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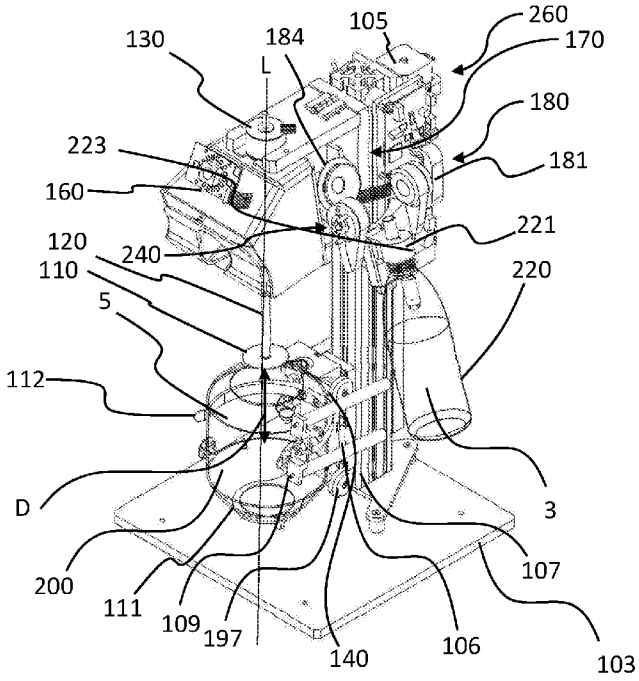

Fig. 1

(57) Abstract: A contrast agent mixer, a contrast agent mixing system and a liquid container are presented. The contrast agent mixer (100) comprises a holding arrangement (109) for supporting a mixing container (200), a mixer blade (110) for mixing a contrast agent (5) with a liquid (3) in the mixing container (200) and a controller (160) configured to control the operation of the contrast agent mixer (100). The contrast agent mixer (100) further comprises a liquid container fixture (180) adapted to receive and releasably hold a liquid container (220) adapted to store the liquid (3) and dispense the liquid (3) to the mixing container (200).

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CONTRAST AGENT MIXING SYSTEM WITH LIQUID DISPENSING

TECHNICAL FIELD

The present invention relates to mixer and more precisely to a contrast agent mixer suitable for providing a per-oral negative contrast agent foam and an associated system and liquid container for dispensing liquid to a mixing container of a contrast agent mixer.

BACKGROUND

Computerized tomography (CT) is a diagnostic imaging technique that creates detailed images of a body, e.g. a human body, with its interior by combining series of X-ray captions that create cross-sectional images or slices of parenchymal organs, muscles, fat tissue, bones, vessels, lymph nodules, etc. in health and disease. Today CT is a frequently used tool due to its lower cost and notably faster examinations compared to other tomography techniques such as magnetic resonance tomography, and also due to its higher availability worldwide. In addition to its common use in diagnosing cancer, CT is widely used to facilitate diagnosing a variety of other diseases and disorders, such as inflammatory diseases, trauma, anomalies, etc.

In CT of the abdomen (CT-abd), contrast agents are used for demarcating structures by increasing differences in density between tissue compartments. The enhanced difference in contrast improves visualization of details necessary for the radiologist to detect and follow abnormalities within the abdomen and pelvis over time and thus, with a possible medical diagnosis. The radiodensity of structures and/or materials is measured in Hounsfield Units (HU). The abdominal organs and structures are displayed in a variety of colors in the grey scale depending on the radiodensity of their composition, from white (such as bones; around +1000 HU), to light grey (such as blood vessels; around +70 HU), and black (such as air in the lungs; around -1000 HU).

A patient routinely referred to CT-abd is usually prepared with a per-oral agent for demarcating the gastro-intestinal tract. Up until now, the most commonly used demarcating agent has been a diluted solution of an iodine contrast medium meant for

intra-venous application, resulting in a white bowel content, i.e. with positive HU. Other agents are iso-osmotic solutions that provide densities of around 10 HU, exhibiting bowel lumen in grey, close to the color of other body structures. Thus, positive oral filling agents provide no or unsatisfactory contrast between the bowel wall and the lumen of the small intestine on CT images. As a consequence, images of the bowel wall are less easy to read which may result in radiological diagnoses of reduced quality, including both false positive and negative diagnoses. Consequently, a negative, "black" filling, contrast agent, with notably larger contrast against the mucosal lining and of the gut wall, was introduced in EP 3589331 thereby creating an opportunity for improved medical evaluation.

The contrast agent introduced in EP 3589331 is a fluid, aqueous foam of microbubbles. The contrast agent is reconstituted manually using a kitchen immersion blender with or without a magnetic stirrer, from a contrast powder and a liquid to a completely homogeneous foam. The foam is whipped until the foam is homogenous and with no visible bubbles. In case visible bubbles are detected by bear eye at the surface of the foam, the bubbles are removed with a spoon or with a suction device such as a Pasteur pipette. If too many bubbles that may not be removed are present at the surface and/or in the bulk, the foam will have to be discarded or re-whipped increasing the preparation time and the cost of the product.

The process of producing a contrast agent foam is sensitive. Excess air will cause an increase in overrun and consequently produce a thicker foam, as well as the formation of big bubbles giving a non-homogenous and high polydispersity foam. Such a foam would negatively interfere with the quality of the x-ray images. The foam should not comprise any clearly visible bubbles among the microbubbles that the foam is made up of.

Mixers for addressing some of the drawbacks of previous solutions and achieving a contrast agent foam are disclosed in Swedish patent application no. 2151200-9 and 2151163-9. Such mixers rely on the user pouring liquid into a liquid container which in turn needs to be routinely filled by a user or alternatively via a pipe connected to a water supply. This is associated with a risk for spilling which is disadvantageous from a hygienic perspective. Furthermore, the mixers of said Swedish

patent applications no. 2151200-9 and 2151163-9 requires use of valves making the mixer more complex and more difficult to keep clean.

Thus, from the above it is understood that there is room for improvements.

SUMMARY

An object of the present invention is to provide a new type of mixer and mixing system which are improved over prior art and which addresses or at least mitigates the drawbacks discussed above. More specifically, an object of the invention is to provide a contrast agent mixer and contrast agent mixing system suitable for providing a per-oral negative contrast agent foam for e.g., abdominal computed tomography. These objects are addressed by the technique set forth in the appended independent claims with preferred embodiments defined in the dependent claims related thereto.

In a first aspect, a contrast agent mixer is provided. The contrast agent mixer comprises a supporting body. The contrast agent mixer further comprises a holding arrangement for supporting a mixing container. The holding arrangement is connected to the supporting body. The contrast agent mixer comprises a mixer blade for mixing a contrast agent with a liquid in the mixing container. The contrast agent mixer comprises a controller configured to control the operation of the contrast agent mixer.

The contrast agent mixer further comprises a liquid container fixture adapted to receive and releasably hold a liquid container adapted to store the liquid and dispense the liquid to the mixing container.

The liquid container fixture allows for easy dismounting of the liquid container such that the liquid container may be filled with liquid or be cleaned at another location. Compared to previously known mixers, a contrast agent mixer which is less susceptible to splashing and spilling and easier to keep clean is thereby achieved.

The liquid container fixture may comprise a movable fixture arm. The movable fixture arm may be adapted to be fixed relatively the liquid container when the liquid container is held by the liquid container fixture such that movement of the movable fixture arm causes tilting of the liquid container to control the dispensing of the liquid to the mixing container. This allows for dispensing of the liquid without requiring complex

moving or driving parts for forcing liquid from the liquid container to the mixing container. Furthermore, compared to having a solution involving valves and pumps etc., the mixer is easier to clean and keep clean.

The movable fixture arm may be detachably connected to the supporting body. Thereby, the movable fixture arm may be detached from the supporting body for cleaning allowing for a contrast agent mixer that is easier to keep clean.

The supporting body may comprise a removable liquid container fixture mount. The liquid container fixture is mounted to the liquid container fixture mount such that it may be detached together with said removable liquid container fixture mount. Thereby, also the connecting parts such as bearings, pivot connections etc. may be cleaned in one operation, whereby a mixer which is easier to keep clean is achieved.

The movable fixture arm may be pivotable such that pivoting of the movable fixture arm when the liquid container is mounted to the liquid container fixture causes tilting of the liquid container to control the dispensing of the liquid to the mixing container. Thereby, a cost-efficient and precise manner of controlling the amount of liquid dispensed into the mixing container is achieved. Furthermore, the pivotable fixture arm allows for the dispensing to be manually and/or automatically controlled in a non-complex manner.

In one embodiment, the contrast agent mixer further comprises a lid arrangement. The lid arrangement comprises a detachable lid. The lid arrangement comprises a detachable lid. The detachable lid is adapted to be mounted to the liquid container for sealing an opening of the liquid container. The lid arrangement comprises a dispensing tube. The dispensing tube extends through an aperture of the lid. The dispensing tube is arranged to extend into the interior of the liquid container when the lid is mounted to said liquid container. The dispensing tube is adapted to pass the liquid from the liquid container towards the mixing container. The dispensing tube mitigates spillage during the dispensing of liquid from the liquid container to the mixing container.

The lid arrangement may further comprise an aeration arrangement. The aeration arrangement extends through the lid. The aeration arrangement is arranged to provide air passage into the liquid container during dispensing of the liquid via the

dispensing tube. Thereby a more controlled dispensing of liquid into the mixing container is achieved due to the aeration opening preventing negative pressure or the air getting trapped inside the container and dispensing tube during dispensing.

In one embodiment, the contrast agent mixer comprises a dispenser nozzle. The dispenser nozzle is arranged to guide the liquid dispensed from the liquid container into the mixing container. The dispenser nozzle mitigates the risk for foreign objects entering into the mixer and the mixing container. The dispenser nozzle further mitigates splashing and spillage as it creates a partially sealed-off passage for the liquid to pass between the liquid container and the mixing container.

Advantageously, the dispenser nozzle is detachably mounted to the supporting body. Thereby, the dispenser nozzle may be detached from the supporting body for cleaning, making the contrast agent mixer easier to clean.

The contrast agent mixer may comprise a movable nozzle cap adapted to selectively enable access through the dispenser nozzle. The movable nozzle cap further prevents foreign objects falling through the dispenser nozzle when no dispensing takes place and the liquid container is not connected to the mixer, e.g., when the dispensing tube is absent.

The dispenser nozzle may have an inlet and an outlet. The inlet has a larger cross-section area than the outlet and is adapted to receive the liquid dispensed from the liquid container. The outlet is adapted to dispense the liquid into the mixing container. Preferably, a portion of the dispensing tube extends into the inlet of the dispenser nozzle. The design of the dispenser nozzle allows for easy insertion of the dispenser tube and prevents liquid splashing back towards the liquid container during mixing.

The inlet of the dispenser nozzle may comprise means for fitting the wide end to a corresponding aperture of a casing member.

The dispenser nozzle may be adapted to direct the liquid into the mixing container and towards the mixer blade and/or a mixer shaft onto which the mixer blade is arranged. This allows for a stream of liquid to be directly led to the mixing blade during mixing, further enhancing the speed and/or quality of the mixing operation.

In one embodiment, the contrast agent mixer may comprise a movable cover. The movable cover is adapted to selectively at least partially cover the liquid container

fixture and selectively enable access to the dispenser nozzle when the movable fixture arm is in a position not allowing for liquid to be dispensed to the mixing container from the liquid container. The movable cover prevents foreign objects to enter the dispenser nozzle and/or interacting with the liquid container fixture.

In one embodiment, the mixer blade is arranged on a mixer shaft. The mixer shaft is rotatable about a longitudinal axis of the mixer shaft by a first motor arrangement controlled by the controller.

In one embodiment, the controller is configured to control a distance between the holding arrangement and the mixer blade. The distance is altered by means of a second motor arrangement controlled by the controller.

In one embodiment, the contrast agent mixer comprises a fixture position sensor arrangement. The fixture position sensor arrangement is configured to monitor the position of the movable fixture arm. The controller is configured to control the operation of the contrast agent mixer based on sensor data obtained from the fixture position sensor arrangement. The fixture position sensor arrangement enables control of the mixer based on the position of the movable fixture arm, whereby the mixing may be controlled based on the current amount of liquid being dispensed as this is directly correlated to the position of the movable fixture arm.

In one embodiment, the movable fixture arm is operated by means of a fixture arm motor. The contrast agent mixer may further comprise a mixing position sensor arrangement configured to monitor the position of the holding arrangement and/or the mixer blade. The controller may be configured to control the operation of the movable fixture arm and the fixture arm motor based on sensor data obtained from the mixing position sensor arrangement. Thereby, the dispensing may be automatically controlled based on the relative movement and state of the mixing. It may also be envisioned that the mixer blade or the holding arrangement is moved to a certain position when a mixing operation is initiated which in turn causes the dispensing of liquid from the liquid container.

In one embodiment, one or more engaging member may each be arranged to engage the liquid container fixture at a set position corresponding at a set position corresponding to a set distance between the holding arrangement and the mixer blade,

thereby causing the movable fixture arm to move. Thereby, the dispensing may be automatically initiated or terminated by means of the second motor arrangement.

Advantageously, the one or more engaging member may be provided on a movable part. The movable part may be driven by means of the second motor arrangement.

In a second aspect, a contrast agent mixing system is provided. The contrast agent mixing system comprises a contrast agent mixer according to any of the above variants and a liquid container.

In a third aspect, a liquid container is provided. The liquid container is adapted to store liquid and dispense the liquid to a mixing container. The liquid container is further adapted to be fixated to a liquid container fixture of a contrast agent mixer for mixing the liquid with a contrast agent in the mixing container.

The liquid container arrangement further comprises a lid arrangement. The lid arrangement comprises a detachable lid. The detachable lid is adapted to be mounted to the liquid container for sealing an opening of the liquid container. The lid arrangement further comprises a dispensing tube extending through an aperture of the lid and extending into the interior of the liquid container. The dispensing tube is adapted to pass the liquid from the liquid container towards the mixing container. The detachable lid allows for a container arrangement which may utilize any type of suitable standard container without risking splashing since the features utilized for the mixing may be provided in the lid arrangement.

The lid arrangement may further comprise an aeration opening extending through the lid. The aeration opening extends through the lid. The aeration tube is arranged to provide air release from the liquid container during dispensing of the liquid via the dispensing tube. Thereby a more controlled dispensing of liquid into the mixing container is achieved due to the aeration opening preventing negative pressure or the air becoming trapped inside the container and dispensing tube during dispensing.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be described in the following; references being made to the appended diagrammatical drawings which illustrate non-limiting examples of how the inventive concept can be reduced into practice.

Fig. 1 is a perspective view of a contrast agent mixing system without the housing of the contrast agent mixer according to an embodiment of the present invention;

Fig 2 is a perspective view of a contrast agent mixing system with parts of the housing of the contrast agent mixer removed according to an embodiment of the present invention;

Fig. 3 is a perspective view of a contrast agent mixing system with parts of the housing of the contrast agent mixer removed according to an embodiment of the present invention;

Fig. 4 is a schematic cross-section view perspective view of a contrast agent mixing system according to an embodiment of the present invention;

Fig. 5 is a top perspective view of a contrast agent mixing system according to an embodiment of the present invention; and

Fig. 6 is a perspective view of a dispenser nozzle according to an embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

Hereinafter, certain embodiments will be described more fully with reference to the accompanying drawings. The invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided by way of example so that this disclosure will be thorough and complete, and will fully convey the scope of the invention, such as it is defined in the appended claims, to those skilled in the art.

The term "coupled" is defined as connected, although not necessarily directly, and not necessarily mechanically. Two or more items that are "coupled" may be integral with each other. The terms "a" and "an" are defined as one or more unless this disclosure explicitly requires otherwise. The terms "substantially," "approximately," and

"about" are defined as largely, but not necessarily wholly what is specified, as understood by a person of ordinary skill in the art. The terms "comprise" (and any form of comprise, such as "comprises" and "comprising"), "have" (and any form of have, such as "has" and "having"), "include" (and any form of include, such as "includes" and "including") and "contain" (and any form of contain, such as "contains" and "containing") are open-ended linking verbs. As a result, a method that "comprises," "has," "includes" or "contains" one or more steps possesses those one or more steps but is not limited to possessing only those one or more steps.

Systems composed of air dispersion in aqueous media provide negative density contrast values in the range of -1000 HU to 0 HU, depending on the proportion of dispersed air, and may thus be used as negative contrast agents. Such a contrast agent is usable for MRI, ultrasound and CT. As it is a food-based contrast agent, it is particularly suitable for per-oral administration and therefor for abdominal imaging. The present disclosure is applicable for providing foam type contrast agents for all of these applications, positive and negative, regardless of use. The disclosure is focused on a per-oral contrast agent foam for abdominal CT imaging but this is but one exemplary embodiment. For abdominal CT imaging, the negative density contrast values provided should preferably be in the range -300 to -800 HU corresponding to a fairly high-volume proportion of air. Further, a contrast agent for use in CT imaging should be sufficiently stable in the gastrointestinal tract to provide essentially the same CT negative density contrast values throughout the gastrointestinal tract. As recognized in the art, dispersion of air in liquids, i.e., foams, may be provided by whipping or beating an aqueous solution or dispersion, comprising a foaming agent. Typical examples of foaming agents are detergents. The type and amount of the foaming agents will affect properties of the final foam. Further, also the amount of air incorporated into the aqueous solution or dispersion will influence in the properties of the final foam. The preparation of a negative contrast agent for abdominal CT involves stirring a contrast agent 5 preferably in the form of a dry powder, further contrast agent 5 or contrast powder or powder, with a liquid to obtain a dispersion, typically using a magnetic stirrer. This dispersion is mixed, generally with a blender, to incorporate air into the dispersion thereby creating a foam that is orally administered to a patient. In order to

arrive at repeatable and comparable results from e.g., CT involving the negative contrast agent, the foam must be consistent regardless of who, where or when the foam is prepared. In addition to this, the use of dual machinery, i.e., the magnetic stirrer and the blender, is tedious, adds time and requires several manual steps in addition to requiring two separate machines to be washed, maintained and services.

Regarding the contrast agent 5, among the food-based proteins, egg white protein has been found to have exceptional functional properties on gelation and foam formation. Egg white protein, or egg albumen, is comprised by several globular proteins (ovalbumin, ovotransferin, ovomucoid, ovomucin, lysozyme, globulin, avidin). Even though ovalbumin is one of the critical proteins, the combination of different proteins contained in egg albumen is advantageous in foaming and foam stability properties. A mixture of opposed charges and the formation of intermolecular bonds improve the stabilization of food foams. The mixture may thus preferably comprise at least ovalbumin, ovomucin and ovoglobulin. In the dispersion, the surfactant, e.g., egg albumen, permits the formation of air bubbles and stabilization thereof, due to their amphiphilic nature. Albumen proteins turned out to have exceptional functional properties on foam formation and gelation and here hence preferred. However, in order to enhance the stabilization of the dispersed air bubbles, a foam stabilizer, e.g., a hydrocolloid acting as foam stabilizer, such as natural gum should be present in the liquid composition.

A repeatable preparation process of a negative oral contrast agent foam is provided by the negative oral contrast agent mixer 100 according to the present invention. The negative oral contrast agent mixer 100, or contrast agent mixer 100 or mixer 100 for short, comprises a mixer blade 110 for providing a per-oral negative contrast agent foam for abdominal computer tomography by mixing the contrast agent 5 with a liquid 3. Preferably, the contrast agent 5 is in the form of a contrast powder. Although the term “contrast powder” is used, the powder does not need to have contrast enhancing properties itself. The term “contrast powder” refers to powder used for providing a contrast agent, or in other words, a contrast agent in powder form. As further elaborated below, the contrast powder may have stabilizing properties for a

foam, wherein the air bubbles of the foam are contrast enhancing, and the contrast powder may hence be described as contrast facilitating.

Preferably, the liquid 3 is water.

Although the contrast agent mixer herein is mostly described as being intended for mixing a contrast agent for CT, it may be envisioned that the contrast agent mixer may be intended to obtain a contrast agent for other applications such as a Magnetic Resonance Imaging (MRI) contrast agent or a contrast agent for ultrasound imaging. It may further be envisioned that the mixer may be utilized for mixing other compounds with a corresponding liquid. For example, mixing a compound for ultrasound imaging with a liquid.

The contrast agent mixer 100 comprises a supporting body 260. The supporting body 260 constitutes the main body of the contrast agent mixer 100. An outer housing and/or casing elements of the mixer 100 may be mounted to the supporting body 260.

The mixer 100 further comprises a controller 160. The controller 160 is configured to control the operation of the mixer 100.

The controller 160 may be configured to control a distance, e.g., a vertical distance D (see Fig. 1) between the mixer blade 110 and a holding arrangement 109 (see Fig. 1) and a rotational speed of the mixer blade 110. The control of the distance, e.g., the vertical distance between the mixer blade 110 and the holding arrangement 109 reduces a risk that comparably large air bubbles become part of the foam and ensures that a homogenous foam is provided. The control of the rotational speed of the mixer blade 110 enables control of the amount of air incorporated in the foam. An increase in rotation speed would cause more air incorporation, and thus larger foam volume, and a decrease in rotational speed would consequently incorporate less air with a reduced foam volume as a result. In this configuration, the mixer 100 enables the forming of the negative contrast agent foam without having to first stir the dry powder 5 with the liquid 3 into a dispersion. In addition to greatly improving the quality of the foam, this significantly reduces the preparation time of the negative contrast agent foam thereby saving precious time of caretakers, hospital personnel etc.

As seen in Fig. 1, the mixing is preferably performed in a mixing container 200 which holds the contrast agent 5. The liquid 3 is contained in a liquid container 220 and

dispensed into the mixing container 200 to be mixed into the negative contrast agent foam. The contrast agent 5 may be manually added to the mixing container 200 by a user of the mixer 100 prior to starting the mixer 100, or, as will be explained in further detail in other sections of this disclosure, be automatically or semi-automatically added to the mixing container 200 by the mixer 100. The mixing container may be supported by a holding arrangement 109 that may, as will be further explained, be fixed or movable along, e.g., parallel to, the longitudinal axis of the mixer shaft L.

The mixer blade 110 is preferably arranged at one end of a mixer shaft 120 of the mixer 100. The mixer shaft 120 may be formed as an integral part of the mixer blade 110, or the mixer blade 110 may be attached to the mixer shaft by welding or a suitable attachment means such as one or more screws, pins etc. The mixer shaft 120 is rotatable about a longitudinal axis L of the mixer shaft 120 by means of a first motor arrangement 130. That is to say, the mixer blade 110 is operatively connected to a first motor comprised in the first motor arrangement 130. A rotational speed of the first motor 130 preferably determines the rotational speed of the mixer blade 110 and the rotational speed of the mixer blade 110 is preferably controlled by the controller 160 controlling the rotational speed of the first motor. The operative connection between the first motor 130 and the mixer blade 110 may comprise a transmission arrangement (not shown) in order to assist in controlling the rotational speed and/or a torque of the mixer blade 110. Accordingly, the mixer blade 110 is arranged on the mixer shaft 120 rotatable about a longitudinal axis of the mixer shaft 120 by the first motor arrangement 130 which is controlled by the controller 160.

Although the figures only depict embodiments with a single mixer blade arranged on a single mixer shaft, other embodiments may be envisioned. For example, one or more mixer blade may be arranged on the mixer shaft. Additionally or alternatively, the mixer may comprise a plurality of driven mixer shafts, whereby one or more mixer blades may be arranged on each of the mixer shafts.

As previously mentioned, the vertical distance D between the mixer blade 110 and the holding arrangement 109 is controlled by the controller 160. Preferably, the mixer further comprises a second motor arrangement 140 configured to move the mixer blade 110. Alternatively or additionally, the second motor arrangement 140 is

configured to move the holding arrangement 109 along, e.g. parallel to, the longitudinal axis L of the mixer shaft 120. Accordingly, the controller 160 may be configured to control the distance D between the holding arrangement 109 and the mixer blade 110. The distance D is altered by means of the second motor arrangement 140 controlled by the controller 160.

In one embodiment, the second motor arrangement 140 may be configured to move the mixer blade 110 along the longitudinal axis L of the mixer shaft 120 in any suitable way such that a distance D between the holding arrangement 109 and the mixer blade 110 is changed. In one further embodiment, the mixer blade 110 is moved together with the first motor arrangement 130. This may be provided by having the second motor arrangement 140 control a position of a carrier 170 of the mixer 100. The carrier 170 may in turn may be arranged to support the first motor 130 and the mixer blade 110 such that when the carrier 170 is moved, the first motor arrangement 130 and the mixer blade 110 are moved with it.

In one embodiment, the controller 160 is configured to control a second distance orthogonal to the distance D. The second distance may be horizontal distance between the holding arrangement 109 and the mixer blade 110. The second distance may be altered by means of a third motor arrangement. The third motor arrangement may be controlled by the controller 160. Hence, the third motor arrangement may be operatively connected to the controller 160.

Hence, the mixing operation may further include controlling the second distance between the mixing container 200 and the mixer blade 120. Preferably, the mixing operation includes moving the mixing container 200 and the mixer blade 120 relative each other between a first and a second horizontal distance.

The supporting body 260 may further comprise a base 103 and a column 105 attached to the base 103, preferably at a substantially perpendicular angle to the base 103. The second motor arrangement 140 may be mounted to the column 103 and provided with a motor shaft in the form of a lead screw, e.g., an acme shaft, connected to the carrier 170. As the second motor arrangement 140 is actuated, the lead screw is rotated and the carrier 170 is moved along the longitudinal axis L of the mixer shaft 120. In some embodiments, the column 105 may be provided with guide rails 107 and

the carrier 170 may be provided with mating guides such as wheels allowing it to be guided along the column 105. It is however recognized that the mating guides may be provided on the column 105 and the guide rails 107 on the carrier 170. The distance D between the mixer blade 110 and the holding arrangement 109 along the longitudinal axis L of the mixer shaft 120 is preferably controlled by the controller 160 controlling the second motor arrangement 140.

In an alternative embodiment of the mixer 100, which is depicted in Fig. 1, the holding arrangement 109 may be movable along the longitudinal axis L of the mixer shaft 120. The movement of the holding arrangement 109 may be controlled by the second motor arrangement 140 similarly to the movement of the mixer blade 110 along the longitudinal axis L, e.g., by means of rotation of the motor shaft of the second motor arrangement 140.

The holding arrangement 109 may be movable along the column 105 of the mixer such that the distance D between the holding arrangement 109 and the mixer blade 110 is variable.

The holding arrangement 109 may thus be provided on a driven member 106. The driven member 106 may be connected to the second motor arrangement 140. The driven member 106 may movably mounted to the supporting body 260, for example the column 103. The second motor arrangement 140 may be configured to drive the driven member 106 along the column 103. The driven member 106 may be movably connected to the column 103 by means of one or more guide rails 107. The guide rails 107 may be provided on the driven member 106 and mating guides which may be formed by one or more wheels 197 for engaging the one or more guide rails 107 provided on the column 103 or vice versa.

Thus, as the second motor arrangement 140 is actuated, the lead screw is rotated and the driven member 106 is moved along the longitudinal axis L of the mixer shaft 120, thereby moving holding arrangement 109 and mixing container 200.

It should be mentioned that changing the distance D between the holding arrangement 109 and the mixer blade 110 by moving the holding arrangement 109 along the longitudinal axis of the mixer shaft 120 may be beneficial as it reduces vibrations and noise. This is due to e.g., that the rotatable mixer blade 110 may be more

securely fastened in this embodiment. However, changing the distance D between the holding arrangement 109 and the mixer blade 110 by moving the mixer blade 110 along the longitudinal axis of the mixer shaft 120 may be beneficial as the second motor arrangement 140 may be reduced in size and weight and thereby reducing cost. This is due to e.g., that the holding arrangement 109 together with the mixing container 200 with liquid 3 and contrast agent 5 is, in most embodiments, heavier than the corresponding movable parts associated with the mixer blade.

The motor of the second motor arrangement 140 may be a stepper motor. The motor of the first motor arrangement 130 may be a brushless DC motor.

It should be emphasized that although both an embodiment in which the mixer blade 110 is movable along the longitudinal axis L of the mixer shaft 120, and an embodiment in which the holding arrangement 109 is movable along the longitudinal axis L of the mixer shaft 120 is described, these embodiments are not mutually exclusive. The skilled person will understand that embodiments wherein both the mixer blade 110 and the holding arrangement 109 are movable along the longitudinal axis L and that the second motor arrangement 140 may be configured with e.g. gearing and/or clutches to facilitate this mutual movement are plausible. In summary, either one of or both of the mixer blade 110 and the holding arrangement 109 may be movable along the longitudinal axis L such that the distance D between the holding arrangement 109 and the mixer blade 110 is changed. It should be mentioned that in embodiments wherein the mixer 100 does not comprise a specific holding arrangement 109, movable or stationary, the distance D between the holding arrangement 109 and the mixer blade 110 is to be interpreted as a distance between the mixer blade 110 and a surface for supporting the mixing container 200. Such a surface may be an element directly engaging the mixing container 200 or a surface of the holding arrangement on which the mixing container 200 rests.

The mixer shaft 120 may in some embodiments be connected to the first motor arrangement 130 by means of a clutch. The clutch is beneficial as it may be configured to allow simple and quick connection and disconnection of the mixer blade 110 to the mixer 100. If, for instance, the mixer blade 110 is reusable, it may be easily removed and cleaned. Additionally, if the mixer blade 110 is disposable, it may be easily

removed and replaced. It should be mentioned that the mixer blade 110 may, depending on embodiment, be interpreted as comprising also the mixer shaft 120. In one embodiment, the mixer blade 110 is a stainless-steel mixer blade 110 which is beneficial as it is easy to clean and durable. In another embodiment, the mixer blade 110 is a plastic mixer blade 110 which is beneficial as it reduces the need of cleaning.

As depicted in Fig. 1, the holding arrangement 109 may comprises a support member 111 and/or a support holder 112. Depending on whether the holding arrangement 109 is movable, the support member 111 and/or support holder 112 may be movable or stationary. In the case of the holding arrangement 109 being stationary, the holding arrangement 109 and thereby the support member 111 and/or support holder 112 may form a part of the supporting body 260.

In the depicted embodiment, the holding arrangement 109 is movably connected to the column 105. Hence, the support member 111 and the support holder 112 may be movably connected to the column 105.

The support member 111 is adapted to support the mixing container 200. Preferably, the support member 111 is adapted to support the bottom of the mixing container 200.

The support holder 112 may be adapted to at least partially wrap around the mixing container 200, thereby holding the mixing container 200. The support holder 112 may thus be in the form of a clamp element adapted to retain the mixing container 200. The support holder may be a U-shaped clamping element.

Although not depicted, it is mentioned that the mixing container 200 may comprise a removable lid. This lid is provided to reduce spill and splatter of the liquid 3 and/or the foam. The lid may be provided with an opening configured to allow the mixer blade 110 to enter the mixing container 200.

It should be mentioned that the mixing container 200 may be any vessel suitable for holding the liquid 3, the contrast agent 5 and allowing them to be mixed into a foam. The mixing container 200 may be a glass, metal or plastic container and in a preferred embodiment, the mixing container is a paper material mixing container 200.

As depicted in Fig. 2 and 3, the mixer 100 may comprise an outer housing 101. The outer housing 101 may be made from any suitable material and in one embodiment

the outer housing 101 is a plastic casing allowing the mixer 100 to, in at least some countries, be powered by main power without a need for protective ground. The outer housing 101 makes the mixer 100 esthetically pleasing, dampens sounds from the mixer 100, reduced the risk of splashes, provides protection for the mixer 100 etc. The outer housing 101 is preferably provided with an openable door, which may be opened to provide access to the mixing container 200 and the mixer blade 120.

The liquid container 180 is preferably accessible from outside the outer housing 101. The door 101' may of a different type of material than the other parts of the outer housing 101. In one embodiment, the door 101' is a transparent plastic door 101' allowing a user of the mixer 100 to see the forming of the foam 7.

In order to ensure a consistent and efficient foaming of the negative contrast agent foam, the inventors behind this disclosure has, through inventive thinking, concluded that the mixer blade 110 is preferably arranged on the mixer shaft 120 such that a blade angle is formed between a plane of the mixer blade 110 and a reference plane. Wherein the reference plane is perpendicular to the mixer shaft 120. A large blade angle will incorporate more air compared to a small blade angle and thus provide a larger foam volume assuming all other conditions are the same. Substantive research and experimenting have concluded that a blade angle a in the range of 0,5 to 5° provides an acceptable per-oral negative contrast agent foam for abdominal CT. If the blade angle a is within the range of 2 to 4°, a better contrast agent foam is provided and a blade angle at substantially 3° has been shown to be most preferable.

The mixer blade 110 may be formed in various shapes, but experimental tests and research has concluded that a homogenous mixer blade 110 provides a suitable negative contrast agent foam 7. Adding holes or cavities to the mixer blade 110 reduces the effect of the mixer blade 110 as the increased turbulence caused by the holes provides a foam that is less homogeneous and with many visible bubbles compared to a homogenous mixer blade 110. Further to this, the mixer blade 110 may be formed in a substantially circular shape; preferably with the mixer shaft 120 centered on the mixer blade 110 as this provides a balanced load and reduces the risk of vibrations when the mixer blade 110 is rotated.

The mixer blade 110 may have a diameter of between 25 and 70 mm and more preferably between 35 and 60 mm. Preferably, the mixing container 200 is substantially cylindrical. Preferably, the ratio between the diameter of the mixer blade 110 and the diameter of the container 200 may be between 0,3 and 0,5 and preferably 0,4.

The movement of the mixer blade 110 and/or the holding arrangement 109 along the longitudinal axis L will be explained in further detail. The mixer blade 110 and/or the holding arrangement 109 is preferably moved repeatedly up and down such that a vertical distance D between the mixer blade 110 and the holding arrangement 109 is shifted between an upper distance and a lower distance along the longitudinal axis L. This may be provided by the controller 160 controlling the second motor arrangement 140 to move the mixer blade 110 and/or the holding arrangement 109 up and down along the longitudinal axis L of the mixer shaft 120. At the lower distance, the mixer blade 110 is preferably located close to a bottom of the mixing container 200 but may for various reasons be distanced from the bottom of the mixing container 200. In some embodiments, at the upper distance, the mixer blade 110 is fixed at a height of approximately half the height of the mixing container 200. In other embodiments, the upper distance between the mixer blade 110 and the holding arrangement 109 is determined based on a wanted height of the negative contrast agent foam in the mixing container 200. In one embodiment, the upper distance of between the mixer blade 110 and the holding arrangement 109 is below 75 % of a wanted height of the negative contrast agent foam, preferably below 65 % of the wanted height of the negative contrast agent foam, and most preferably below 55 % of the wanted height of the negative contrast agent foam in the mixer container 200. In some embodiments, the upper distance is adapted based on a current height of the negative contrast agent foam in the mixing container 200. The upper distance may be adapted to be below 75%, preferably below 65 %, and most preferably below 55 % of the current height of the negative contrast agent foam in the mixer container 200.

The controlling of the vertical distance D between the mixer blade 110 and the holding arrangement 109 may be done with a substantially constant movement such that the vertical distance between the mixer blade 110 and the holding arrangement 109 plotted over time will describe a sawtooth curve. Alternatively, the controlling 320 of

the vertical distance D between the mixer blade 110 and the holding arrangement 109 may be done with a substantially sinusoidal movement such that the vertical distance between the mixer blade 110 and the holding arrangement 109 plotted over time will describe a sinusodial curve.

As most clearly depicted in Fig. 4 and 5, the mixing system may include means to provide for dispensing of liquid for the mixing in a hygienic and splash-free manner.

Hence, the contrast agent mixer may comprise a liquid container fixture 180. The liquid container fixture 180 is adapted to receive and releasably hold a liquid container 220. The liquid container 220 is adapted to store the liquid 3 and dispense the liquid into the mixing container 200.

The liquid container 220 may be of any suitable shape, size or form and is not limited to the bottle shape as illustrated in Fig. 4. However, it is recognized that bottles such as the one depicted in Fig. 4 are readily available for a relatively low cost and are therefore preferable.

The liquid container fixture 180 may comprise a movable fixture arm 181. The movable fixture arm is adapted to be fixed relatively the liquid container 220 when the liquid container is held by the liquid container fixture 180 such that movement of the movable fixture arm 181 causes tilting of the liquid container 220 to control the dispensing of the liquid 3 to the mixing container.

The movable fixture arm 181 may comprise a retaining part 183. The retaining part 183 is adapted to retain the liquid container 220 and/or a lid arrangement connected to the liquid container 220. The retaining part 183 may be in the form of a clamping member. The retaining part 183 is adapted to fixate the liquid container 220 relative the movable fixture arm 181, thereby allowing the movable fixture arm 181 to move the liquid container 220.

The movable fixture arm 181 may be movable between a dispensing position and a non-dispensing position. In the dispensing position, the movable fixture arm 181 is arranged to tilt the liquid container 220 such that gravity causes liquid in the liquid container 220 to flow towards an opening of liquid container 220 and towards the mixing container 200. In the non-dispensing position, the movable fixture arm 181 is arranged to tilt the liquid container 220 such that gravity causes liquid in the liquid

container 220 to be stationary inside the liquid container 220 such that no liquid can be dispensed into the mixing container 200.

Thus, the dispensing position of movable fixture arm 181 may correspond to an orientation of the liquid container 220 wherein gravity causes movement of the liquid out of the opening of the liquid container 220. Correspondingly, the non-dispensing position of the movable fixture arm 181 may correspond to an orientation of the liquid container 220 wherein gravity causes the liquid to remain in the liquid container 220 such that no liquid can be passed through the opening of the liquid container 220.

The movable fixture arm 181 may be manually or automatically operated. Preferably, the movable fixture arm 181 is manually operated, whereby the movably fixture arm 181 is arranged to return to the non-dispensing position by means of gravity and moved towards the dispensing position by means of manual operation. It may be envisioned however that a motor may be utilized to produce the aforementioned movement.

The mixer 100 may comprise one or more stop members. A stop member may be provided to engage the movable fixture arm or liquid container 220 when the movable fixture arm 181 is in the dispensing position thereby preventing movement beyond said dispensing position. Correspondingly, a stop member may be provided to engage the movable fixture arm 181 or liquid container 220 when the movable fixture arm 181 is in the non-dispensing position thereby preventing movement beyond said non-dispensing position.

The movable fixture arm 181 may be pivotable, e.g., pivotally mounted to the supporting body 260. The movable fixture arm 181 may be pivotable so that pivoting of the movable fixture arm 181 when the liquid container 220 is mounted to the liquid container fixture 180 causes tilting of the liquid container 220 to control the dispensing of the liquid 3 to the mixing container 200. The movable fixture arm may be pivotable about a horizontal axis. Hence, the movable fixture arm 181 may be pivotable between the dispensing position and the non-dispensing position.

Advantageously, the movable fixture arm 181 may be movable between 45 and 180 degrees between the dispensing position and the non-dispensing position. The non-dispensing position may correspond to the liquid container 220 having a substantially

vertical orientation (with the opening facing upwards). In one embodiment, the dispensing position may correspond to the liquid container 220 having a substantially horizontal orientation (with the opening facing the mixer).

The movably fixture arm 181 may be connected to the supporting body 260 by means of a pivot connection 182. Such a pivot connection 182 may include one or more bearings allowing for the turning of the movable fixture arm.

The movable fixture arm 181 may be detachably connected to the supporting body 260. This may be preferably achieved by the pivot connection 182 providing a releasable connection. The pivot movable fixture arm 181 may thus be connected to the pivot connection 182 by means of a threaded connection or a snap-fit connection for example.

To further ease cleaning of the mixer, a removable liquid container fixture mount 187 may be provided. Hence, the supporting body 260 may comprise the removable liquid container fixture mount 187. The liquid container fixture 180 may be mounted to the liquid container fixture mount 187 such that it may be detached together with said removable liquid container fixture mount 187. The liquid container fixture mount 187 may accordingly comprise the pivot connection 182. The liquid container fixture mount 187 may further comprise a casing part adapted to partially enclose the liquid container fixture 180. Preferably, the liquid container fixture mount 187 is detachably connected to a main member of the supporting body 260. Advantageously, the liquid container fixture mount 187 may be slidably connected to the main member of the supporting body 260.

Although not depicted it may be envisioned that the mixer 100 may comprise one or more engaging member. The one or more engaging member may be arranged to engage the liquid container fixture 180, e.g., the movable fixture arm 181 of the liquid container fixture 180, at a set position corresponding to a set distance between the holding arrangement 109 and the mixer blade 110. Thereby the engaging member causes the movable fixture arm 181 to move. Hence, the second motor arrangement may cause movement of one or more engaging member thereby pushing the movable fixture arm 181 such that the dispensing of liquid is controlled.

For example, an engaging member may be adapted to push the movable fixture arm 181 from the non-dispensing position towards the dispensing position. Additionally or alternatively, an engaging member may be adapted to push the movable fixture arm from the dispensing position towards the non-dispensing position.

Preferably, the one or more engaging member may be provided on a movable part. The movable part may be driven by means of the second motor arrangement 140. Advantageously, the one or more engaging member may be provided on the carrier 170 or the driven member 106 (depending on whether mixer blade or the holding arrangement is driven in the vertical direction).

It may also be envisioned an alternative embodiment wherein the liquid container 180 is operatively connected to a tube member arranged to guide the liquid 3 from the liquid container 180 to the mixing container 200. According to such an embodiment, a valve may be arranged to control the flow of liquid 3 from the liquid container 180 into the mixing container 200. The valve may be arranged between the liquid container 180 and the tube member. The valve may be controllable between an open and a closed position and in one embodiment, the controlling of the position of the valve is provided by the controller 160. The valve may be controllable in one or more discrete steps or continuously and step-less between the open position and the closed position. The liquid container 180 may optionally be provided with one or more sensors (not shown) configured to detect a presence of liquid 3 in the liquid container 180. It is however noted that compared to the movable fixture described above, a valve is difficult to clean. Furthermore, such a solution may be less preferable as it is associated with relatively large cost compared to the movable fixture described above.

In the depicted embodiments, the contrast agent 5 is intended to be manually inserted by a user into the mixing container 200. In alternative embodiment of the mixer 100, the mixer 100 may comprise means for dispensing the contrast agent. Hence, the mixer 100 may further comprise a contrast agent container such as a contrast powder container arranged to dispense the contrast agent 5 into the mixing container 200. In one embodiment, the contrast agent container is pivotably connected to the mixer 100 and controllable between a tilted position, at which the contrast agent 5 is dispensed into the mixing container 200, and an upright position, at which the contrast agent 5 is stayed in

the contrast agent container. The control of the contrast agent container may preferably be provided by the controller 160. The contrast agent container may also be operatively connected to a tube member (not shown) for guiding the contrast agent into the mixing container. The release of the contrast agent into the tube member may be controlled by e.g., a hinged trap-door configuration.

The support holder 112 is thus usable to hold the mixing container 200 in position during operation of the mixer 100.

The mixer 100 may comprise a movable cover 141 (most clearly shown in Fig. 2). Thus, the outer housing 101 may include the movable cover 141. The movable cover 141 is adapted to selectively at least partially cover the liquid container fixture 180 when the movable fixture arm 181 is in a position not allowing for liquid to be dispensed to the mixing container 200 from the liquid container 220. The movable cover 141 may be connected to the supporting body 260 via a hinge 142.

Upon use of the mixer 100, the movable cover 141 may be moved to a position allowing access, whereby the dispensing tube (which will be described further below) can be positioned to pass liquid into the mixing container 200.

In one embodiment, the movable fixture arm 181 may be arranged to engage the movable cover when moved in a direction enabling dispensing of liquid. Alternatively, the movable fixture arm 181 may be arranged such that the liquid container 220 when mounted to the fixture arm 181 engages the movable cover when moved in a direction enabling dispensing of liquid. Thus, the movable fixture arm 181 or the liquid container 220 may be arranged to engage the movable cover 141 upon movement of the movable fixture arm 181 from the non-dispensing position to the dispensing position.

Further referencing Fig. 4 and 5, the mixer 100 may also comprise a lid arrangement intended to be connected to the liquid container 220. Lid arrangement 240 comprises a detachable lid 241. The detachable lid 241 is adapted to be mounted to the liquid container 220 for sealing an opening of the liquid container 220. The detachable lid 241 may mounted to the liquid container 220 via for example a threaded connection or a snap connection.

In one embodiment, the detachable lid 241 is adapted to be releasably connected to the retaining part 183 of the movable fixture arm 181. The detachable lid 241 and the retaining part 183 may be releasably connected by means of a snap connection or a threaded connection.

The lid arrangement 240 further comprises a dispensing tube 242. The dispensing tube 242 extends through an aperture of the lid 241. The dispensing tube 242 is arranged to extend into the interior of the liquid container 220 when the lid 241 is mounted to the liquid container 220. The dispensing tube 242 is adapted to pass the liquid 3 from the liquid container 220 towards the mixing container 200.

Thus a first end of the dispensing tube 242, e.g. an inlet of the dispensing tube 242, is adapted to extend inside the liquid container 220 when the lid 241 is connected to the liquid container 220. A second end of the dispensing tube 242, e.g. an outlet of the dispensing tube 242, is adapted to extend towards the mixing container 200 to guide the liquid 3 towards the mixing container when the movable fixture arm 181 is in the dispensing position.

The lid arrangement 240 further comprises an aeration arrangement 243. The aeration arrangement extends through the lid 241. The aeration arrangement 243 is arranged to provide air passage into the liquid container 220 during dispensing of the liquid 3 via the dispensing tube 242. The aeration arrangement 243 may comprise an air passage adapted to enable air passage through the lid. The air passage may be provided as a hole in the lid or an opening provided on a tube extending through an aperture of the lid 241.

In one embodiment, the aeration arrangement 243 is arranged such that air may be freely pass through the air passage without any liquid reaching it when the movable fixture arm 181 is in the dispensing position.

However, in order to enable air passage regardless of the position of the liquid container, the aeration arrangement 243 may further comprise a valve. The valve may be arranged in the air passage. The valve may be adapted to allow air to pass through the air passage and preventing liquid passing through said air passage. Furthermore, the valve may be a one-way valve, such as a check valve, only allowing for air passage into the liquid container through the lid and not air passage in the opposite direction. This

results in the pressure inside and outside of the liquid container to be the same which in turn causes the liquid to flow evenly and smooth without stuttering from the liquid container towards the mixing container.

With the provision of the valve, the aeration arrangement 243 is functional regardless of the positioning and liquid level of the liquid container 220. The valve may be in the form of a mechanical valve or a membrane.

In the depicted embodiment, the air passage is formed by a tube extending from the dispensing tube 242 and through an aperture of the lid. The air passage is thus connected to (e.g. in fluid communication with) the dispensing tube 242.

To accommodate the dispensing tube 242 and allow for passage of the liquid into the mixing container 200, the mixer 100 may comprise a dispenser nozzle 184 which is depicted in further detail in Fig. 6. The dispenser nozzle 184 may be arranged to guide the liquid 3 dispensed from the liquid container 220 into the mixing container. The dispensing tube 242 may extend into the dispenser nozzle 184. The dispenser nozzle 184 is thus adapted to guide the liquid 3 from the liquid container 220 and preferably the dispenser tube 242 towards the mixing container 200.

The dispenser nozzle 184 may be detachably mounted to the supporting body 260. This may be achieved for example by means of providing an outer surface of the dispenser nozzle with threads for engaging corresponding threads in the supporting body or by means of providing the supporting body and/or the dispenser nozzle with retention features for retaining the dispenser nozzle to the supporting body. In the depicted embodiment, the dispenser nozzle 184 is provided with a retention flange 320 for this purpose. The retention flange 320 may be adapted to be detachably mounted to the supporting body by means of a snap-fit connection.

Although not depicted, the contrast agent mixer may further comprise a movable nozzle cap. The movable nozzle cap may be adapted to selectively enable access through the dispenser nozzle. For example, the movable nozzle cap may be adapted to selectively enable access for liquid 3 dispensed from the liquid container 200. Additionally, the movable nozzle cap may be adapted to selectively prevent splashing from the mixing container 200 passing through the dispenser nozzle 184 and out of the mixer.

The movable nozzle cap may be operated by means of engaging the dispensing tube 242. Hence, upon a user inserting the dispensing tube the movable nozzle cap is moved by means of engaging said dispensing tube 242 to allow passage of the dispensing tube 242 into the dispenser nozzle 184.

The movable nozzle cap may be adapted to return to a blocking position by means of gravity or a spring. Thus, upon a user pulling the dispensing tube 242 out of the dispenser nozzle 184, the movable nozzle cap may return to a position in which it blocks passage into the dispenser nozzle 184.

The movable nozzle cap may be movably connected to the dispenser nozzle directly or to the supporting body or external housing of the mixer.

As most clearly shown in Fig. 6, the dispenser nozzle 184 has an inlet 311 and an outlet 312. Preferably, the inlet 311 has a larger cross-section area than the outlet 312. The inlet 311 is adapted to receive the liquid 3 dispensed from the liquid container 220. The outlet 312 is adapted to dispense the liquid 3 into the mixing container 200. Preferably a portion of the dispensing tube 242 may extend into the inlet 311 of the dispenser nozzle 184.

The outlet 312, i.e. the outlet portion, may be arranged to extend through a splash-guard of the mixer. The outlet 312 is thus arranged to extend through an aperture provided in the splash-guard. The outlet 312, i.e. the outlet portion, may be provided with an anti-splash collar 319 adapted to abut to the splash-guard when the outlet 312 extends through the aperture of said splash-guard in order to prevent spillage and splashing.

The dispenser nozzle may be tapered in a lengthwise direction. A wide end of the nozzle 184 may be adapted to receive the liquid dispensed from the liquid container 220. A narrow end of the nozzle 184 opposite to the wide end of the nozzle relative the lengthwise direction is adapted to dispense the liquid 3 into the mixing container. Preferably, a portion of the dispensing tube 242 may extend into the wide end of the dispenser nozzle 184.

The inlet 311 may form a part of an inlet portion of the dispenser nozzle 184. The inlet portion may be substantially funnel shaped, wherein said inlet portion is

tapered in a direction extending from the inlet towards the outlet of the dispenser nozzle 184.

In one embodiment, the inlet 311, i.e., the inlet portion, may be provided with the means for fitting the inlet 311 to a corresponding aperture of a casing member. Preferably, the inlet 311, i.e. the inlet portion, is releasably connected to the corresponding aperture of the casing member by means of a snap-fit connection.

The dispenser nozzle 184 may be adapted to direct the liquid 3 into the mixing container 200 and in a direction extending substantially towards the mixer blade 110 and/or the mixer shaft 120. Hence, the dispenser nozzle may be arranged to direct a stream of liquid 3 directly towards the mixer blade 110 and/or the mixer blade 120 during operation of the mixer 100.

As depicted in Fig. 6, the outlet 312 may form a part of an outlet portion of the dispenser nozzle 184. The outlet portion may be adapted to extend at an angle relative a vertical reference axis such that the liquid 3 is directed towards the mixer blade 110 during operation of the mixer 100.

Preferably, the inlet portion extends substantially in a horizontal direction. Preferably, the outlet portion extends substantially in a vertical direction. The horizontal extension in combination with the wider cross-section of the inlet allows for easy insertion of the dispensing tube while the outlet portion provides guidance for the liquid towards the mixing container.

As earlier described, the mixer 100 may comprise the movable cover 141. The movable cover 141 is adapted to selectively at least partially cover the liquid container fixture 180 and selectively enable access to the dispenser nozzle 184 when the movable fixture arm 181 is in a position not allowing for liquid to be dispensed to the mixing container 200 from the liquid container 220. Hence, the movable cover 141 may be moved to enable or deny access to the dispenser nozzle 184 for the dispensing tube 242 when the movable fixture arm 181 is in the non-dispensing position.

The mixer 100 may be provided with a user interface 300. The user interface 300 may be controlled by the controller 160 and may be used to communicate operational data to a user of the mixer 100 and also to receive operational data from the user. In one embodiment, the user interface 190 is an illuminated button 301. When the

button 301 is pressed, the mixer 100 is started and a color of the illumination indicate the status of the mixer 100. Different illumination colors and patterns may be utilized to indicate different states and/or different requested actions from the user. Such states and actions may be, but are not limited to, an off state where the mixer 100 is unpowered, an idle state where the mixer 100 is ready to use, a state wherein the door 101' is open, a state wherein the mixing container 200 is missing, a state wherein the liquid container 180 is empty, a state wherein the powder container 181 is empty, a mixing state wherein mixing is in process, a mixing completed state etc.

The mixer 100 may be provided with one or more external interfaces. These external interfaces may be one or more of any suitable wired or wireless interfaces e.g. serial interfaces (RS232, USB etc.), parallel interface (IEEE 1284 etc.), WiFi, cellular interface (GSM, UMTS, LTE, NR etc.), Bluetooth (BLE), low power WAN (LoRa, Sigfox etc.), etc. The external interface may be configured to allow the mixer to be connected to other devices directly or via e.g. a cloud service forming part of an Internet of Things, IoT network. The mixer 100 may be configured to, preferably by means of the controller 160, to communicate with a server in order to share a current operational status, receive control commands and/or receive software or configurational updates. The current operational status may comprise one or more of a number of mixing cycles performed, any error messages, current amount of liquid in the liquid container 180, current amount of powder in the liquid container 180, any need for maintenance etc.

The data provided by the mixer 100 may be used to schedule maintenance of the mixer 100, place orders for contrast agent and/or liquid etc. The control commands received through the external interface may be service commands, start commands, stop commands etc. The control commands may be provided from a cloud service or directly to the mixer via e.g., Bluetooth. The external interface allows for remote and/or touchless control of the mixer by e.g., a mobile device.

The mixer 100 may further be provided with one or more sensors. Sensors may be provided to detect an amount of liquid 3 added to the mixing container 200, an amount of contrast agent 5 added to the mixing container 200, a status of the foaming of the negative contrast agent foam, a height of the foam in the container 200, a weight of the container 200, a level of liquid 3 in the liquid container 180, a level of contrast agent

5 in the contrast agent container, a rotational speed of the mixer blade 110, a presence of the mixer blade 110, a presence of the mixing container 200, the vertical distance D between the mixer blade 110 and the holding arrangement 109 etc. The sensors may be any type of suitable sensor 165 such as, but not limited to, switches, optical sensors, pressure sensors, ultrasonic sensors, accelerometers, current sensors, voltage detectors etc. The controller 160 is preferably operatively connected to the sensors and configured to control the operation of the mixer 100 based on data provided by the sensors.

In one embodiment, the one or more sensors may include a fixture position sensor arrangement. The fixture position sensor arrangement is operatively connected to the controller 160. The fixture position sensor arrangement may be configured to monitor the position of the movable fixture arm 181. The controller 160 may be configured to control the operation of the mixer 100 based on sensor data obtained from said position sensor arrangement. For example, if the movable fixture arm 181 is detected to be in the dispensing position, the controller 160 may initiate mixing and similarly terminate mixing if the movable fixture arm 181 is in the non-dispensing position.

In one embodiment, the one or more sensor may include a mixing position sensor arrangement. The mixing position sensor arrangement is operatively connected to the controller 160. The mixing position sensor arrangement may be configured to monitor the position of the holding arrangement 109 and/or the mixer blade 110. Such a mixing position sensor arrangement is preferably implemented together with an automatically operated movable fixture arm. Thus, according to such an embodiment, the mixer 100 may comprise a fixture arm motor configured to operate the movable fixture arm 181. The fixture arm motor may be operatively connected to the controller 160. The controller 160 may be configured to control the operation of the movable fixture arm 181 and the fixture arm motor based on sensor data obtained from the mixing position sensor arrangement. According to this embodiment, the initiating of the mixing may prompt movement of the movable fixture arm 181 to the dispensing position. The movement of the movable fixture arm 181 may be performed in response to the sensor data obtained from the mixing position sensor arrangement indicating

relative movement between the mixer blade and the holding arrangement associated with the initiation of a mixing operation.

A method for providing a per-oral negative contrast agent foam for abdominal CT will be presented.

The method may include filling the liquid container 220 with the liquid 3 and thereafter mounting the lid arrangement 240 to the opening of the liquid container 220. The lid arrangement 240 may in turn be fixated to the movable fixture arm 181.

In order to ensure that the liquid can be dispensed to the mixing container 200, the dispensing tube 242 is inserted into the dispenser nozzle 184.

The contrast agent 5 may be added to the mixing container 200 either directly by the user or via a contrast agent dispenser. The liquid may then be dispensed into the mixing container by means of movement of movable fixture arm 181 either before operation of the mixer 100 or during operation of the mixer 100.

The operation of the mixing may be performed by any suitable means configured to control a vertical distance D between a mixer blade and a holding arrangement and the rotational speed of the mixer blade, but is preferably performed by the controller 160 of the negative oral contrast agent mixer 100 as disclosed herein. The mixer blade 110 is configurable to mix the contrast agent 5 with the liquid in the mixing container 200. The mixing comprises controlling the mixer blade 110 to rotate at a wanted rotational speed. This may be provided by the controller 160 controlling the first motor arrangement 130 to rotate at the wanted rotational speed. It may further comprise accelerating, for a predetermined or configurable acceleration time period, the rotational speed mixer blade 110 until it reaches the wanted rotational speed. This is beneficial as it reduces the wear of the first motor arrangement 130 and also the risk of splashes of the liquid due to sudden changes in rotational speed of the mixer blade 110. In one embodiment, the wanted rotational speed is in the range of 6500 to 10000 rpm, preferably in the range of 8000 to 8500 rpm. It should be mentioned that the wanted rotational speed may very well be different at different stages of the mixing. In one embodiment, the rotational speed of the mixer blade 110 is lower at a start of the method 300 than at the end of the method 300.

As the dispersion will have a different viscosity compared to the negative contrast agent foam, it is beneficial to control a current of the first motor arrangement 130 when controlling the rotational speed of the mixer blade 110. This ensures a constant rotational speed of the first motor arrangement 130 regardless of the load presented to the mixer blade 110.

The method 300 further comprises controlling 320 the vertical distance D between the mixer blade 110 and the holding arrangement to repeatedly change said distance. This may be provided by the controller 160 controlling the second motor arrangement 140 to move the mixer blade 110 and/or the holding arrangement 109 up and down along the longitudinal axis L of the mixer shaft 120. The controlling of the distance D between the mixer blade 110 and the holding arrangement may be done with a substantially constant movement such that the distance D between the mixer blade 110 and the holding arrangement 109 plotted over time will describe a sawtooth curve. Alternatively, the controlling 320 of the distance D between the mixer blade 110 and the holding arrangement 109 may be done with a substantially sinusoidal movement such that the distance D between the mixer blade 110 and the holding arrangement 109 plotted over time will describe a sinusodial curve.

It should be mentioned that controlling the distance D between the mixer blade 110 and the holding arrangement 109 to repeatedly move between an upper and lower limit may be performed a predefined or configurable number of times.

In order to reduce the risk of buildup of large bubbles of air in the foam, it may be beneficial to pause the rotation of the mixer blade 110 for a period to allow any oversized bubbles to raise to a surface of the foam and collapse. This may be provided by stopping he rotation of the mixer blade 110 for a rest period.

The method 300 may, as the skilled person will understand after digesting the teachings of this disclosure, be modified to comprise reading data from any of the sensors mentioned in this disclosure. The method may comprise ensuring that liquid 3, contrast agent 5, the mixing container 200 etc. is present before initiating the mixing. The method 300 may be executed until a sensor indicate that sufficient foaming is accomplished.

According to an aspect, a contrast agent mixing system is provided. The contrast agent mixing system may comprise the contrast agent mixer 100 according to any one of the above described embodiments and a liquid container 220.

According to an aspect, a contrast agent mixing arrangement is provided. The contrast agent mixing arrangement may comprise the contrast agent mixing system and a mixing container.

According to an aspect, a liquid container arrangement is provided. The liquid container arrangement comprises a liquid container 220. The liquid container 220 is adapted to store liquid 3 and dispense the liquid 3 to the mixing container 200. The liquid container 220 is further adapted to be fixated to the liquid container fixture 180 of the contrast agent mixer 100 for mixing the liquid 3 with the contrast agent 5 in the mixing container 200. The liquid container arrangement further comprises the lid arrangement 240. The lid arrangement 240 comprises the detachable lid 241. The detachable lid 241 is adapted to be mounted to the liquid container 220 for sealing an opening of the liquid container 220. The lid arrangement 240 comprises a dispensing tube 242. The dispensing tube 242 extends through an aperture of the lid 241. The dispensing tube 242 extends into the interior of the liquid container 220. The dispensing tube 242 is adapted to pass the liquid 3 from the liquid container 220 towards the mixing container 200.

In one embodiment, the lid arrangement 240 may further comprise the aeration opening 243. The aeration opening 243 extends through the lid 241. The aeration opening 243 is arranged to provide air release from the liquid container 220 during dispensing of the liquid 3 via the dispensing tube 242.

Modifications and other variants of the described embodiments will come to mind to one skilled in the art having benefit of the teachings presented in the foregoing description and associated drawings. Therefore, it is to be understood that the embodiments are not limited to the specific example embodiments described in this disclosure and that modifications and other variants are intended to be included within the scope of this disclosure. For example, while embodiments of the invention have been described with reference to a negative oral contrast agent mixer with related methods and systems, persons skilled in the art will appreciate that the embodiments of

the invention can equivalently be applied to mixing of other agents where a homogenous and controlled foaming is desired. Furthermore, although specific terms may be employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation. Therefore, a person skilled in the art would recognize numerous variations to the described embodiments that would still fall within the scope of the appended claims. Furthermore, although individual features may be included in different claims (or embodiments), these may possibly advantageously be combined, and the inclusion of different claims (or embodiments) does not imply that a combination of features is not feasible and/or advantageous. In addition, singular references do not exclude a plurality. Finally, reference signs in the claims are provided merely as a clarifying example and should not be construed as limiting the scope of the claims in any way.

CLAIMS

1. A contrast agent mixer (100), comprising a supporting body (260), a holding arrangement (109) connected to the supporting body (260) for supporting a mixing container (200), a mixer blade (110) for mixing a contrast agent (5) with a liquid (3) in the mixing container (200) and a controller (160) configured to control the operation of the contrast agent mixer (100),

wherein the contrast agent mixer (100) further comprises a liquid container fixture (180) adapted to receive and releasably hold a liquid container (220) adapted to store the liquid (3) and dispense the liquid (3) to the mixing container (200).

2. The contrast agent mixer (100) according to claim 1, wherein the liquid container fixture (180) comprises a movable fixture arm (181) adapted to be fixed relatively the liquid container (220) when the liquid container (220) is held by the liquid container fixture (180) such that movement of the movable fixture arm (181) causes tilting of the liquid container (220) to control the dispensing of the liquid (3) to the mixing container (200).

3. The contrast agent mixer (100) according to claim 2, wherein the movable fixture arm (181) is detachably connected to the supporting body (260).

4. The contrast agent mixer (100) according to any one of the preceding claims, wherein the supporting body (260) comprises a removable liquid container fixture mount (187), wherein the liquid container fixture (180) is mounted to said liquid container fixture mount (187) such that it may be detached together with said removable liquid container fixture mount (187).

5. The contrast agent mixer (100) according to claim any one claim 2 to 4, wherein the movable fixture arm (181) is pivotable such that pivoting of the movable fixture arm (181) when the liquid container (220) is mounted to the liquid container

fixture (180) causes tilting of the liquid container (220) to control the dispensing of the liquid (3) to the mixing container (200).

6. The contrast agent mixer (100) according to any one of the preceding claims, further comprising a lid arrangement (240), the lid arrangement (240) comprising a detachable lid (241) adapted to be mounted to the liquid container (220) for sealing an opening of the liquid container (220) and a dispensing tube (242) extending through an aperture of the lid (241) and arranged to extend into the interior of the liquid container (220) when the lid (241) is mounted to said liquid container (220), wherein the dispensing tube (242) is adapted to pass the liquid (3) from the liquid container (220) towards the mixing container (200).

7. The contrast agent mixer (100) according to claim 6, wherein the lid arrangement (240) further comprises an aeration arrangement (243) extending through the lid (241) and arranged to provide air passage into the liquid container (220) during dispensing of the liquid (3) via the dispensing tube (242).

8. The contrast agent mixer (100) according to any one of the preceding claims, further comprising a dispenser nozzle (184) arranged to guide the liquid (3) dispensed from the liquid container (220) into the mixing container (200).

9. The contrast agent mixer (100) according to claim 8, wherein the dispenser nozzle (184) is detachably mounted to the supporting body (260).

10. The contrast agent mixer (100) according to any one of claim 8 or 9, further comprising a movable nozzle cap adapted to selectively enable access through the dispenser nozzle (184).

11. The contrast agent mixer (100) according to any one of claim 8 to 10, wherein the dispenser nozzle (184) has an inlet (311) and an outlet (312), wherein the inlet (311) has a larger cross-section area than the outlet (312) and is adapted to receive

the liquid (3) dispensed from the liquid container (220) and the outlet (312) is adapted to dispense the liquid (3) into the mixing container (200), preferably a portion of the dispensing tube (242) extends into the inlet (311) of the dispenser nozzle (184).

12. The contrast agent mixer (100) according to claim 11, wherein the inlet (311) of the dispenser nozzle (184) comprises means for fitting the inlet (311) to a corresponding aperture of a casing member.

13. The contrast agent mixer (100) according to any one of claim 8 to 12, wherein the dispenser nozzle (184) is adapted to direct the liquid (3) into the mixing container (200) in a direction extending substantially towards the mixer blade (110) and/or a mixer shaft (120) onto which the mixer blade (110) is arranged.

14. The contrast agent mixer (100) according to any one of claim 8 to 13, further comprising a movable cover (141) adapted to selectively at least partially cover the liquid container fixture (180) and selectively enable access to the dispenser nozzle (184) when the movable fixture arm (181) is in a position not allowing for liquid to be dispensed to the mixing container (200) from the liquid container (220).

15. The contrast agent mixer (100) according to any one of the preceding claims, wherein the mixer blade (110) is arranged on a mixer shaft (120) rotatable about a longitudinal axis of the mixer shaft (120) by a first motor arrangement (130) controlled by the controller (160).

16. The contrast agent mixer (100) according to any one of the preceding claims, wherein the controller (160) is configured to control a distance (D) between the holding arrangement (109) and the mixer blade (110), wherein the distance (D) is altered by means of a second motor arrangement (140) controlled by the controller (160).

17. The contrast agent mixer (100) according to any one of claim 2 to 16, further comprising a fixture position sensor arrangement configured to monitor the position of the movable fixture arm (181), whereby the controller (160) is configured to control the operation of the contrast agent mixer (100) based on sensor data obtained from said fixture position sensor arrangement.

18. The contrast agent mixer (100) according to any one of claim 2 to 17, wherein the movable fixture arm (181) is operated by means of a fixture arm motor and the contrast agent mixer (100) further comprises a mixing position sensor arrangement configured to monitor the position of the holding arrangement (109) and/or the mixer blade (110), whereby the controller (160) is configured to control the operation of the movable fixture arm (181) and the fixture arm motor based on sensor data obtained from the mixing positon sensor arrangement.

19. A contrast agent mixing system comprising a contrast agent mixer (100) according to any one of claim 1 to 18 and a liquid container (220).

20. A liquid container arrangement comprising a liquid container (220) adapted to store liquid (3) and dispense the liquid (3) to a mixing container (200), the liquid container (220) being further adapted to be fixated to a liquid container fixture (180) of a contrast agent mixer (100) for mixing the liquid (3) with a contrast agent (5) in the mixing container (200), the liquid container arrangement further comprising a lid arrangement (240), the lid arrangement (240) comprising a detachable lid (241) adapted to be mounted to the liquid container (220) for sealing an opening of the liquid container (220) and a dispensing tube (242) extending through an aperture of the lid (241) and extending into the interior of the liquid container (220), wherein the dispensing tube (242) is adapted to pass the liquid (3) from the liquid container (220) towards the mixing container (200).

21. The liquid container arrangement (220) according to claim 20, wherein the lid arrangement (240) further comprises an aeration arrangement (243) extending

through the lid (241) and arranged to provide air passage into the liquid container (220) during dispensing of the liquid (3) via the dispensing tube (242).

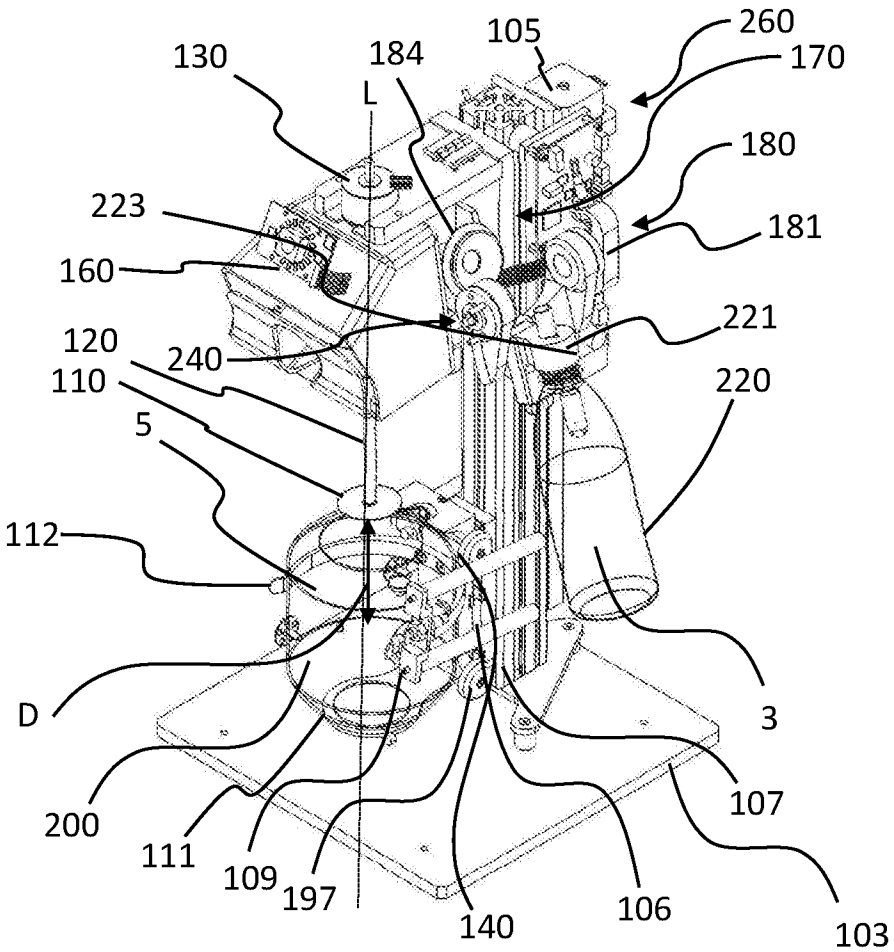
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Fig. 1

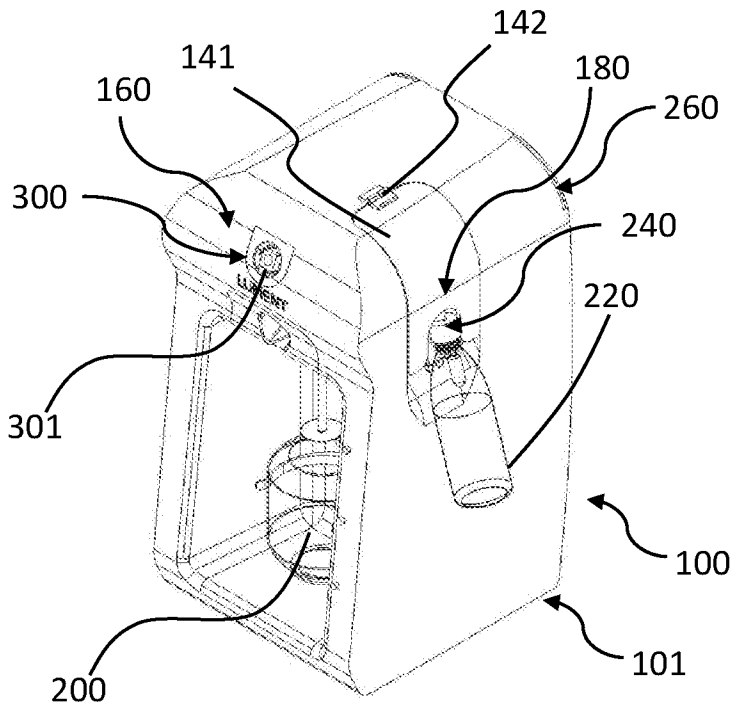
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Fig. 2

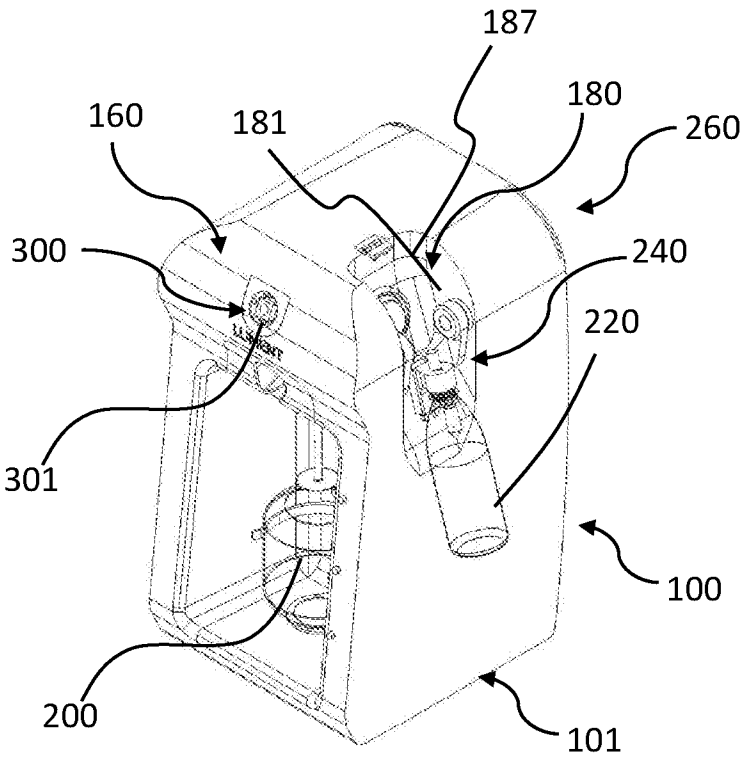

Fig. 3

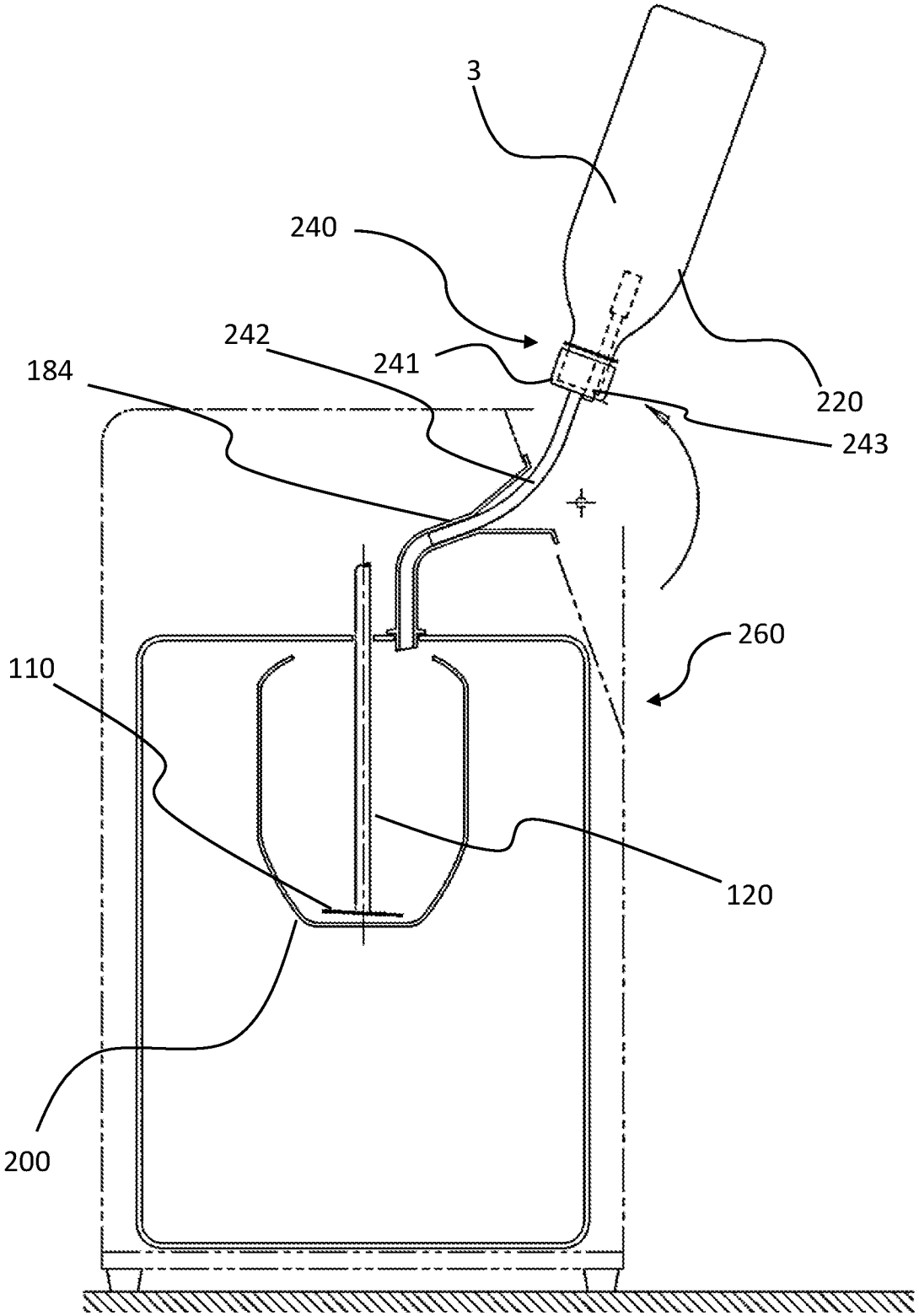

Fig. 4

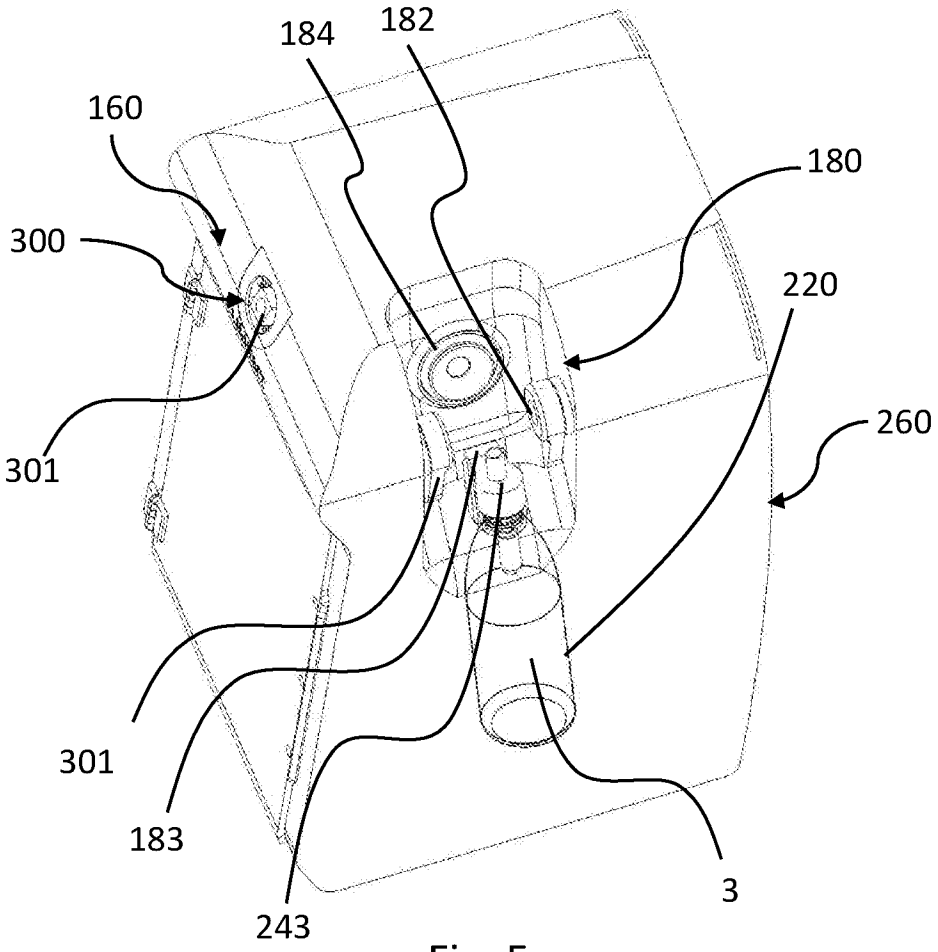

Fig. 5

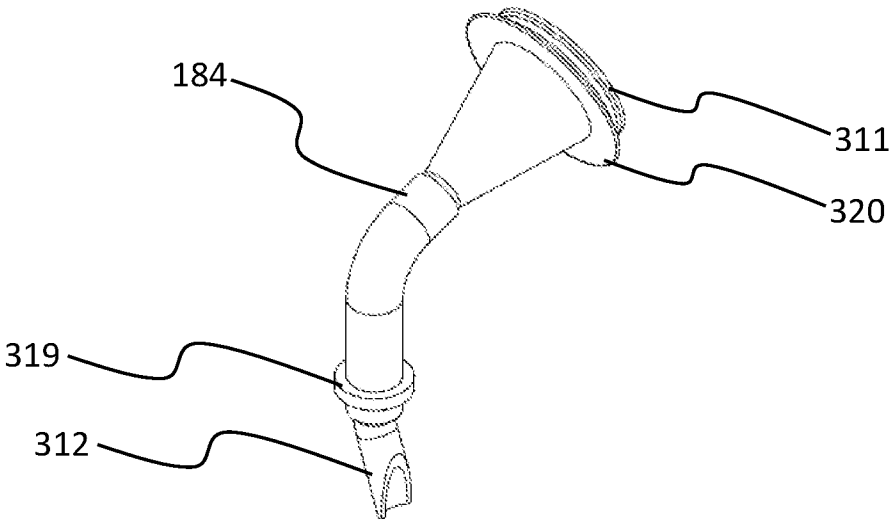

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/SE2023/050896

A. CLASSIFICATION OF SUBJECT MATTER
INV. B01F23/53 B01F27/806 B01F27/93 B01F35/71
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)
B01F

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 3 514 080 A (PRICE HOWARD ET AL) 26 May 1970 (1970-05-26) column 2, lines 60-66 column 3, line 49 - column 4, line 4 column 4, lines 26-53 figures 7,10	1,6-16, 19-21 2-5,17, 18
X	US 6 326 047 B1 (FARRELL JAMES J [US]) 4 December 2001 (2001-12-04) column 6, line 32 - column 7, line 26 figure 5	1,8,15, 16,19

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

☒ See patent family annex.

* Special categories of cited documents :

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

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

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

"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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 December 2023	08/01/2024

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	Posten, Katharina

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/SE2023/050896

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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