particular, the hollow cylinder 26 of the dosing syringe 20 has a Luer-Lock tip 21, inserted into the connection element 18, and a piston 22 inserted slidingly inside it.

[0039] The piston 22 and the cylinder 26 are able to slide one with respect to the other, along the common longitudinal axis X, to perform the known intake and injection of the syringe 20.

[0040] The piston 22 is provided with a piston-thrust portion 24, which is constrained to suitable retaining fins 32.

[0041] A suitable electric motor 28, shown schematically in fig. 1, is able to act by means of a transmission mechanism 29, on the fins 32, in order to drive the piston-thrust 24 and thus move the piston 22 in alternate mode, along its longitudinal axis X. If the piston 22 is moved in the direction of the arrow F in fig. 1, the syringe 20 operates in intake mode, whereas if the piston 22 is moved in the direction of the arrow G in fig. 1, the syringe 20 operates in injection mode.

[0042] The transmission mechanism 29 can consist of a worm screw, a screw pin, metal or polymer telescopic extensions, as required.

[0043] The base 23 of the cylinder 26 is constrained to other fins 30, mounted on the motor 28.

[0044] The connection between the fins 30 and 32 and the base 23 and the piston-thrust 24 may be made by

means of a screw, an elastic element, an attachment tooth or by means of vacuum.

[0045] The preparation of the drug according to the present invention is made according to updated dosages of the drugs to be administered to each patient. In a first step of the method to prepare the drug, indicated by block 51 in fig. 2, the doses are memorized in a database 42 as drug preparation data, together with the chemical-physical characteristics of the components and possible other necessary data.

[0046] In a second step of the method according to the invention, the containers 12 and 14 are prepared, block 52 in fig. 2.

[0047] Moreover, in the second step, block 53 in fig. 2, the medical sac 16 is prepared, into which the drug, prepared and ready to be administered, is introduced.

[0048] According to the invention, we then have a step of opening at least one of the two taps 34 and 36, block 54 in fig. 2, to allow the passage of a determinate dosed quantity of drug in solution and/or diluent. In the typical step of preparing the drug, we find both the taps 34 and 36 open, simultaneously or following a predetermined sequence, so as to allow the passage of a determinate quantity of drug in solution and diluent. When only the tap 36 is open, this corresponds to the step when the circuits and the syringe are washed by the diluents, which is propaedeutic to the preparation of a new drug.

[0049] Subsequently, the method according to the invention provides an intake step by the syringe 20, block 55 in fig. 2, which is simultaneous with the step of mixing the drug in solution and the diluent in the cylinder 26 of the syringe 20, so as to prepare the final drug.

[0050] Afterwards, we have a step of closing the taps 34 and 36 so as to prevent unwanted returns of liquid towards the containers 12 and 14, block 56, and a subsequent step of injection by means of the syringe 20, block 59, of the drug prepared, formed by the drug in solution and the diluent, into the appropriate sac 16.

[0051] In order to coordinate the opening and closing of the taps 34 and 36 with the movement of the piston 22 during the intake and injection steps, and to guarantee the correct dosage of the drug, the apparatus 10 is provided with a control unit 40, which is electronically connected also to the clinical database 42 which contains the dosages.

[0052] The control unit 40 commands the two motors 35 and 37 of the taps 34 and 36, in order to selectively control the opening and closing thereof, simultaneously or in sequence, according to the dosage provided for the preparation of a determinate drug to be administered.

[0053] Furthermore, the control unit 40 is also able to command the activation of the electric motor that drives the piston-thrust 24, so as to determine the relative steps of intake and injection.

[0054] The entity of the travel of the piston 22 and the opening of the taps 34 and 36 determines the quantity of drug in solution and of diluent taken in, and is controlled by suitable electro-mechanical and/or electronic sensors

39, 41 and 43, shown schematically in the drawings.

[0055] In particular, during the intake step, the sensors 39, 41 and 43 detect signals relating to the dosed quantities and send them to the control unit 40, and also the sequence with which the components are taken in through the taps 34 and 36.

[0056] The signals are used for a safety check, block 57 in fig. 2, by the control unit 40, which calculates the exact composition of the various components in the drug, and verifies if the doses are correct by comparing them with the pre-set ones in the database 42. If the doses are not correct, then the drug prepared in container 16 is expelled, block 58 in fig. 2, and eliminated, with the restoration of a new container 16, block 53 in fig. 2. On the contrary, if the doses are correct, the drug prepared is injected, block 59.

[0057] The quantity and speed of transfer of the drug in solution and diluent through the circuits 15, 17 and 19 depends on the speed of movement of the piston 22, commanded by the electric motor 28 which in turn is commanded by the unit 40. The speed, in particular, is adjustable according to the doses of drug prescribed, and also according to the nature of the components to be taken in, for example lyophilized drug or in solution, and the viscosity of the solutions prepared or injected, to prevent the formation of instantaneous over-pressure or back flows into the containers 12, 14 and 16.

[0058] Advantageously, furthermore, the force applied by the motor to move the piston 22 is such as to allow operations in depression and to empty the containers 12 and 14 also without an air valve, with a considerable reduction of waste. Alternatively, it is possible to use a ventilated needle and perform the same emptying operation at atmospheric pressure. However, the depression operation allows to reduce the possibility of leakages in the subsequent operation of the feed container.

[0059] Another safety and precision measure is given by a spirit level device 38.

[0060] One advantage of the invention is that, all in all, the operating parts of the apparatus 10, that is, the motor that drives the syringe 20, the syringe 20 itself, the taps 34 and 36 with the relative motors 35 and 37 and part of the circuits 15, 17 and 19, have a limited overall bulk, such that they can easily be housed on the work surface of the chemical or microbiological hoods, or hoods for chemotherapy, and the isolators for advanced aseptic processing.

[0061] Advantageously, the containers 12, 14 and 16 used are provided with recognition labels, read optically or electromagnetically, for example a bar code, so that each operation to insert data relating to the components used in the control unit 40 can be validated by means of automatic reading, thus considerably reducing possibilities of mistakes that are found when said data is introduced manually by means of a keyboard. In particular, at the end of the preparation of the drug, the control unit 40 commands a bar code to be printed, which certifies the correct sequence and conformity of preparation and

which contains the references of the final destination, the sequence of operations performed and the operators who intervened. Instead of the bar code, an RFID tag can be used, which also gives the advantage of traceability.

[0062] Advantageously, furthermore, the apparatus 10 can be aligned with other identical apparatuses for a battery functioning on the work surface of the hoods, or on a surface suspended by a frame outside the hoods. The modular nature of the apparatus 10 allows to associate several lines to prepare the drug in a battery under the same hood or insulator. In this case, the connections and electric feeds and the electric control boards for the functioning of the apparatuses 10 can be disposed towards the outside of the work surface of the hoods and can converge independently, by means of an electric circuit, in the sole control unit 40. In this way, the simultaneous functioning of the individual lines is possible even in the event of an interruption or malfunction of an apparatus.

[0063] It is clear that modifications and/or additions of parts and/or steps may be made to the apparatus for the automatic preparation of a drug and the relative method of preparation as described heretofore, without departing from the field and scope of the present invention.

[0064] For example, it comes within the field of the present invention to provide that the motor 28 that commands the movement of the piston 22 is of the pneumatic type and that this movement is transmitted directly or by mechanical transmission and that it is controlled electro-mechanically.

[0065] Moreover, the motors 35 and 37, instead of shaped guides, may be provided with grippers or hooks or clamps, in order to drive the external wings of the taps 34 and 36.

[0066] Furthermore, the motor 28 may be conformed so as to collect the possible leaks from the circuits 15 and 17, and may be made of material resistant to corrosion from chemical substances used in the operation to decontaminate the work spaces and/or the chemical neutralization operation.

[0067] Advantageously, moreover, a transparent shell may be mounted on the motor 28, which surrounds the syringe 20 and the taps 34 and 36, to reveal and/or confine any sprays that develop.

[0068] It is also clear that, although the present invention has been described with reference to specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of apparatus for the preparation of a drug and the relative method of preparation, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

Claims

1. Apparatus for the automatic preparation of a drug consisting of at least two components, comprising a

first container (12) for a first of said components, a second container (14) for a second of said components, a third container (16) to receive the prepared drug, **characterized in that** it also comprises:

- an intake/injection device able to be activated in intake mode to simultaneously take in and mix dosed quantities of said first and second component, and activated in injection mode to transfer the mixed drug to said third container (16) and consisting of a sterile dosing syringe (20) comprising a hollow cylinder (26), which defines an intermediate container (27) for the mixing of said at least two components to obtain said drug, connected both to said third container (16) and also, by means of valve means (34, 36) driven by relative independent motors (35, 37) and selectively openable and closable, to said first container (12) and to said second container (14), and a piston (22) able to slide inside the hollow cylinder (26) to perform the intake/injection operation of the dosing syringe (20);

- a first (15) and a second (17) sterile circuit which respectively connect, by means of said valve means (34, 36), a hydraulic connection element formed by a two-way Luer-Lock ramp (18) to the respective first container (12) and second container (14), inside said two-way Luer-Lock ramp. (18) dosed quantities of said at least two components, taken in from said first container (12) and second container (14), being made to pass before entering in said intermediate container (27);

- a third (19) sterile circuit being provided to connect said two-way Luer-Lock ramp (18) with the third container (16),

- said hollow cylinder (26) of said dosing syringe (20) comprising a Luer-Lock tip (21) inserted into the two-way Luer-Lock ramp (18) for the connection of the dosing syringe (20) to the two-way Luer-Lock ramp (18);

- an electronic control unit (40) suitable to manage automatically and in a coordinated manner the selective activation of said valve means (34, 36) and of said intake/injection device (20).

2. Apparatus as in claim 1, **characterized in that** the electronic control unit (40) is associated with, or comprises, memorization means (42) able to memorize data relating to pre-determined preparation doses of the drug.

3. Apparatus as in claim 1 or 2, **characterized in that** it also comprises sensor means (39, 41, 43) able to detect the values of the quantities dosed and to transmit them to the electronic control unit (40).

4. Apparatus as in any claim hereinbefore, **character-**

ized in that it comprises drive means (28), controlled by the electronic control unit (40), which is able to drive the intake/injection device (20).

5. Apparatus as in claims 4, **characterized in that** said drive means (28) is able to apply a force to move the piston (22) of the dosing syringe (20) such as to allow operations in depression and to empty the first container (12) and the second container (14).

6. Apparatus as in claims 4 and 5 or 6, **characterized in that** said piston (22) is provided with a piston-thrust portion (24), which is constrained to suitable retaining fins (32), said drive means comprising an electric motor (28) being able to act by means of a transmission mechanism (29) on the fins (32) in order to drive the piston-thrust (24) and thus move the piston (22) in alternate mode, so as to determine the intake or injection operation mode of the dosing syringe (20).

7. Method for the automatic preparation of a drug consisting of at least two components, **characterized in that** it comprises:

- a first step in which the data relating to pre-determined preparation doses of said drug are memorized in memorization means (42) associated with an electronic control unit (40);

- a second step in which at least a first container (12) is prepared for a first of said components, a second container (14) for a second of said components and a third container (16) to receive the drug prepared;

- a third step in which, by means of said electronic control unit (40), valve means (34, 36) driven by relative independent motors (35, 37) are selectively opened, associated with an intermediate container (27) for the mixing of said at least two components to obtain said drug, so as to put the first container (12) and the second container (14) in communication with said intermediate container (27), a hydraulic connection element formed by a two-way Luer-Lock ramp (18) being used to connect, by means of said valve means (34, 36), a first (15) and a second (17) sterile circuit to the respective first container (12) and second container (14), inside which two-way Luer-Lock ramp (18) dosed quantities of said at least two components, taken in from said first container (12) and second container (14), are made to pass before entering in said intermediate container (27);

- a fourth step in which, by means of the electronic control unit (40), an intake/injection device consisting of a sterile dosing syringe (20) comprising a hollow cylinder (26), which defines said intermediate container (27) for the mixing of said

at least two components to obtain said drug and comprises a Luer-Lock tip (21) inserted into the two-way Luer-Lock ramp (18) for the connection of the dosing syringe (20) to the two-way Luer-Lock ramp (18), is activated in intake mode in order to take in, selectively, dosed quantities of the first component and the second component from said two-way Luer-Lock ramp (18) inside the intermediate container (27), and in which, simultaneously with the intake, said components are mixed and the drug prepared;

- a fifth step in which, by means of said electronic control unit (40), said valve means (34, 36) are closed;
- a sixth step in which, by means of said electronic control unit (40), the intake/injection device (20) is activated in injection mode in order to transfer the prepared drug from the intermediate container (27) through the two-way Luer-Lock ramp (18) to the third container (16).

8. Method as in claim 7, **characterized in that** in the fourth step it provides to detect the values of the dosed quantities by means of sensor means (39, 41, 43) and to transmit the values to the electronic control unit (40) and **in that**, before the sixth step, a step is provided to verify the dosed quantities according to the data memorized in the memorization means (42).
9. Method as in claim 7 or 8, **characterized by** the use of a sterile dosing syringe (20) as the intake/injection device, said sterile dosing syringe (20) comprising a hollow cylinder (26), which defines said intermediate container (27) for the preparation of said drug, and a piston (22) able to slide inside the hollow cylinder (26).
10. Method as in claim 9, **characterized in that** the dosing syringe (20) is driven by means of drive means (28), controlled by the electronic control unit (40), applying a force to move the piston (22) of the dosing syringe (20) such as to allow operations in depression and to empty the first container (12) and the second container (14).

Patentansprüche

1. Vorrichtung zum automatischen Herstellen eines Arzneimittels, das aus mindestens zwei Komponenten besteht, aufweisend einen ersten Behälter (12) für eine erste der Komponenten, einen zweiten Behälter (14) für eine zweite der Komponenten, einen dritten Behälter (16), um das hergestellte Arzneimittel aufzunehmen, **dadurch gekennzeichnet, dass** sie ferner aufweist:

- eine Ansaug-/Injektionsvorrichtung, die in ei-

nem Ansaugmodus aktivierbar ist, um dosierte Mengen der ersten und der zweiten Komponente gleichzeitig anzusaugen und zu mischen, und in einem Injektionsmodus aktivierbar ist, um das gemischte Arzneimittel dem dritten Behälter (16) zuzuführen, und die aus einer sterilen Dosierspritze (20) besteht, die aufweist: einen hohlen Zylinder (26), der einen Zwischenbehälter (27) zum Mischen der mindestens zwei Komponenten definiert, um das Arzneimittel zu erhalten, der sowohl mit dem dritten Behälter (16) als auch mit dem ersten Behälter (12) und mit dem zweiten Behälter (14) mittels Ventilmitteln (34, 36), die von jeweiligen unabhängigen Motoren (35, 37) angetrieben werden und wahlweise geöffnet und geschlossen werden können, verbunden ist, und einen Kolben (22), der in der Lage ist, in dem hohlen Zylinder (26) zu gleiten, um die Ansaug-/Injektionsfunktion der Dosierspritze (20) durchzuführen,

- einen ersten (15) und einen zweiten (17) sterilen Kreis, die mittels der Ventilmittel (34, 36) ein durch eine Zweigege-Luer-Lock-Rampe (18) ausgebildetes Hydraulikanschlusselement jeweils mit dem jeweiligen ersten Behälter (12) und zweiten Behälter (14) verbinden, wobei bewirkt wird, dass aus dem ersten Behälter (12) und dem zweiten Behälter (14) angesaugte dosierte Mengen der mindestens zwei Komponenten innerhalb der Zweigege-Luer-Lock-Rampe (18) hindurchströmen, bevor sie in den Zwischenbehälter (27) eintreten,
- einen dritten (19) sterilen Kreis, der vorgesehen ist, um die Zweigege-Luer-Lock-Rampe (18) mit dem dritten Behälter (16) zu verbinden,
- wobei der hohle Zylinder (26) der Dosierspritze (20) eine Luer-Lock-Spitze (21) aufweist, die für die Verbindung der Dosierspritze (20) mit der Zweigege-Luer-Lock-Rampe (18) in die Zweigege-Luer-Lock-Rampe (18) eingesetzt ist,
- eine elektronische Steuereinheit (40), die geeignet ist, um automatisch und auf koordinierte Weise die wahlweise Aktivierung der Ventilmittel (34, 36) und der Ansaug-/Injektionsvorrichtung (20) zu verwalten.

2. Vorrichtung gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die elektronische Steuereinheit (40) Speichermitteln (42) zugeordnet ist oder diese aufweist, die in der Lage sind, Daten zu speichern, die vorbestimmte Herstellungsdosen des Arzneimittels betreffen.
3. Vorrichtung gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** sie ferner Sensormittel (39, 41, 43) aufweist, die in der Lage sind, die Werte der dosierten Mengen zu erfassen und diese an die elektronische Steuereinheit (40) zu übermitteln.

4. Vorrichtung gemäß irgendeinem vorhergehenden Anspruch, **dadurch gekennzeichnet, dass** sie ein durch die elektronische Steuereinheit (40) gesteuertes Antriebsmittel (28) aufweist, das in der Lage ist, die Ansaug-/Injektionsvorrichtung (20) anzutreiben. 5
5. Vorrichtung gemäß Anspruch 4, **dadurch gekennzeichnet, dass** das Antriebsmittel (28) in der Lage ist, eine Kraft aufzubringen, um den Kolben (22) der Dosierspritze (20) zu bewegen, um Funktionen mit Unterdruck zu ermöglichen und den ersten Behälter (12) und den zweiten Behälter (14) zu leeren. 10
6. Vorrichtung gemäß Anspruch 4 und 5 oder 6, **dadurch gekennzeichnet, dass** der Kolben (22) mit einem Kolbendruckabschnitt (24) versehen ist, der auf entsprechende Halterippen (32) beschränkt ist, wobei das Antriebsmittel einen Elektromotor (28) aufweist, der in der Lage ist, mittels eines Übertragungsmechanismus (29) auf die Rippen (32) einzuwirken, um den Kolbendruck (24) anzutreiben und somit den Kolben (22) in einem wechselnden Modus zu bewegen, um den Ansaug- oder Injektions-Funktionsmodus der Dosierspritze (20) zu bestimmen. 15
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7. Verfahren zum automatischen Herstellen eines aus mindestens zwei Komponenten bestehenden Arzneimittels, **dadurch gekennzeichnet, dass** es aufweist: 30
 - einen ersten Schritt, in dem die vorbestimmte Herstellungsdosen des Arzneimittels betreffenden Daten in Speichermitteln (42) gespeichert werden, die einer elektronischen Steuereinheit (40) zugeordnet sind, 35
 - einen zweiten Schritt, in dem mindestens ein erster Behälter (12) für eine erste der Komponenten, ein zweiter Behälter (14) für eine zweite der Komponenten und ein dritter Behälter (16) zum Aufnehmen des hergestellten Arzneimittels vorbereitet wird, 40
 - einen dritten Schritt, in dem mittels der elektronischen Steuereinheit (40) durch jeweilige unabhängige Motoren (35, 37) angetriebene Ventilmittel (34, 36), die einem Zwischenbehälter (27) zugeordnet sind, für das Mischen der mindestens zwei Komponenten wahlweise geöffnet werden, um das Arzneimittel zu erhalten, um den ersten Behälter (12) und den zweiten Behälter (14) mit dem Zwischenbehälter (27) in Kommunikation zu bringen, wobei ein durch eine Zweige-Luer-Lock-Rampe (18) gebildeter Hydraulikanschluss verwendet wird, um mittels der Ventilmittel (34, 36) einen ersten (15) und einen zweiten (17) sterilen Kreis mit dem jeweiligen ersten Behälter (12) und zweiten Behälter (14) zu verbinden, innerhalb welcher Zweige- 45
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Luer-Lock-Rampe (18) dosierte Mengen der mindestens zwei Komponenten, die aus dem ersten Behälter (12) und dem zweiten Behälter (14) angesaugt werden, zum Hindurchströmen gebracht werden, bevor sie in den Zwischenbehälter (27) eintreten,

- einen vierten Schritt, in dem mittels der elektronischen Steuereinheit (40) eine Ansaug-/Injektionsvorrichtung, die aus einer sterilen Dosierspritze (20) besteht, die einen hohlen Zylinder (26) aufweist, der den Zwischenbehälter (27) zum Mischen der mindestens zwei Komponenten zum Erhalten des Arzneimittels definiert und eine Luer-Lock-Spitze (21) aufweist, die für das Verbinden der Dosierspritze (20) mit der Zweige-Luer-Lock-Rampe (18) in die Zweige-Luer-Lock-Rampe (18) eingesetzt ist, in einem Ansaugmodus aktiviert wird, um wahlweise dosierte Mengen der ersten Komponente und der zweiten Komponente aus der Zweige-Luer-Lock-Rampe (18) innerhalb des Zwischenbehälters (27) anzusaugen, und in dem gleichzeitig mit dem Ansaugen die Komponenten gemischt werden und das Arzneimittel hergestellt wird,
- einen fünften Schritt, in dem mittels der elektronischen Steuereinheit (40) die Ventilmittel (34, 36) geschlossen werden,
- einen sechsten Schritt, in dem mittels der elektronischen Steuereinheit (40) die Ansaug-/Injektions-Vorrichtung (20) im Injektionsmodus aktiviert wird, um das hergestellte Arzneimittel aus dem Zwischenbehälter (27) durch die Zweige-Luer-Lock-Rampe (18) hindurch an den dritten Behälter (16) zu übertragen.

8. Verfahren gemäß Anspruch 7, **dadurch gekennzeichnet, dass** es im vierten Schritt vorsieht, die Werte der dosierten Mengen mittels Sensormitteln (39, 41, 43) zu erfassen und die Werte an die elektronische Steuereinheit (40) zu übermitteln, und dass vor dem sechsten Schritt ein Schritt vorgesehen ist, um die dosierten Mengen gemäß den in den Speichermitteln (42) gespeicherten Daten zu verifizieren.
9. Verfahren gemäß Anspruch 7 oder 8, **gekennzeichnet durch** die Verwendung einer sterilen Dosierspritze (20) als die Ansaug-/Injektionsvorrichtung, wobei die sterile Dosierspritze (20) aufweist: einen hohlen Zylinder (26), der den Zwischenbehälter (27) für das Herstellen des Arzneimittels definiert, und einen Kolben (22), der in der Lage ist, innerhalb des hohlen Zylinders (26) zu gleiten.
10. Verfahren gemäß Anspruch 9, **dadurch gekennzeichnet, dass** die Dosierspritze (20) mittels eines Antriebsmittels (28) gesteuert durch die elektroni-

sche Steuereinheit (40) angetrieben wird, das eine Kraft ausbringt, um den Kolben (22) der Dosierspritze (20) zu bewegen, um Funktionen mit Unterdruck zu ermöglichen und den ersten Behälter (12) und den zweiten Behälter (14) zu leeren.

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Revendications

1. Appareil pour la préparation automatique d'un médicament constitué d'au moins deux composants, comprenant un premier récipient (12) pour un premier desdits composants, un deuxième récipient (14) pour un second desdits composants, un troisième récipient (16) destiné à recevoir la préparation médicamenteuse, **caractérisé en ce qu'il** comprend aussi :

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- un dispositif d'introduction/injection pouvant être activé en mode d'introduction afin d'introduire et de mélanger simultanément des quantités dosées desdits premier et second composants, et activé en mode d'injection pour transférer le mélange médicamenteux audit troisième récipient (16), et constitué d'une seringue doseuse stérile (20) comprenant un cylindre creux (26), qui définit un récipient intermédiaire (27) destiné à mélanger lesdits au moins deux composants afin d'obtenir ledit médicament, relié à la fois audit troisième récipient (16) et, par l'intermédiaire d'un système de clapets (34, 36) entraînés par des moteurs électriques indépendants correspondants (35, 37) et pouvant être ouverts et fermés sélectivement, audit premier récipient (12) et audit deuxième récipient (14), ainsi qu'un piston (22) pouvant coulisser à l'intérieur du cylindre creux (26) pour effectuer l'opération d'introduction/injection de la seringue doseuse (20) ;

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- un premier (15) et un deuxième (17) circuits stériles qui raccordent respectivement, par l'intermédiaire dudit système de clapets (34, 36), un élément de raccordement hydraulique formé par une rampe Luer-Lock à deux voies (18) au premier récipient (12) et au deuxième récipient (14), en faisant passer à l'intérieur de ladite rampe Luer-Lock à deux voies (18) des quantités dosées desdits au moins deux composants, prélevées dans lesdits premier récipient (12) et deuxième récipient (14), avant de les faire entrer dans ledit récipient intermédiaire (27) ;
- un troisième (19) circuit stérile étant prévu pour raccorder ladite rampe Luer-Lock à deux voies (18) au troisième récipient (16) ;
- ledit cylindre creux (26) de ladite seringue doseuse (20) comprenant un embout Luer-Lock (21) inséré dans la rampe Luer-Lock à deux voies (18) et destiné à raccorder cette dernière

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à la seringue doseuse (20) ;

- une unité de commande électronique (40) capable de gérer automatiquement et de façon coordonnée l'activation sélective dudit système de clapets (34, 36) et dudit dispositif d'introduction/injection (20).

2. Appareil selon la revendication 1, **caractérisé en ce que** l'unité de commande électronique (40) est associée à, ou comprend, un moyen de mémorisation (42) capable de mémoriser les données relatives à des doses prédéfinies de préparation du médicament.

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3. Appareil selon la revendication 1 ou 2, **caractérisé en ce qu'il** comprend aussi des capteurs (39, 41, 43) capables de détecter les valeurs des quantités dosées et de les transmettre à l'unité de commande électronique (40).

4. Appareil selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'il** comprend un moyen d'entraînement (28) commandé par l'unité de commande électronique (40) et capable d'entraîner le dispositif d'introduction/injection (20).

5. Appareil selon la revendication 4, **caractérisé en ce que** ledit moyen d'entraînement (28) est capable d'appliquer une force pour déplacer le piston (22) de la seringue doseuse (20) de manière à lui permettre de travailler en aspiration et de vider le premier récipient (12) et le deuxième récipient (14).

6. Appareil selon les revendications 4 et 5 ou 6, **caractérisé en ce que** ledit piston (22) est muni d'un poussoir (24) contraint contre des ailettes de retenue (32) appropriées, ledit moyen d'entraînement comprenant un moteur électrique (28) capable d'agir sur les ailettes (32) par un mécanisme de transmission (29) afin d'entraîner le poussoir (24) et de déplacer ainsi le piston (22) en va-et-vient, de manière à faire fonctionner la seringue doseuse (20) en mode d'introduction ou en mode d'injection.

7. Procédé pour la préparation automatique d'un médicament constitué d'au moins deux composants, **caractérisé en ce qu'il** comprend ;

- une première étape consistant à mémoriser les données relatives à des doses prédéfinies de préparation dudit médicament, dans un moyen de mémorisation (42) associé à une unité de commande électronique (40) ;
- une deuxième étape consistant à préparer au moins un premier récipient (12) pour un premier desdits composants, un deuxième récipient (14) pour un second desdits composants et un troisième récipient (16) destiné à recevoir la prépa-

ration médicamenteuse ;

- une troisième étape consistant à ouvrir sélec-
tivement, au moyen de ladite unité de comman-
de électronique (40), un système de clapets (34,
36) entraînés par des moteurs électriques indé-
pendants correspondants (35, 37) et associés
à un récipient intermédiaire (27), afin de mélan-
ger lesdits au moins deux composants pour ob-
tenir ledit médicament, de manière à mettre le
premier récipient (12) et le deuxième récipient
(14) en communication avec ledit récipient in-
termédiaire (27), en utilisant un élément de rac-
cordement hydraulique formé par une rampe
Luer-Lock à deux voies (18) pour raccorder, au
moyen dudit système de clapets (34, 36), un pre-
mier (15) et un second (17) circuits stériles au
premier récipient (12) et au deuxième récipient
(14) respectifs, en faisant passer à l'intérieur de
cette rampe Luer-Lock à deux voies (18) des
quantités dosées desdits au moins deux compo-
sants, prélevées dans lesdits premier réci-
pient (12) et deuxième récipient (14), avant de
les faire entrer dans ledit récipient intermédiaire
(27);
- une quatrième étape consistant à activer en
mode d'introduction, au moyen de l'unité de
commande électronique (40), un dispositif d'in-
troduction/injection constitué d'une seringue do-
seuse stérile (20) comprenant un cylindre creux
(26), qui définit ledit récipient intermédiaire (27)
destiné à mélanger lesdits au moins deux compo-
sants afin d'obtenir ledit médicament et com-
prend un embout Luer-Lock (21) inséré dans la
rampe Luer-Lock à deux voies (18) et destiné à
raccorder cette dernière à la seringue doseuse
(20), afin de prélever sélectivement des quanti-
tés dosées du premier composant et du second
composant dans ladite rampe Luer-Lock à deux
voies (18) pour les introduire dans le récipient
intermédiaire (27); étape au cours de laquelle,
simultanément à introduction, lesdits compo-
sants sont mélangés et le médicament préparé ;
- une cinquième étape consistant à fermer ledit
système de clapets (34, 36) au moyen de ladite
unité de commande électronique (40) ;
- une sixième étape consistant à activer en mode
d'injection, au moyen de ladite unité de com-
mande électronique (40), le dispositif d'introduc-
tion/injection (20) afin de transférer la prépara-
tion médicamenteuse depuis le réservoir inter-
médiaire (27) jusqu'au troisième récipient (16),
en passant par la rampe Luer-Lock à deux voies
(18).

8. Procédé selon la revendication 7, **caractérisé en ce qu'il** prévoit, à la quatrième étape, de détecter les valeurs des quantités dosées au moyen de capteurs (39, 41, 43) et de transmettre ces valeurs à l'unité

de commande électronique (40), et **caractérisé en ce que**, préalablement à la sixième étape, il prévoit une étape de vérification des quantités dosées en fonction des données mémorisées dans le moyen de mémorisation (42).

9. Procédé selon la revendication 7 ou 8, **caractérisé par** l'emploi d'une seringue doseuse stérile (20) comme dispositif d'introduction/injection, ladite seringue doseuse stérile (20) comprenant un cylindre creux (26) qui définit ledit récipient intermédiaire (27) destiné à la préparation dudit médicament, et un piston (22) capable de coulisser à l'intérieur du cylindre creux (26).
10. Procédé selon la revendication 9, **caractérisé en ce que** la seringue doseuse (20) est entraînée par un moyen d'entraînement (28) commandé par l'unité de commande électronique (40) et qui applique une force pour déplacer le piston (22) de la seringue doseuse (20) de manière à lui permettre de travailler en aspiration et de vider le premier récipient (12) et le deuxième récipient (14).

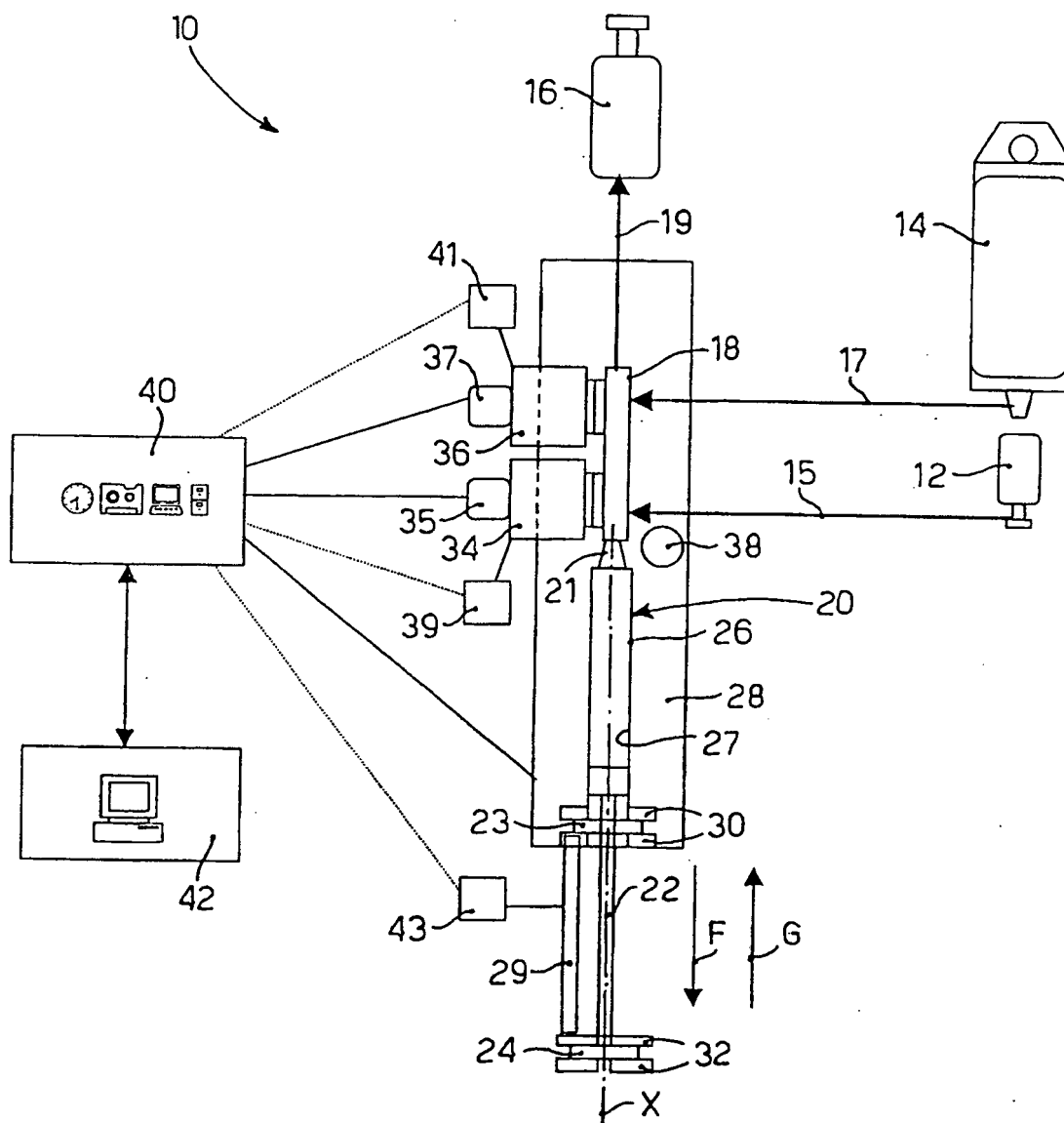


fig. 1

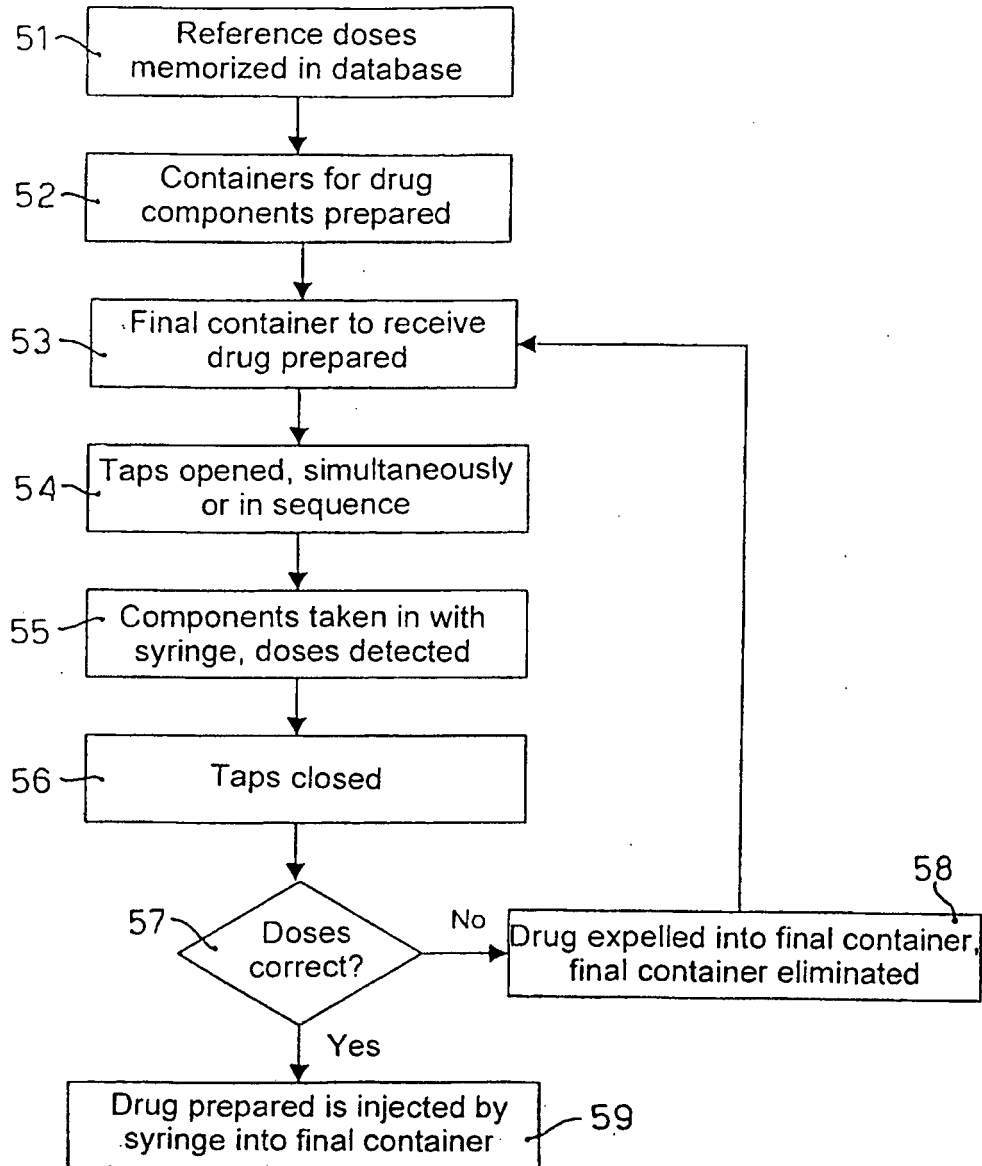


fig. 2

REFERENCES CITED IN THE DESCRIPTION

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