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(71) **Applicant: UNIVERSITE DE LIEGE** [BE/BE]; Place du 20-Août 7, 4000 Liège (BE).

(72) **Inventors: GHOLIZADEH, Ali**; Rue Claude Strebelle 2, 4031 Angleur (BE). **MAZZUCCHELLI, Gabriel**; Rue de la Justice 9, 4020 Liège (BE). **KUNE, Christopher**; Rue Darchis 1A, 4000 Liège (BE). **GILET, Tristan**; Rue de Tiff 15, 4100 Boncelles (BE).

(74) **Agent: GEVERS PATENTS**; De Kleetlaan 7A, 1831 Diegem (BE).

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(54) **Title:** FLUIDIC DEVICE FOR METERING AND DISPENSING A PLURALITY OF SAMPLES

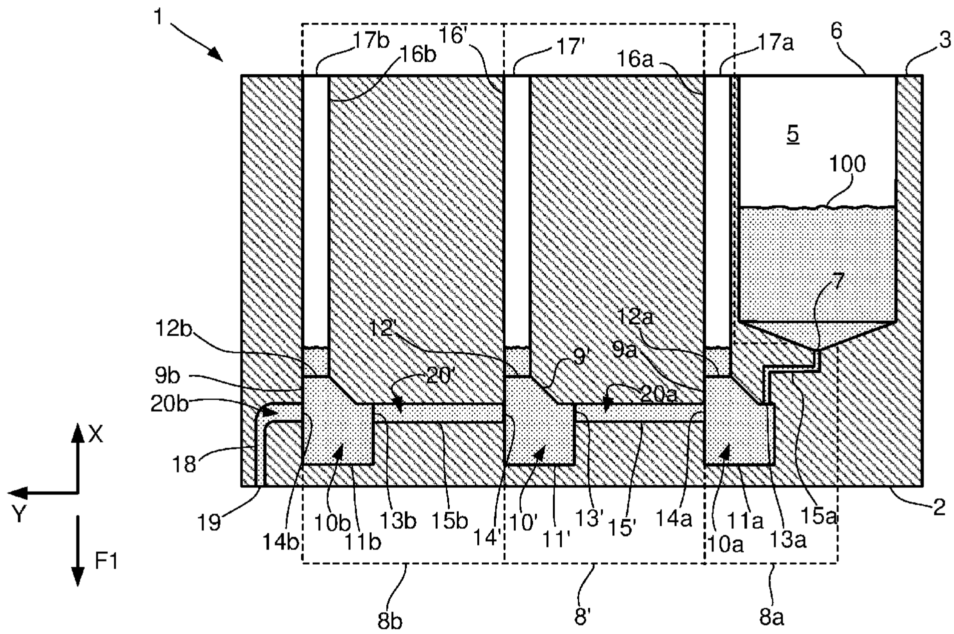

Fig. 1

(57) **Abstract:** Fluidic device (1) for metering a plurality of samples each having a volume inferior to 1 milliliter from an initial volume of a liquid (100), the fluidic device comprising a well (5) for receiving the initial volume of the liquid (100) and a plurality of metering circuits (8a, 8b, 8') each comprising a metering chamber (10a, 10b, 10') for metering one of the samples and a dispensing conduit (16a, 16b, 16') for evacuating the sample from the metering chamber (16a, 16b, 16') out of the fluidic device (1), wherein the well (5) and the metering chambers (10a, 10b, 10') of the group are fluidically coupled in series through inlet conduit (15a, 15b, 15'), wherein a metering chamber most remote from the well is in fluid communication with a liquid surplus output conduit (18) for evacuating a portion of the initial volume of the liquid in excess of all of the samples from the fluidic circuit.

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Fluidic device for metering and dispensing a plurality of samples

Technical area

According to a first aspect, the invention relates to a fluidic device for metering, and preferably dispensing, a plurality of samples each having a volume inferior to 1 milliliter. According to a second aspect, the invention relates to a multi-well plate comprising one or more fluidic devices according to the invention. According to a third aspect, the invention relates to a method for metering, and preferably dispensing, a plurality of samples each having a volume inferior to 1 milliliter.

Prior art

Sample preparation for highly-sensitive analytical methods or experiments require the precise manipulation of small volumes of liquids (e.g., smaller than 1 milliliter, preferably smaller than 1 microliter, and more preferably smaller than 200 nanoliters). Hence, there is a trend to use fluidic devices, and preferably microfluidic devices which enable the manipulation of volumes below 1 microliter. Experiments often require the preparation of numerous samples. Hence, fluidic devices, and preferably microfluidic devices enable to automate, parallelise and easily scale-up manipulation of volumes below the milliliter range. Furthermore, the waste of costly liquids should be avoided.

An aim of the invention is to provide a device that simplifies the metering of a plurality of submilliliter liquid samples from an initial liquid volume while allowing a retrieval of the spare portion in excess of the metered samples.

Summary of the invention

According to a first aspect, one of the objects of the present invention is to provide a fluidic device for metering a plurality of samples each having a volume inferior to 1 milliliter, preferably inferior to 1 microliter, from an initial volume of a liquid.

The fluidic device extends along an axis X and in a direction of increasing X from a lower surface to an upper surface of the fluidic device. The fluidic device comprises a fluidic circuit comprising:

- a well for receiving the initial volume of the liquid, wherein the well opens onto the upper surface through a well inlet aperture and extends along the axis X and in the direction of increasing X from a well outlet aperture to the well inlet aperture, and

- a group of N>1 metering circuits each comprising:

  - a cavity comprising a metering chamber for metering one of the samples, the cavity extending along the axis X and in the direction of increasing X from a bottom of the metering chamber to an upper end of the cavity, the cavity comprising an inlet aperture for receiving the liquid and an excess portion outlet aperture for evacuating a portion of the liquid received in the cavity in excess of the sample, wherein the inlet aperture and the excess portion outlet aperture are both located between the metering chamber and the upper end of the cavity along the axis X,

  - an inlet conduit in fluid communication with the cavity through the inlet aperture,

  - a dispensing conduit opening onto one of the upper or the lower surface through a dispensing aperture, the dispensing conduit extending from a sample outlet aperture of the cavity to the dispensing aperture, the sample outlet aperture being comprised in one of the upper ends of the cavity or the bottom of the metering chamber, respectively,

wherein, for each n such that 1<n<N+1, the inlet conduit of an nth metering circuit is in fluid communication with the excess portion outlet aperture of an (n-1)th metering circuit,

wherein the inlet conduit of a first (n=1) metering circuit is in fluid communication with the well and extends along the axis X and in the direction of increasing X from the inlet aperture of the first metering circuit to the well outlet aperture,

the fluidic circuit further comprising a liquid surplus output conduit opening onto the lower surface through a liquid surplus output aperture, the liquid surplus output conduit extending from the liquid surplus output aperture to the excess portion outlet aperture of the Nth (n=N) metering circuit.

Thanks to the fluidic coupling in series of well, the metering circuits, and the liquid surplus output conduit, the fluidic device allows for simultaneously metering the plurality of samples from the initial volume of the liquid while retrieving the portion of the initial volume of the liquid in excess of the samples. The metering of a plurality of samples at a time reduces the number of manipulation steps for metering the samples by a user.

For example, the fluidic device is a multi-well plate and preferably configured for use in a conventional centrifuge machine.

Preferably, the fluidic device is a microfluidic device. By microfluidic devices is meant devices with microchannels and/or microcavities, with at least one dimension in the micrometer range.

Preferably, the well has a volume comprised between 25 milliter (ml) and 10 microliter (µl), preferably between 600 µl and 20 µl. Preferably, a ratio of the volume of the well to a sum of the volumes of the metering chambers is comprised between 1 and 10, preferably between 1.1 and 5, preferably between 1.5 and 2.

Preferably, the well is configured for receiving the initial volume of the liquid of at least 10 µl, preferably at least 10 ml. Preferably, the well volume is adapted as a function of the number of metering chambers, which may advantageously be a multiple of 24 (eg. 24, 48, 96 or even 384).

Preferably, a diameter of the well inlet aperture is comprised between 1 cm and 2 mm, preferably between 5 mm and 3 mm. This allows for inserting the liquid by hand and/or with conventional pipettes, for example.

In the fluidic device of the invention, the well outlet and inlet apertures are located at extremal ends of the well along the axis X.

In the fluidic device of the invention, each metering circuit is configured for metering, and preferably dispensing, a respective sample of the liquid.

The metering chamber is comprised in the cavity. Typically, the cavity is larger than the metering chamber. In other words, the metering chamber does not constitute the entire cavity.

Preferably, the metering chamber has a volume comprised between 1 milliliter (ml) and 1 nanoliter (nl), preferably between 10 microliter (µl) and 10 nanoliter (nl), preferably between 1 microliter (µl) and 300 nanoliter (nl).

Preferably, each metering chamber is configured for metering a sample having a volume comprised between 1 milliliter (ml) and 1 nanoliter (nl), preferably between 10 microliter (µl) and 10 nanoliter (nl), preferably between 1 microliter (µl) and 300 nanoliter (nl).

The metering chamber is a portion of the cavity located at the lower end of the cavity. The lower end of the cavity is substantially opposed to the upper end of the cavity along the axis X.

The metering chamber extends along the axis X and in the direction of increasing X from a bottom to a top of the metering chamber.

Preferably, the metering chambers are of the overflow type. In this case, a position of the excess portion outlet aperture along the axis X defines a position of the upper end of the metering chamber along the axis X.

The inlet conduits are fluidically connecting the cavities of the metering circuits in series with each other and with the well.

Preferably, the liquid surplus output conduit extends along the axis X and in the direction of increasing X from the liquid surplus output aperture to the excess portion outlet aperture of the Nth (n=N) metering circuit.

Preferably, a position of the liquid surplus output conduit measured along the axis X and in the direction of increasing X monotonically increases when travelling along the inlet conduit from the liquid surplus output aperture to the excess portion outlet aperture of the Nth metering circuit.

In an embodiment of the invention, the fluidic device is configured such that, in response to an application of a first force field F1 along the axis X and in the direction of decreasing X:

- the initial volume of the liquid is able to pass from the well to the cavity and up to the metering chamber of the first metering circuit via the inlet conduit of the first metering circuit,
- a first sample is prevented from exiting the metering chamber of the first metering circuit,
- a first excess portion of the liquid received in the cavity of the first metering circuit in excess of the first sample is able to exit from the cavity of the first metering circuit through the excess portion outlet aperture of the first metering circuit,
- for each n such that $1<n<N+1$:
    - an (n-1)th excess portion of the liquid is able to pass from the cavity of the (n-1)th metering circuit to the cavity and metering chamber of the nth metering circuit via the inlet conduit of the nth metering circuit,
    - an nth sample is prevented from exiting the metering chamber of the nth metering circuit,
    - an nth excess portion of the liquid received in the cavity of the nth metering circuit in excess of the nth sample is able to exit from the cavity of the nth metering circuit through the excess portion outlet aperture of the nth metering circuit,

- the Nth (n=N) excess portion of the liquid is able to exit from the cavity of the Nth metering circuit and from the fluidic circuit through the liquid surplus output conduit.

Such fluidic device eliminates the need of modifying the fluidic circuit to perform the metering. For example, the need of opening or closing valves and the associated valve control means is eliminated. This allows a simple, robust and reliable metering of the samples.

Preferably, the fluidic device is configured such that, in response to an application of a first force field F1 along the axis X and in the direction of decreasing X, the Nth (n=N) excess portion of the liquid is able to exit from the cavity of the Nth metering circuit and from the fluidic circuit through the liquid surplus output conduit and the liquid surplus output aperture.

Preferably, an amplitude of the first force field F1 is comprised between 100 m/s^2 (meter per second squared) (e.g. for a metering chambers of 1µL) and 10000 m/s^2 (e.g. for a metering chamber of 1nL). Preferably, a direction of the first force field F1 is parallel to the axis X.

As an example, the application of the first force field F1 along the axis X and in the direction of decreasing X may be achieved by using a centrifuge machine, preferably a swinging-bucket centrifuge.

Preferably, a position of each inlet conduit measured along the axis X and in the direction of increasing X monotonically increases when travelling along the inlet conduit from the inlet aperture to the other end of the inlet conduit. For example, the other end of the inlet conduit is the well outlet aperture or the excess portion outlet aperture of an adjacent cavity. This prevents the liquid to remain stuck in the inlet aperture when the first force field is applied on the fluidic device.

In a first embodiment of the fluidic device according to the invention, the fluidic device is configured for dispensing the plurality of samples, and the dispensing conduit of each metering circuit:

- opens onto the upper surface through a dispensing aperture, and

- extends along the axis X and in the direction of increasing X from the sample outlet aperture comprised in the upper end of the cavity to the dispensing aperture,

and the fluidic device is configured such that, in each of the metering circuits, a sample is allowed to exit from the metering chamber through the dispensing conduit and up to the dispensing aperture in response to an application of a second force field F2 along the axis X and in the direction of increasing X.

Such device allows for both metering and dispensing the samples. The samples can be subsequently metered and dispensed by applying force fields along the axis X and in the direction of decreasing and increasing X, respectively. This reversal of the direction of the force field applied on the fluidic device can be achieved by flipping the fluidic device upside-down i.e., by 180° around an axis orthogonal to the axis X, with respect to a generator of force field. For example, the fluidic device can be flipped upside-down around an axis orthogonal to the axis X with respect to the bucket of a centrifuge machine, between the metering and the dispensing of the samples.

Such device allows for simultaneously metering a plurality of samples, which reduces the number of manipulation steps by a user. Furthermore, it is not necessary to modify the fluidic circuit to perform the dispensing after having performed the metering. For example, the need of opening or closing valves and of providing the associated valve control means is eliminated. This allows a simple, robust and reliable metering and dispensing of several samples with a same device.

Preferably, an amplitude of the second force field F2 is comprised between 100 m/s^2 and 10000 m/s^2. Preferably, a direction of the second force field F2 is parallel to the axis X.

In a second embodiment of the fluidic device according to the invention, the fluidic device is configured for dispensing the plurality of samples, and the dispensing conduit of each fluidic circuit:

- opens onto the lower surface through a dispensing aperture, and
- extends along the axis X and in the direction of decreasing X from the sample outlet aperture comprised in the bottom of the metering chamber to the dispensing aperture,

and the fluidic device is configured such that, in each of the metering circuits, a sample is allowed to exit from the metering chamber through the dispensing conduit and up to the dispensing aperture in response to an application of a third force field F3 along the axis X and in the direction of decreasing X.

Such a device allows for simultaneously dispensing of the metered samples without modifying the direction of the force field applied on the device, and thus further reduces the number of manipulation steps required for dispensing the samples.

Preferably, an amplitude of the third force field F3 is comprised between 100 m/s^2 and 10000 m/s^2. Preferably, a direction of the third force field F3 is parallel to the axis X.

In the second embodiment of the fluidic device according to the invention, the dispensing conduits preferably act as a capillary valve such that the liquid cannot pass through under the effect of accelerations as low as the gravity force field. Preferably, the dispensing conduits is configured to act as a capillary valve such that the liquid passes through the dispensing conduits upon application of the third force field F3 with an amplitude greater than a third threshold T3.

Preferably, the fluidic device is configured such that an amplitude of the first force field F1 is lower than the third threshold T3 and the amplitude of the third force field F3 is greater than the third threshold T3. In this way, the liquid passes through the dispensing conduit in response to the application of the third force field F3 and is prevented from passing through the dispensing conduit in response to the application of the first force field F1.

In the fluidic device according to the invention, the metering chambers of the fluidic circuit may have a same or different volumes, the volume of each of the metering chambers being preferably comprised between 1 ml and 1 nanoliter.

Chambers having the same volume allow for precisely metering identical samples with submilliliter volumes, preferably submicroliter volumes. Alternatively, chambers with different volumes allow for precisely metering sample with various, different volumes.

Preferably, one or more of the dispensing conduits and/or the liquid surplus output conduit are closable such that no liquid can flow through.

Preferably, the fluidic device comprises obstruction means for closing and opening one or more of the dispensing conduits and/or the liquid surplus output conduit, the obstruction means being selected among:

- a valve;
- a tape;
- a plug;
- a dead-end openable by piercing or drilling the fluidic device;
- a dissolvable membrane.

For example, the valve is configured for closing and opening the dispensing conduits and/or the liquid surplus output conduit.

For example, the tape is configured for removably sticking to the lower surface of the fluidic device to obstruct one or more of the dispensing apertures and/or the liquid surplus output aperture.

For example, the tape is configured for removably sticking to the upper surface of the fluidic device to obstruct one or more of the dispensing apertures and/or the liquid surplus output aperture.

For example, one or more plugs are configured for removably obstructing one, or more, or all of the dispensing apertures. For example, the plug is configured for removably obstructing the liquid surplus output aperture.

For example, the dead-end is configured for opening to obtain one or more of the dispensing apertures and/or the liquid surplus output aperture.

The dissolvable membrane is configured for dissolving upon an application of a solvent on it.

Preferably, the fluidic device comprises one or more of the fluidic circuits. This allows for metering and preferably dispensing more samples and/or samples from different liquids.

Preferably, the fluidic device also extends along an axis Y orthogonal to the axis X, the fluidic device comprising two fluidic circuits having a common well, wherein the two fluidic circuits preferably extend on opposite sides of the common well along the longitudinal axis Y. This configuration allows for metering, and preferably dispensing, a larger number of samples of the liquid with the common well. For given sample volumes, this allows for a larger initial volume of fluid to be received in the common well. Such larger initial volume of the liquid is easier to manipulate and dispense in the common well by a user, for example using a pipette.

Preferably, the fluidic device comprises a first bar having a hollowed lateral surface comprising recessed portions and a sealing member having a sealing lateral surface in contact with the hollowed lateral surface of the first bar, wherein the fluidic circuit is formed between the recessed portions of the hollowed lateral surface of the first bar and the sealing lateral surface of the sealing member.

Preferably, the sealing member is a second bar.

For example, the sealing member may be a sealant such as tape.

In an example, the fluidic circuit is sealed by chemical materials between the first bar and the sealing member. In an example, the fluidic circuit is sealed by solvent or adhesive bonding of the first hollowed lateral surface to the sealing lateral surface. In other words, this means that sealing lateral surface may be in direct or indirect contact with the hollowed lateral surface.

In the scope of the present disclosure, the use of the wording ‘in contact’ does not necessarily imply that parts are in direct contact with each other. They may also be in indirect contact with each other, via glue or a sealant. In other words, the terms ‘in contact’ may be replaced by the terms ‘applied against’ in the present disclosure.

This eases the manufacturing of the fluidic device. For example, the fluidic circuit of such fluidic device can be manufactured by milling the hollowed lateral surface to produce the recessed portions.

The hollowed and sealing lateral surfaces in contact with each other preferably each join the upper surface of the fluidic device to the lower surface of the fluidic device.

Preferably, a part of the hollowed lateral surface adjacent to the recessed portions is substantially planar, and a part of the sealing lateral surface in contact with said part of the hollowed lateral surface is substantially planar.

This simplifies the manufacturing and assembly of the fluidic device, in particular under the constraint of sealing contact between the hollowed and sealing lateral surfaces to avoid leakage of the liquid out of the fluidic circuit.

Preferably, a portion of the sealing member facing one of the recessed portions of the first bar comprises a material transparent to electromagnetic radiations for allowing electromagnetic radiations to pass through the sealing member to reach the fluidic circuit.

Such device allows for performing tests on the liquid samples involving the use of electromagnetic radiations, for example optical or visual inspection tests.

Generally speaking, the fluidic device according to the invention allows the metering and dispensing of samples of liquid with submilliliter volumes, while keeping the concentration of products in the liquid constant. In addition, the fluidic device allows for retrieving the spare portion of the initial liquid volume in excess of the samples.

For example, the fluidic device of the invention may be manufactured by any of the following techniques or a combination thereof: milling, injection molding, and embossing. Alternatively, the device may be prepared by additive manufacturing techniques. In such case, the sealing member may be part of the same piece as the bar.

According to a second aspect, one of the objects of the present invention is to provide a multi-well plate comprising one or more fluidic devices according to the invention.

The integration of the fluidic device in the multi-well plate allows for using the device in conventional laboratory machines, such as centrifuge machines for generating the first and second force fields.

In an embodiment of the multi-well plate according to the invention, the fluidic devices comprise the first bar and the sealing member. The fluidic devices of the multi-well plate may be in contact or spaced apart i.e. spaced with respect to each other. When the fluidic devices are spaced apart, sensors (e.g. optical) or heaters may be inserted between the fluidic devices. A spacing between fluidic devices and/or bars may also be foreseen for airflow circulation.

In an embodiment of the multi-well plate according to the invention, the multi-well plate comprises a previous fluidic device according to the invention and comprising the first bar and the sealing member, wherein the sealing member of the previous fluidic device is a second bar and comprises a hollowed lateral surface opposed to the sealing lateral surface of the second bar (i.e., of the sealing member being the second bar) and comprising recessed portions, the multi-well plate comprising a third bar having a sealing lateral surface in contact with the hollowed lateral surface of the second bar, the second and third bars forming a next fluidic device according to the invention wherein the fluidic circuit is formed between the recessed portions of the hollowed lateral surface of the second bar and the sealing lateral surface of the third bar.

Such multi-well plate comprises the second bar having both a sealing lateral surface and a hollowed lateral surface. For a given number of bars to assemble for forming the multi-well plate, this increases the number of fluidic circuits in the multi-well plate.

The fluidic circuits of the previous and next fluidic devices may be identical or different.

For example, the fluidic circuits of the previous and next fluidic devices may differ by their geometries, dimensions, respective numbers N of cavities, arrangements of the chambers.

Preferably, the multi-well plate extends along the axis X between a top surface comprising the upper surfaces of the fluidic devices and a bottom surface comprising the lower surfaces of the fluidic devices.

In this way, the wells of all the fluidic devices all open on the top surface of the multi-well plate. Consequently, a same force field can be applied on the entire plate for the metering of the samples, and preferably also for the dispensing thereof.

Preferably, the multi-well plate is configured for stacking on a second multi-well plate such that each of the dispensing apertures of the multi-well plate is facing a well of the second multi-well plate, wherein the second multi-well plate can be according to the invention or not.

The second multi-well plate may be any conventional well plate or according to the invention.This allows for dispensing the samples directly in the wells of an adjacent multi-well plate.

According to a third aspect, one of the objects of the present invention is to provide a method for metering a plurality of samples from an initial volume of a liquid. The method comprises the steps of:

- providing a fluidic device or a multi-well plate according to the invention,

- inserting an initial volume of a liquid in the well of the fluidic device or multi-well plate, respectively, via the well inlet aperture,
- applying a first force field F1 to the fluidic device or multi-well plate, respectively, along the axis X and in the direction of decreasing X, such that:
  - the initial volume of the liquid passes from the well to the cavity and up to the metering chamber of the first metering circuit via the inlet conduit of the first metering circuit,
  - a first sample is prevented from exiting the metering chamber of the first metering circuit,
  - a first excess portion of the liquid received in the cavity of the first metering circuit in excess of the first sample exits from the cavity of the first metering circuit through the excess portion outlet aperture of the first metering circuit,
  - for each n such that 1<n<N+1:
    - an (n-1)th excess portion of the liquid passes from the cavity of the (n-1)th metering circuit to the cavity and metering chamber of the nth metering circuit via the inlet conduit of the nth metering circuit,
    - an nth sample is prevented from exiting the metering chamber of the nth metering circuit,
    - an nth excess portion of the liquid received in the cavity of the nth metering circuit in excess of the nth sample exits from the cavity of the nth metering circuit through the excess portion outlet aperture of the nth metering circuit,
  - the Nth (n=N) excess portion of the liquid exits from the cavity of the Nth metering circuit and from the fluidic circuit through the liquid surplus output conduit.

The advantages presented for the fluidic device or multi-well plate according to the invention apply mutatis mutandis to the method according to the invention.

When the first force field F1 is applied to the fluidic device or multi-well plate, the Nth excess portion of the liquid may exit from the fluidic device or multi-well plate, respectively, via the liquid surplus output aperture.

The method preferably comprises the steps of:

- positioning the fluidic device or multi-well plate, respectively, in a first position in a centrifuge machine, preferably a swinging-bucket centrifuge machine,
- setting a rotating speed of the centrifuge machine such that the first force field F1 is applied to the fluidic device or multi-well plate, respectively, along the axis X and in the direction of decreasing X.

In a first embodiment of the method according to the invention, the method is for metering and dispensing a plurality of samples from an initial volume of a liquid and comprises the steps of:

- applying a second force field F2 to the fluidic device or multi-well plate, respectively, along the axis X and in the direction of increasing X such that in each of the metering circuits the metered sample exits from the metering chamber and the cavity up to the dispensing aperture through the dispensing conduit.

Preferably, the method according to the first embodiment comprises the steps of:

- flipping the fluidic device or multi-well plate, respectively, upside-down from the first position to a second position in the centrifuge machine,
- setting a rotating speed of the centrifuge machine such that the second force field F2 is applied to the fluidic device or multi-well plate, respectively, along the axis X and in the direction of increasing X.

Preferably, the method according to the first embodiment comprises the steps of:

- stacking the multi-well plate according to the invention on a second multi-well plate such that:
    - each of the dispensing apertures of the multi-well plate is facing a well of the second multi-well plate, and
    - the metered samples exiting from the dispensing conduit via the dispensing aperture are received in one of the wells of the second multi-well plate upon application of the second force field F2.

According to a second embodiment of the method of the invention, the method is for metering and dispensing a plurality of samples from an initial volume of a liquid, and comprises the step of:

- applying a third force field F3 to the fluidic device or multi-well plate, respectively, along the axis X and in the direction of decreasing X such that in each of the metering circuits the metered sample exits from the metering chamber up to the dispensing aperture through the dispensing conduit.

Preferably, the method according to the second embodiment comprises the step of:

- stacking the multi-well plate according to the invention on a second multi-well plate such that:
    - each of the dispensing apertures of the multi-well plate is facing a well of the second multi-well plate, and
    - the metered samples exiting from the dispensing conduit via the dispensing aperture are received in one of the wells of the second multi-well plate upon application of the third force field F3.

In this way, the evacuation and dispensing of the samples in the wells of the second multi-well plate is achieved in a single step.

Preferably, the dispensing apertures of the multi-well plate according to the invention are positioned on the top or bottom surfaces of the multi-well plate such that each of them faces a well of a conventional multi-well plate when stacked onto it.

The first, second, and third force field may result from an acceleration of the fluidic device or multi-well plate of the invention. For example, the acceleration field source may be a centrifuge machine. In this case, the acceleration force is applied by rotating the fluidic device or multi-well plate in the centrifuge machine.

In the present application, the use of the formulations ‘extending along the axis X and in the direction of increasing X’ or ‘extending along the axis X and in the direction of increasing X’ for characterizing a feature of the invention does not preclude that such feature may extend along other axes orthogonal to the axis X. For example, a conduit or chamber may be characterized as ‘extending along the axis X and in the direction of increasing X’, while it also extends along the axis Y and/or the axis Z.

Similarly, in the present application, the use of the formulations ‘extending along the axis X and in the direction of increasing X’ or ‘extending along the axis X and in the direction of increasing X’ for characterizing a force field does not preclude that such force field may have other non-zero components orthogonal to the axis X, unless specified otherwise. For example, one of the first, second, and third force fields may have non-zero components orthogonal to the axis X.

Brief description of the figures

These aspects of the invention as well as others will be explained in the detailed description of specified embodiments of the invention, with reference to the drawings in the figures, in which:

Fig. 1 and 2 show a cross-sectional view of an exemplary embodiment of the fluidic device of the invention during and after the metering of the liquid samples, respectively.

Fig. 3 shows a cross-sectional view of an exemplary embodiment of the fluidic device of the invention, during the dispensing of the liquid samples.

Fig. 4 shows an exemplary embodiment of a first bar having a hollowed lateral surface comprising recessed portions for forming a fluidic device according to the invention.

The drawings in the figures are not to scale. Generally, similar elements are designated by similar reference signs in the figures. The presence of reference numbers in the drawings is not to be considered limiting, even when such numbers are also included in the claims.

Detailed description of possible embodiments of the invention

Figures 1 to 3 show a cross-sectional view of a fluidic device 1 according to the invention. In particular, figure 1 shows the fluidic device 1 during the metering of the samples. Figure 2 shows the fluidic device upon termination of the metering of the samples, and figure 3 shows the fluidic device during the dispensing of the samples.

The fluidic device 1 is configured for metering a plurality of samples 100a, 100b, 100' from an initial volume of a liquid 100. Each sample has a volume inferior to 1 milliliter.

The liquid 100 is typically an aqueous solution. The fluidic device 1 is preferably configured for receiving liquid 100 with the following properties:

- low or intermediate viscosity, preferably smaller than 100 cS (centistokes);
- finite contact angle with the solid surface of the fluidic device, preferably larger than 45°;
- vapor pressure sufficiently high to prevent immediate evaporation.

As shown in figures 1 to 3, the fluidic device 1 extends along an axis X and in the direction of increasing X from a lower surface 2 to an upper surface 3. The fluidic device 1 also extends along an axis Y orthogonal to the axis X, and along an axis Z orthogonal to the axes X and Y.

The fluidic device 1 comprises a fluidic circuit 4 comprising a well 5 for receiving an initial volume of a liquid 100. The well 5 opens on an upper surface 3 of the fluidic device 1 via a well inlet aperture 6 such that the initial volume of the liquid 100 can be deposited or fed therein. Typically, the initial volume of the liquid 100 is supplied by a pipette. The pipette can be manipulated by a user or moved by a robot. The well 5 typically has a volume comprised between 25 ml and 10 µl, preferably between 1 ml and 10 µl. This allows to receive a quantity of the liquid of the same volume.

The well extends along the axis X and in the direction of increasing X from a well outlet aperture 7 to the well inlet aperture 6. The well inlet and outlet apertures 6, 7 are comprised in opposite ends of the well 5 along the axis X. The well inlet and outlet apertures 6, 7 are located at the top and bottom of the well, respectively. As a result, the initial volume of the liquid received in the well 5 is forced to exit the well 5 through the well outlet aperture 7 when a first force field F1 is applied on the fluidic device 1 along the axis X and in the direction of decreasing X.

The fluidic circuit 4 comprises a group of several metering circuits 8a, 8b, 8’ fluidically coupled in series with the well 5 on one end, and with a liquid surplus output conduit 18 on the other end. The well and the metering circuits are fluidically coupled in series via inlet conduit 15a, 15b, 15’ of the metering circuits.

Each metering circuit 8a, 8b, 8’ comprises a respective cavity 9a, 9b, 9’ extending along the axis X and in the direction of increasing X from a lower to an upper end of the cavity 9a, 9b, 9’. The cavity 9a, 9b, 9’ comprises a metering chamber 10a, 10b, 10’ for metering a respective sample 100a, 100b, 100’ of the liquid. The metering chamber extends along the axis X and in the direction of increasing X from a bottom to a top of the metering chamber. Thus, the lower end of the cavity 9a, 9b, 9’ is also the bottom 11a, 11b, 11’ of the corresponding metering chamber 10a, 10b, 10’.

In the device of figures 1 to 3, the metering chambers are of the overflow type.

Each cavity 9a, 9b, 9’ comprises an inlet aperture 13a, 13b, 13’ for receiving the liquid 100 and an excess portion outlet aperture 14a, 14b, 14’ for evacuating a portion of the liquid received in the cavity in excess of the sample. The inlet aperture 13a, 13b, 13’ and the excess portion outlet aperture 14a, 14b, 14’ are both located between the metering chamber 10a, 10b, 10’, i.e., the upper end of the metering chamber, and the upper end of the cavity 9a, 9b, 9’ along the axis X. The position of the excess portion outlet aperture 14a, 14b, 14’ along the axis X defines the upper end of the metering chamber, because the portion of the liquid received in the cavity in excess of the sample can exit the cavity via the excess portion outlet aperture 14a, 14b, 14’.

In the invention, the well 5, the metering chambers of the metering circuits, and the liquid surplus output conduit 18 are fluidically coupled in series and in this order.

In the embodiment of figures 1 to 3, the well 5 is fluidically coupled to a cavity 9a of a first (n=1) metering circuit 8a via an inlet conduit 15a of the first metering circuit 8a. The inlet conduit 15a of the first metering circuit 8a extends along the axis X and in the direction of increasing X from the inlet aperture 13a of the first metering circuit 8a to the well outlet aperture 7. In this way, the initial volume of the liquid 100 exiting the well via the well outlet aperture 7 flows towards the cavity 9a when the first force field F1 is applied on the fluidic device 1.

In the embodiment of figures 1 to 3, the inlet conduit 15a of the first metering circuit 8a acts as a capillary valve such that the liquid cannot pass there through under the effect of accelerations as low as the gravity force field. Thus, the liquid received in the well 5 remains in the well under the effect of the gravity force field during manipulation of the fluidic device 1, but does not exit via the well outlet aperture 7 unless a force field of a greater amplitude than the acceleration of gravity drives it through the inlet conduit 15a of the first metering circuit 8a.

As shown in figure 1, the liquid entering the cavity 9a is forced towards the metering chamber 10a under the effect of the first force field F1. Under the effect of the first force field F1, the portion of the liquid received in the cavity 9a that is in excess of the sample 100a flows out of the cavity through the excess portion outlet aperture 14a whereas the sample 100a remains trapped in the metering chamber 10a.

The fluidic device comprises a second (n=2) metering circuit 8’. As shown in figure 1, under the effect of the first force field F1:

- the portion of the liquid in excess of the sample 100a and flowing out of the cavity 9a of the first metering circuit 8a is received in the cavity 9’ of the second metering circuit 8’,
- the liquid received in the cavity 9’ is forced towards the metering chamber 10’,
- the portion of the liquid received in the cavity 9’ that is in excess of the sample 100’ flows out of the cavity 9’ through the excess portion outlet aperture 14’ whereas the sample 100’ remains trapped in the metering chamber 10’.

Similarly, under the effect of the first force field F1:

- the portion of the liquid in excess of the sample 100’ and flowing out of the cavity 9’ of the second metering circuit 8’ is received in the cavity 9b of the third (n=3) metering circuit 8b.
- the liquid received in the cavity 9b is forced towards the metering chamber 10b,
- the portion of the liquid received in the cavity 9b that is in excess of the sample 100b flows out of the cavity 9b through the excess portion outlet aperture 14b of the third metering circuit 8b, whereas the sample 100b remains trapped in the metering chamber 10b.

The fluidic circuit 4 comprises a liquid surplus output conduit 18 opening onto the lower surface 2 through a liquid surplus output aperture 19. As shown in figures 1 to 3, the liquid surplus output conduit 18 extends along the axis X and in the direction of increasing X from the liquid surplus output aperture 19 to the excess portion outlet aperture 14b of the third (n=3) metering circuit 8b.

Under the effect of the first force field F1, the portion of the liquid in excess of the sample 100b flows out of the cavity 9b of the third (n=3) metering circuit 8b via the liquid surplus output conduit 18, and is thereby evacuated from the fluidic device 1.

As a result, only the metered samples 100a, 100’, 100b remain in respective metering chambers 10a, 10’, 10b of the fluidic device 1, as shown in figure 2.

As exposed previously, the fluidic device 1 according to the invention allows for simultaneously metering several liquid samples. In the context of the present application, the term simultaneously means that the metering of the samples is performed in a single batch, i.e. without requiring manipulation of the fluidic device by a user between the metering of the different samples.

No liquid is wasted after the metering of the samples using the fluidic device of the invention, because all the liquid from the initial volume of the liquid and in excess of the samples 100 is evacuated from the fluidic device and can be retrieved for subsequent use.

As shown in figure 1, the liquid may enter the dispensing conduit 16a, 16b, 16’ during the samples metering phase. However, the liquid in the dispensing conduits returns towards the cavities 9a, 9b, 9’ under the effect of the first force field F1. Only the samples remain in the fluidic device after the samples metering phase, as shown in figure 2.

Once the samples are metered, they may be dispensed out of the fluidic device for further processing. The fluidic device 1 according to the invention is configured for dispensing the samples.

As shown in figure 3, this can be achieved by flipping the fluidic device upside down with respect to a source of force field, for example with respect to a centrifuge machine. As a result, a second force field F2 is applied on the fluidic device 1 in a direction opposite to the first force field F1.

Under the effect of the second force field F2, the samples 100a, 100b, 100’ are forced out of the metering chambers 10a, 10b, 10’ and the cavities through the sample outlet apertures 12a, 12b, 12’. The samples travel through the dispensing conduit 16a, 16b, 16’ towards to the dispensing apertures 17a, 17b, 17’.

In an example, the fluidic device 1 is comprised in a first multi-well plate and the upper and lower surfaces 3, 2 of the fluidic device belong to the top and bottom surfaces of the first multi-well plate, respectively. The first multi-well plate can be stacked on a second multi-well plate such that the dispensing apertures 17a, 17b, 17’ of the first multi-well plate each face a well of the second multi-well plate. In this way, the samples 100a, 100b, 100’ exiting the first multi-well plate through the dispensing apertures 17a, 17b, 17’ are dispensed directly in the wells of the second multi-well plate.

The fluidic device 1 according to the invention may be formed by assembling bars. For example, a first bar 21 having a hollowed lateral surface 22 comprising recessed portions 23 is shown in figure 4. The first bar 21 may be assembled with a second bar having a sealing lateral surface such that the hollowed lateral surface 22 and the sealing lateral surface are in contact.

As a result, a fluidic circuit 4 according to the invention is formed between the recessed portions 23 of the first bar 21 and the sealing lateral surface of the second bar.

The first bar 21 shown in figure 4 allows for forming two fluidic circuits 4. The two fluidic circuits 4 extend on opposite sides of the well 5 along the Y axis. The two fluidic circuits 4 share a common well 5.

In an example, a multi-well plate is formed by assembling a plurality of bars, by fastening them together. Preferably, a number of the bars forming the multi-well plate have both a hollowed lateral surface and a sealing lateral surface opposed to each other. This reduces the number of parts required for assembling the multi-well plate. The multi-well plate may also be an assembly of bars. The multi-well plate may be an assembly of bars mounted on a support, in a fixed or in a removable manner. This renders the device particularly modular. Hence, in particular embodiments, a bar may be moved under an instrument (e.g., microscope), enabling for example real-time observation within the fluidic circuit.

Claims

1. Fluidic device (1) for metering a plurality of samples (100a, 100b, 100’) each having a volume inferior to 1 milliliter from an initial volume of a liquid (100), the fluidic device (1) extending along an axis X and in a direction of increasing X from a lower surface (2) to an upper surface (3) of the fluidic device (1), the fluidic device (1) comprising a fluidic circuit (4) comprising:
   - a well (5) for receiving the initial volume of the liquid (100), wherein the well (5) opens onto the upper surface (3) through a well inlet aperture (6) and extends along the axis X and in the direction of increasing X from a well outlet aperture (7) to the well inlet aperture (6),
   - a group of N>1 metering circuits (8a, 8b, 8’) each comprising:
     - a cavity (9a, 9b, 9’) comprising a metering chamber (10a, 10b, 10’) for metering one of the samples (100a, 100b, 100’), the cavity (9a, 9b, 9’) extending along the axis X and in the direction of increasing X from a bottom (11a, 11b, 11’) of the metering chamber (10a, 10b, 10’) to an upper end of the cavity (9a, 9b, 9’), the cavity (9a, 9b, 9’) comprising an inlet aperture (13a, 13b, 13’) for receiving the liquid (100) and an excess portion outlet aperture (14a, 14b, 14’) for evacuating a portion of the liquid received in the cavity in excess of the sample, wherein the inlet aperture (13a, 13b, 13’) and the excess portion outlet aperture (14a, 14b, 14’) are both located between the metering chamber (10a, 10b, 10’) and the upper end of the cavity (9a, 9b, 9’) along the axis X,
     - an inlet conduit (15a, 15b, 15’) in fluid communication with the cavity (9a, 9b, 9’) through the inlet aperture (13a, 13b, 13’),
     - a dispensing conduit (16a, 16b, 16’) opening onto one of the upper or the lower surface (3, 2) through a dispensing aperture (17a, 17b,17’), the dispensing conduit (16a, 16b, 16’) extending from a sample outlet aperture (12a, 12b, 12’) of the cavity (9a, 9b, 9’) to the dispensing aperture (17a, 17b, 17’), the sample

outlet aperture (12a, 12b, 12’) being comprised in one of the upper ends of the cavity (9a, 9b, 9’) or the bottom (11a, 11b, 11’) of the metering chamber (10a, 10b, 10’), respectively,

wherein, for each n such that $1<n<N+1$, the inlet conduit (15b, 15’) of an nth metering circuit (8b, 8’) is in fluid communication with the excess portion outlet aperture (14a, 14’) of an (n-1)th metering circuit (8a, 8’),

wherein the inlet conduit (15a) of a first (n=1) metering circuit (8a) is in fluid communication with the well (5) and extends along the axis X and in the direction of increasing X from the inlet aperture (13a) of the first metering circuit (8a) to the well outlet aperture (7),

the fluidic circuit (4) further comprising a liquid surplus output conduit (18) opening onto the lower surface (2) through a liquid surplus output aperture (19), the liquid surplus output conduit (18) extending from the liquid surplus output aperture (19) to the excess portion outlet aperture (14b) of the Nth (n=N) metering circuit.

2. Fluidic device (1) according to claim 1, and configured such that, in response to an application of a first force field F1 along the axis X and in the direction of decreasing X:
   - the initial volume of the liquid (100) is able to pass from the well (5) to the cavity (9a) and up to the metering chamber (10a) of the first metering circuit (8a) via the inlet conduit (15a) of the first metering circuit (8a),
   - a first sample (100a) is prevented from exiting the metering chamber (10a) of the first metering circuit (8a),
   - a first excess portion (20a) of the liquid (100) received in the cavity (9a) of the first metering circuit (8a) in excess of the first sample (100a) is able to exit from the cavity (9a) of the first metering circuit (8a) through the excess portion outlet aperture (14a) of the first metering circuit (8a),
   - for each n such that $1<n<N+1$:
     - an (n-1)th excess portion (20a, 20’) of the liquid (100) is able to pass from the cavity (9a, 9’) of the (n-1)th metering circuit (8a,

8') to the cavity (9b, 9') and metering chamber (10b, 10') of the nth metering circuit (8b, 8') via the inlet conduit (15b, 15') of the nth metering circuit (8b, 8'),

  - an nth sample (100b, 100') is prevented from exiting the metering chamber (10b, 10') of the nth metering circuit (8b, 8'),
  - an nth excess portion (20b, 20') of the liquid (100) received in the cavity (9b, 9') of the nth metering circuit (8b, 8') in excess of the nth sample (100b, 100') is able to exit from the cavity (9b, 9') of the nth metering circuit (8b, 8') through the excess portion outlet aperture (14b, 14') of the nth metering circuit (8b, 8'),

- the Nth (n=N) excess portion (20b) of the liquid (100) is able to exit from the cavity (9b) of the Nth metering circuit (8b) and from the fluidic circuit (4) through the liquid surplus output conduit (18).

3. Fluidic device (1) according to claim 1 or 2, for dispensing the plurality of samples (100a, 100b, 100'), wherein the dispensing conduit (16a, 16b, 16') of each metering circuit (8a, 8b, 8'):
   - opens onto the upper surface (3) through a dispensing aperture (17a, 17b, 17'), and
   - extends along the axis X and in the direction of increasing X from the sample outlet aperture (12a, 12b, 12') comprised in the upper end of the cavity (9a, 9b) to the dispensing aperture (17a, 17b, 17'),

   wherein the fluidic device (1) is configured such that, in each of the metering circuits (8a, 8b, 8'), a sample (100a, 100b, 100') is allowed to exit from the metering chamber (10a, 10b, 10') through the dispensing conduit (16a, 16b, 16') and up to the dispensing aperture (17a, 17b, 17') in response to an application of a second force field F2 along the axis X and in the direction of increasing X.

4. Fluidic device (1) according to claim 1 or 2, for dispensing the plurality of samples (100a, 100b, 100'), wherein the dispensing conduit (16a, 16b, 16') of each fluidic circuit (4):

- opens onto the lower surface (2) through a dispensing aperture (17a, 17b, 17'), and
- extends along the axis X and in the direction of decreasing X from the sample outlet aperture (12a, 12b, 12') comprised in the bottom (11a, 11b, 11') of the metering chamber (10a, 10b, 10') to the dispensing aperture (17a, 17b, 17'),

wherein the fluidic device (1) is configured such that, in each of the metering circuits (8a, 8b, 8'), a sample (100a, 100b, 100') is allowed to exit from the metering chamber (10a, 10b, 10') through the dispensing conduit (16a, 16b, 16') and up to the dispensing aperture (17a, 17b, 17') in response to an application of a third force field F3 along the axis X and in the direction of decreasing X.

5. Fluidic device (1) according to any of the previous claims, wherein the metering chambers (10a, 10b, 10') of the fluidic circuit (4) have a same or different volumes, the volume of each of the metering chambers (10a, 10b, 10') being preferably comprised between 1 milliliter and 1 nanoliter.

6. Fluidic device (1) according to any of the previous claims, wherein one or more of the dispensing conduits (16a, 16b, 16') and/or the liquid surplus output conduit (18) are closable such that no liquid can flow through.

7. Fluidic device (1) according to claim 6, comprising obstruction means for closing and opening one or more of the dispensing conduits (16a, 16b, 16') and/or the liquid surplus output conduit (18), the obstruction means being selected among:
   - a valve;
   - a tape;
   - a plug;
   - a dead-end openable by piercing or drilling the fluidic device;
   - a dissolvable membrane.

8. Fluidic device (1) according to any of the previous claims, wherein the fluidic device (1) comprises one or more of the fluidic circuits (4).

9. Fluidic device (1) according to claim 8 and extending along an axis Y orthogonal to the axis X, the fluidic device (1) comprising two fluidic circuits (4) having a common well (5), wherein the two fluidic circuits (4) preferably extend on opposite sides of the common well (5) along the longitudinal axis Y.

10. Fluidic device (1) according to any of the previous claims, comprising a first bar (21) having a hollowed lateral surface (22) comprising recessed portions (23) and a sealing member having a sealing lateral surface in contact with the hollowed lateral surface (22) of the first bar (21), wherein the fluidic circuit (4) is formed between the recessed portions (23) of the hollowed lateral surface (22) of the first bar (21) and the sealing lateral surface of the sealing member.

11. Fluidic device (1) according to claim 10, wherein a part of the hollowed lateral surface (22) adjacent to the recessed portions (23) is substantially planar, and a part of the sealing lateral surface in contact with said part of the hollowed lateral surface (22) is substantially planar.

12. Fluidic device (1) according to claim 10 or 11, wherein a portion of the sealing member facing one of the recessed portions (23) of the first bar (21) comprises a material transparent to electromagnetic radiations for allowing electromagnetic radiations to pass through the sealing member to reach the fluidic circuit (4).

13. Multi-well plate comprising one or more fluidic devices (1) according to any of the previous claims.

14. Multi-well plate comprising a previous fluidic device (1) according to any of claims 10 to 12, wherein the sealing member is a second bar and comprises

a hollowed lateral surface opposed to the sealing lateral surface of the second bar and comprising recessed portions, the multi-well plate comprising a third bar having a sealing lateral surface in contact with the hollowed lateral surface of the second bar, the second and third bars forming a next fluidic device (1) according to any of claims 10 to 12 wherein the fluidic circuit (4) is formed between the recessed portions of the hollowed lateral surface of the second bar and the sealing lateral surface of the third bar.

15. Multi-well plate according to the previous claim, wherein the fluidic circuits (4) of the previous and next fluidic devices are identical or different.

16. Multi-well plate according to any of claims 13 to 15 and extending along the axis X between a top surface comprising the upper surfaces (3) of the fluidic devices and a bottom surface comprising the lower surfaces (2) of the fluidic devices.

17. Multi-well plate according to any of claims 13 to 16, and configured for stacking on a second multi-well plate such that each of the dispensing apertures (17a, 17b, 17’) of the multi-well plate is facing a well of the second multi-well plate, wherein the second multi-well plate can be according to any of claims 13 to 16 or not.

18. Method for metering a plurality of samples (100a, 100b, 100’) from an initial volume of a liquid (100), comprising the steps of:
   - providing a fluidic device (1) according to any of claims 1 to 12 or a multi-well plate according to any of claims 13 to 17,
   - inserting an initial volume of a liquid (100) in the well (5) of the fluidic device (1) or multi-well plate, respectively, via the well inlet aperture (6),
   - applying a first force field F1 to the fluidic device (1) or multi-well plate, respectively, along the axis X and in the direction of decreasing X, such that:

- the initial volume of the liquid (100) passes from the well (5) to the cavity (9a) and up to the metering chamber (10a) of the first metering circuit (8a) via the inlet conduit (15a) of the first metering circuit (8a),
- a first sample (100a) is prevented from exiting the metering chamber (10a) of the first metering circuit (8a),
- a first excess portion (20a) of the liquid (100) received in the cavity (9a) of the first metering circuit (8a) in excess of the first sample (100a) exits from the cavity (9a) of the first metering circuit (8a) through the excess portion outlet aperture (14a) of the first metering circuit (8a),
- for each n such that 1<n<N+1:
    - an (n-1)th excess portion (20a, 20’) of the liquid (100) passes from the cavity (9a, 9’) of the (n-1)th metering circuit (8a, 8’) to the cavity (9b, 9’) and metering chamber (10b, 10’) of the nth metering circuit (8b, 8’) via the inlet conduit (15b, 15’) of the nth metering circuit (8b, 8’),
    - an nth sample (100b, 100’) is prevented from exiting the metering chamber (10b, 10’) of the nth metering circuit (8b, 8’),
    - an nth excess portion (20b, 20’) of the liquid (100) received in the cavity (9b, 9’) of the nth metering circuit (8b, 8’) in excess of the nth sample (100b, 100’) exits from the cavity (9b, 9’) of the nth metering circuit (8b, 8’) through the excess portion outlet aperture (14b, 14’) of the nth metering circuit (8b, 8’),
- the Nth (n=N) excess portion (20b) of the liquid (100) exits from the cavity (9b) of the Nth metering circuit (8b) and from the fluidic circuit (4) through the liquid surplus output conduit (18).

19. Method according to claim 18, comprising the steps of:

- positioning the fluidic device (1) or multi-well plate, respectively, in a first position in a centrifuge machine,
- setting a rotating speed of the centrifuge machine such that the first force field F1 is applied to the fluidic device (1) or multi-well plate, respectively, along the axis X and in the direction of decreasing X.

20. Method according to claim 18 or 19, for metering and dispensing a plurality of samples (100a, 100b, 100') from an initial volume of a liquid (100), wherein the fluidic device (1) or multi-well plate depends at least on claim 3, the method comprising the steps of:
    - applying a second force field F2 to the fluidic device (1) or multi-well plate, respectively, along the axis X and in the direction of increasing X such that in each of the metering circuits (8a, 8b, 8') the metered sample (100a, 100b, 100') exits from the metering chamber (10a, 10b, 10') and the cavity (9a, 9b, 9') up to the dispensing aperture (17a, 17b, 17') through the dispensing conduit (16a, 16b, 16').

21. Method according to claim 20 when depending on claim 19, comprising the steps of:
    - flipping the fluidic device (1) or multi-well plate, respectively, upside-down from the first position to a second position in the centrifuge machine,
    - setting a rotating speed of the centrifuge machine such that the second force field F2 is applied to the fluidic device (1) or multi-well plate, respectively, along the axis X and in the direction of increasing X.

22. Method according to claim 20 or 21 wherein the multi-well plate depends at least on claim 17, and comprising the step of:
    - stacking the multi-well plate according to any of claims 13 to 16 on a second multi-well plate such that:
        - each of the dispensing apertures (17a, 17b, 17') of the multi-well plate is facing a well of the second multi-well plate, and

- the metered samples (100a, 100b, 100’) exiting from the dispensing conduit (16a, 16b, 16’) via the dispensing aperture (17a, 17b, 17’) are received in one of the wells of the second multi-well plate upon application of the second force field F2.

23. Method according to claim 18 or 19, for metering and dispensing a plurality of samples (100a, 100b, 100’) from an initial volume of a liquid (100), wherein the fluidic device (1) or multi-well plate depends at least on claim 4, the method comprising the step of:
    - o applying a third force field F3 to the fluidic device (1) or multi-well plate, respectively, along the axis X and in the direction of decreasing X such that in each of the metering circuits (8a, 8b, 8’) the metered sample (100a, 100b, 100’) exits from the metering chamber (10a, 10b, 10’) up to the dispensing aperture (17a, 17b, 17’) through the dispensing conduit (16a, 16b, 16’).

24. Method according to claim 23 wherein the multi-well plate depends at least on claim 17, and comprising the step of:
    - o stacking the multi-well plate according to any of claims 13 to 16 on a second multi-well plate such that:
        - each of the dispensing apertures (17a, 17b, 17’) of the multi-well plate is facing a well of the second multi-well plate, and
        - the metered samples (100a, 100b, 100’) exiting from the dispensing conduit (16a, 16b, 16’) via the dispensing aperture (17a, 17b, 17’) are received in one of the wells of the second multi-well plate upon application of the third force field F3.

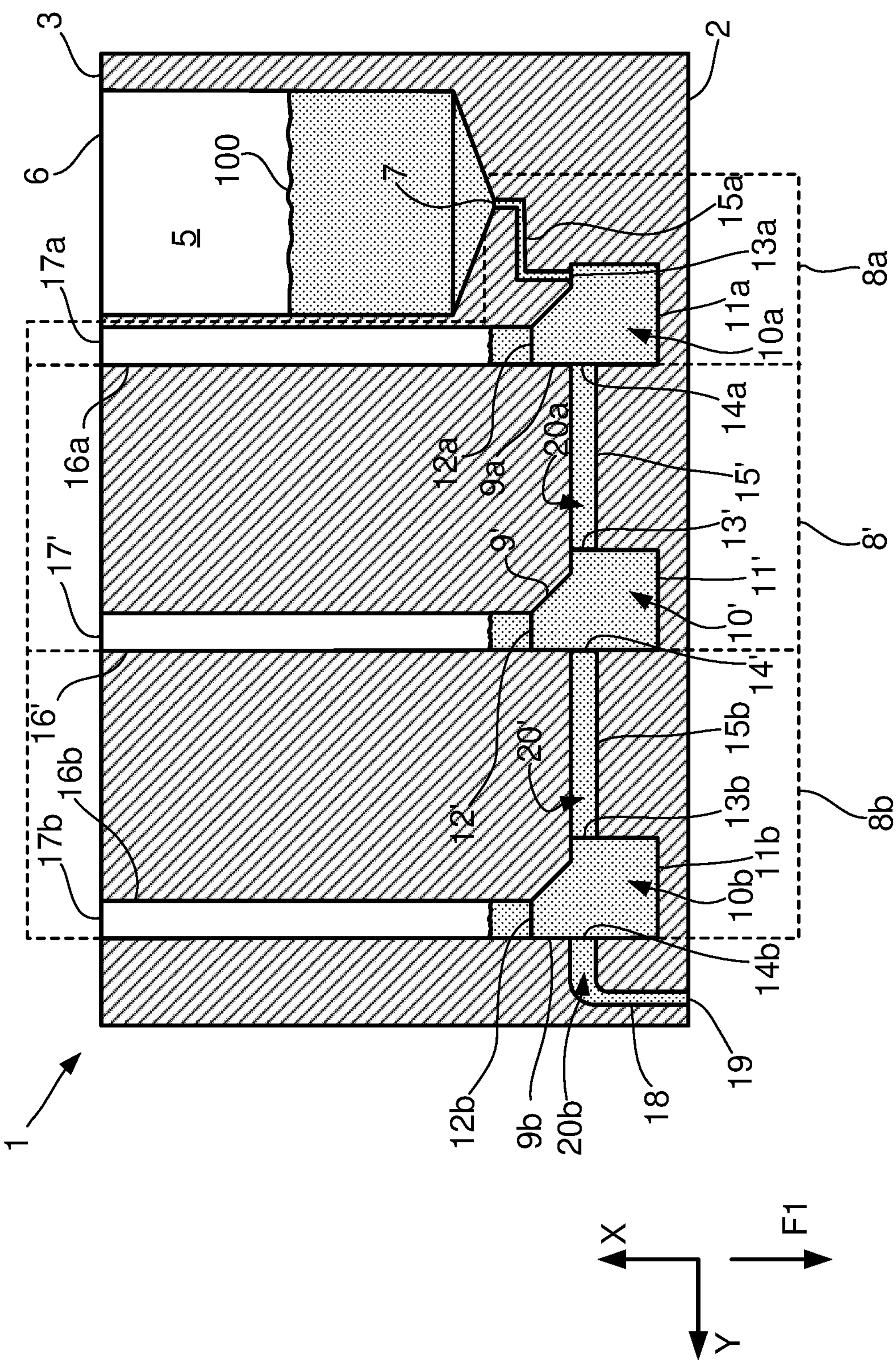
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Fig. 1

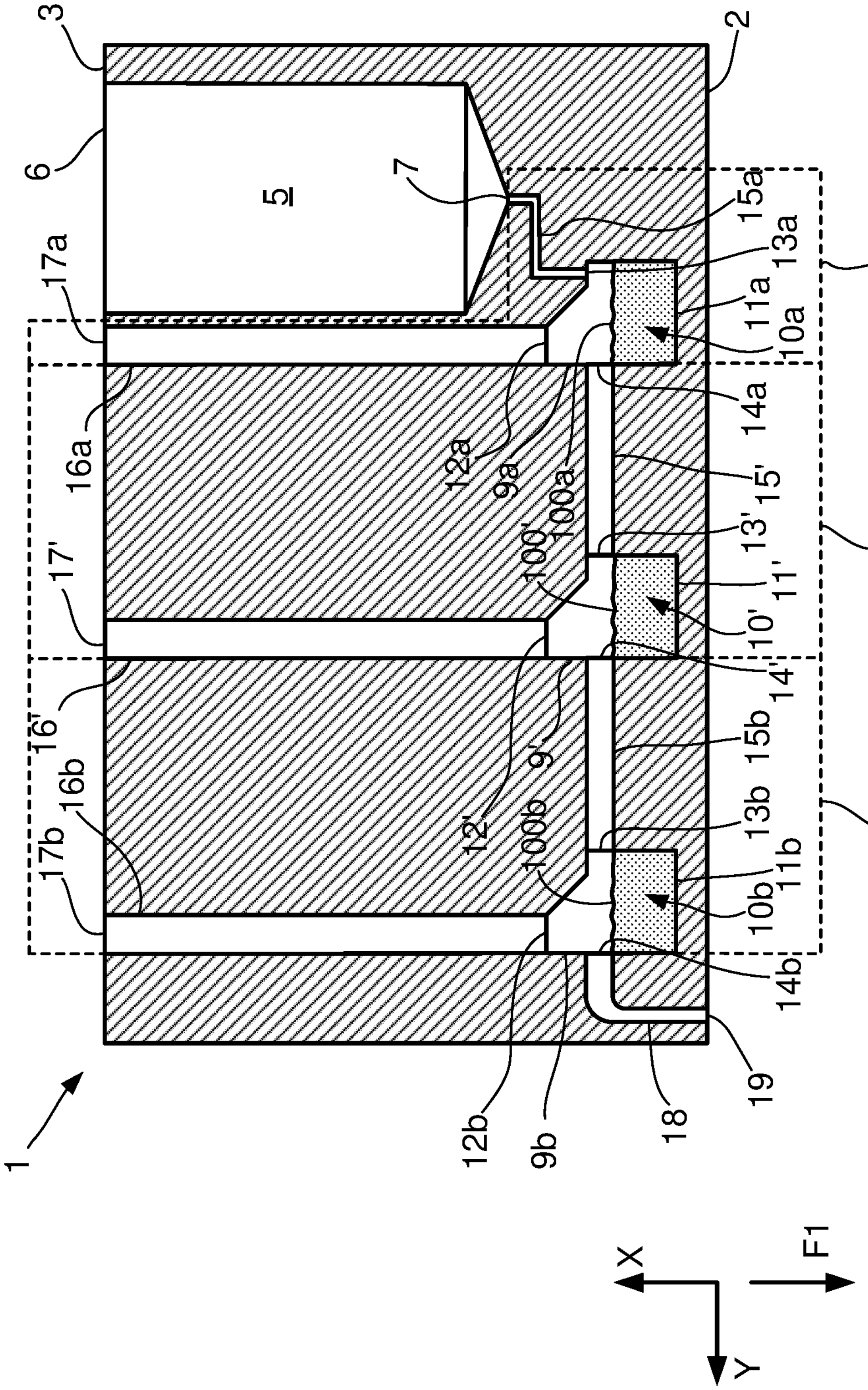
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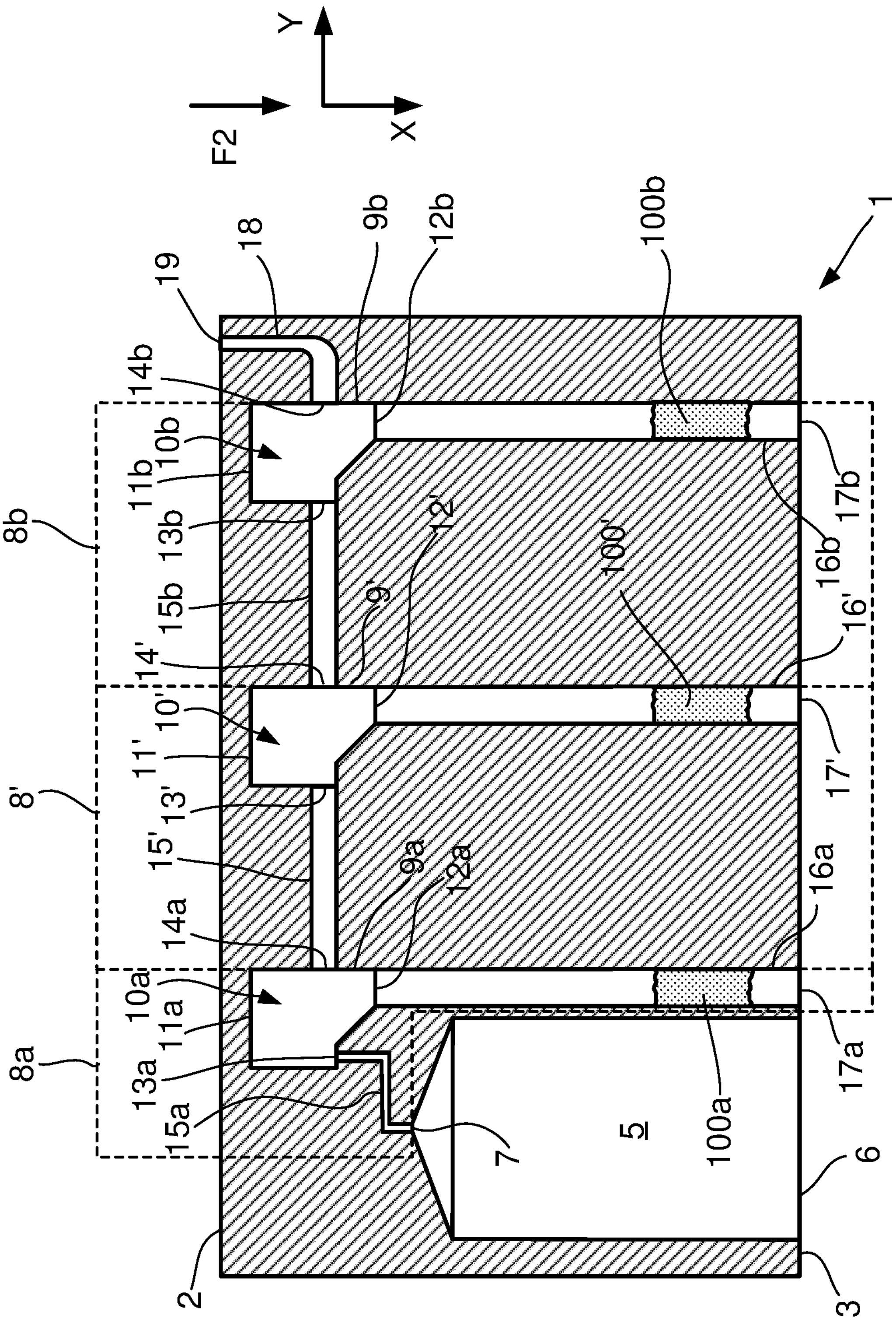
Fig. 2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17'
17b
18
19
100a
100'
100b

Fig. 3

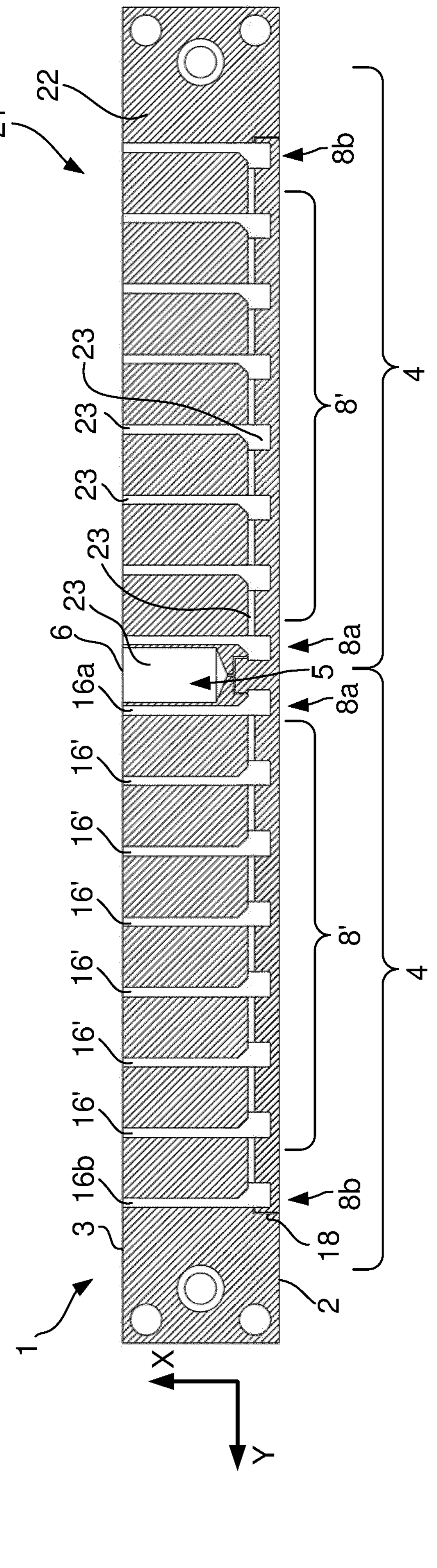

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/054645

A. CLASSIFICATION OF SUBJECT MATTER
INV. B01L3/02 B01L3/00 G01N35/10
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B01L

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2006/228734 A1 (VANN CHARLES S [US] ET AL) 12 October 2006 (2006-10-12) abstract paragraphs [0040] - [0046], [0070] - [0073]; figures 1,11,12z -----	1-24
A	US 2022/288585 A1 (REITER GOTTFRIED [AT] ET AL) 15 September 2022 (2022-09-15) the whole document -----	1-24
A	US 2023/256447 A1 (ROSEN MICHA [IL] ET AL) 17 August 2023 (2023-08-17) the whole document -----	1-24

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 September 2024	24/09/2024

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

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2024/054645

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006228734 A1	12-10-2006	EP 1868723 A2	26-12-2007
		JP 2008532016 A	14-08-2008
		US 2006228734 A1	12-10-2006
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		EP 4182701 A1	24-05-2023
		US 2023256447 A1	17-08-2023
		WO 2022013875 A1	20-01-2022