[0035] FIG. 4 illustrates a cross-sectional perspective view of the fluid dispensing system according to various embodiments;

[0036] FIG. 5 illustrates a bottom cross-sectional view of the fluid dispensing system according to various embodiments;

[0037] FIG. 6A illustrates a control element using gears for differential extraction of constituent fluids according to various embodiments;

[0038] FIG. 6B illustrates a control element using gears for differential extraction of constituent fluids according to various embodiments;

[0039] FIG. 7 illustrates an alternative embodiment of a fluid dispensing system according to various embodiments;

[0040] FIG. 8 illustrates another alternative embodiment of a fluid dispensing system according to various embodiments;

[0041] FIG.9 illustrates a front view of a fluid dispensing system according to various embodiments;

[0042] FIG. 10 illustrates a rear cross-sectional view of a fluid dispensing system according to various embodiments;

[0043] FIG. 11 illustrates a flowchart for dispensing a customized formulation to the user according to various embodiments;

[0044] FIG. 12A illustrates a fluid passage using an internal structure according to various embodiments;

[0045] FIG. 12B illustrates a fluid passage using another internal structure according to various embodiments;

[0046] FIG. 13 illustrates a fluid passage using an internal incongruent structure according to various embodiments; and

[0047] FIG. 14 illustrates a fluid passage using another internal incongruent structure according to various embodiments.

Detailed Description

[0048] The following detailed description refers to the accompanying drawings that show, by way of illustration, specific details and embodiments in which the invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention. Other embodiments may be utilized and structural, and logical changes may be made without departing from the scope of the invention. The various embodiments are not necessarily mutually exclusive, as some embodiments can be combined with one or more other embodiments to form new embodiments.

[0049] In the specification the term "comprising" shall be understood to have a broad meaning similar to the term "including" and will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps. This definition also applies to variations on the term "comprising" such as "comprise" and "comprises".

[0050] Relative terms such as "below" or "above" or "upper" or "lower" or "horizontal" or "vertical" or "top" or "bottom" may be used herein to describe a relationship of one element, layer or region to another element, layer or region as illustrated in the figures. It will be understood that these terms are intended to encompass different orientations of the device in addition to the orientation depicted in the figures.

[0051] The term “coupled” (or “connected”) herein may be understood as electrically coupled or as mechanically coupled, for example attached or fixed, or just in contact without any fixation, and it will be understood that both direct coupling or indirect coupling (in other words: coupling without direct contact) may be provided.

[0052] In order that the invention may be readily understood and put into practical effect, particular embodiments will now be described by way of examples and not limitations, and with reference to the figures. It will be understood that any property described herein for a specific system may also hold for any system described herein. It will be understood that any property described herein for a specific method may also hold for any method described herein. Furthermore, it will be understood that for any system or method described herein, not necessarily all the components or steps described must be enclosed in the system or method, but only some (but not all) components or steps may be enclosed.

[0053] To achieve the stated features, advantages and objects, the present disclosure provides solutions directed towards the mixing of consumer products including but not limited to shampoos, conditioners, hair masks, hair and scalp treatments, hair color, hair styling products, skin care products, color cosmetics, epoxy systems, etc., at the site of a user which may include a salon, a trichology office, retail location or at an individual’s home.

[0054] FIG. 1 shows an exemplary embodiment of a fluid dispensing system 100 for preparing and dispensing a uniformly mixed formulation. The fluid dispensing system 100 can be adapted for use as a dispenser that is ideal for dispensing a customized formulation for cosmetic, skin or hair care applications. The fluid dispensing system 100 may be used to generate a mixed formulation of a desired formula based on mixing constituent fluids combined in various proportions to generate a mixed formulation. The fluid dispensing system 100 includes a housing 101 for holding a plurality of containers 102. The fluid dispensing system 100 includes three containers 102 each of which is configured to store different constituent fluids that can be combined in various

proportions to provide a mixed formulation. In other words, the fluid dispensing system 100 is intended to store a supply of up to three different constituent fluids that can be combined in varying proportions to generate the mixed formulation. In some embodiments, the fluid dispensing system may include two containers or more than three containers. In some embodiments, it may be desirable in some applications for the constituent fluids to have same or similar viscosities for ease of mixing to achieve a uniform mixed formulation. In some embodiments, although the containers may contain different constituent fluids, it may be desirable in some applications for two or more containers to contain the same constituent fluid.

[0055] The housing 101 includes openings for partially receiving each container in the housing 101 of the dispensing system 100 so that a portion of each container 102 is visible to the user. Each container 102 is removable from the housing 101 so that a user can easily wash the containers 102 or to replace it with other containers. The housing 100 includes a dispensing mechansim (not shown) in fluid communication with the plurality of containers 102 and an outlet 104 where the mixed formulation is dispensed to the user. The housing 102 includes a plurality of control elements 103 to allow a user to preset an amount of constituent fluid for extraction from each container 102. Each control element 103 is operably engaging with a pump and a first valve in fluid communication with each container. The control element 103 is configured to allow a user to preset a desired the amount of constituent fluid to be mixed with one another to generate a mixed formulation. The housing 101 further includes a plunger 105 for dispensing the mixed formulation to the user through the outlet 104. The plunger 105 operably engages with the pumps and first valves of the containers for directing the preset amounts of constituent fluids from the containers 102 to the respective pumps.

[0056] The constituent fluids are pre-formulated and pre-packaged to achieve one or more functions or desired effects. In some embodiments, a specific constituent fluid is pre-packaged into each container 102 for mixing with other containers containing other constituent fluids and for placement in the housing 101 of the dispensing system 100. In order to achieve one or more desired effects, a shampoo may include one or more

constituent fluids for cleansing, conditioning, strengthening, scalp health. In other examples, a conditioner may include one or more constituent fluids for conditioning, hydration and damage repair. In other embodiments, the constituent fluids may include a resin system where a curing agent and a polymer are mixed together prior to application such as epoxy systems. For example, the constituent fluids may include a first predetermined amount of a curing agent in one container and a second predetermined amount of a polymer in another container. In other embodiments, the constituent fluids may include a first predetermined amount of a first epoxy resin in one container and a second predetermined amount of a second epoxy resin in another container. The combination of the first and second constituent fluids in each container react with each other to create a resulting hard product for use in several industrial and commercial applications such as work repairs, protective coating or lining applications, building and repairing of boats, runways, damaged concrete, etc.

[0057] FIG. 2 shows an exemplary rear view embodiment of a fluid dispensing system 100 for preparing and dispensing a mixed formulation. Each container 102 is in fluid communication with a pump and a first valve, details of which will be explained hereinafter, that allows a user to adjust the control element 103 for the purpose of controlling the amount of constituent fluid to be dispensed from each container 102. An intake pipe 107 located partially within the housing and partially outside the housing receives and directs the constituent fluid from each container into a pump housing operable with a pump and the plunger 105 to extract the constituent fluid from the container through the intake pipe 107 when the plunger 105 is actuated.

[0058] FIG. 3 illustrates three cylindrical containers 102a, 102b, 102c in which each container is configured to hold one or more constituent fluids to generate a mixed formulation. The containers may of any desired shape capable of holding one or more constituent fluids. In some embodiments, the container may have an opening 108 at the top end of the container 102c for replenishing the constituent fluid. A cap (not shown) may be provided on the opening 108 to ensure that the container 102c can be closed from the environment. Each container also has an opening proximal to the bottom of the

container for fluid communication with a pump and a first valve, details of which are explained hereinafter. The opening at the bottom of the container allows the constituent fluid to flow into the pump disposed within a pump housing. Each constituent fluid can be prepared by mixing a first constituent fluid and a second constituent fluid. For example, a first constituent fluid may be a functional ingredient and a second constituent fluid may be a base formulation. In some embodiments, the first constituent fluid may be a combination of a base formulation and a functional ingredient. For example, a constituent fluid for preventing hair-fall can be prepared by adding a first constituent fluid containing a functional ingredient for hair fall control into a second constituent fluid containing a base formulation. In other embodiments, for example as shown in FIG 3, container 102a may contain a first constituent fluid including a base formulation, container 102b may contain a second constituent fluid including a functional ingredient such as a hair hydration ingredient mixed into a base formulation and container 102c may contain a third constituent fluid including a functional ingredient such as a hair damage repair ingredient mixed into a base formulation. In other embodiments, container 102a may contain a first constituent fluid including a first epoxy resin, container 102b may contain a second constituent fluid including second epoxy resin, and container 102c may contain a third constituent fluid including a hardener. By mixing separate constituent fluids with one another in such a way, this helps in preparing stable constituent fluids having similar viscosities, which allows the respective constituent fluids to mix uniformly and homogeneously to generate a uniformly mixed formulation without using any heating or blending equipment. It also provides the advantage of allowing the operator of the fluid dispensing system 100 to be able to vary desired amount of constituent fluids easily to optimize the formulation of the cosmetic, hair, skin care product or epoxy systems for an individual.

[0059] FIG. 4 illustrates a cross-sectional perspective view of the fluid dispensing system 100 without the conatiners. As described previously, each container (not shown) is in fluid communication with a pump 110 and a first valve (not shown) that allows a user to adjust the control element 103 for the purpose of controlling the amount of

constituent fluid to be dispensed from each container 102. An intake pipe 107 partially located within the housing 101 receives and directs the constituent fluid from each container into the pump housing operable with a pump 110 and the plunger 105 to extract the constituent fluid from the container through the intake pipe 107 when the plunger 105 is actuated. The pump 110 may be spring-biased which allows the pump 110 to revert to its original position when the pump completes a stroke length. The pump 110 includes a stopper 115 that is movably displaced by adjustment of the control element 103. By adjusting the control element 103, the stroke length of the pump 110 within the pump 110 can be varied. The stroke length of the pump 110 corresponds to the amount of constituent fluid that can fill the pump housing with each stroke. The control element 103 allows the user to preset an amount of constituent fluid to be dispensed from each container that corresponds to the stroke length of the pump. In an exemplary embodiment of the present invention, the control element 103 includes a rotary dial or a rotary knob operably communicative with the stopper 115. To preset an amount to be extracted for each container, the user sets the amount of constituent fluid to be included in the final formulation by rotating the control element 103 to a desired volume indicator indicated on the control element 103, which in turn movably displaces the stopper 115 longitudinally within the pump 110. For example, a clockwise rotation of the control element 103 may cause the stopper 115 to move closer to one end of the pump housing which leads to a corresponding smaller volume of constituent fluid. An anti-clockwise rotation of the control element 103 may cause the stopper 115 to move closer to the opposite end of the pump housing (closer to the plunger) which leads to a corresponding larger volume of constituent fluid. The stopper 115 alters the stroke length of the pump. Since each control element is preset to a different volume indicator, the stoppers are movably displaced to either the same or different positions within the pump housing depending on the desired mix of constituent fluids, and consequently the stroke-length of each of the pumps are varied corresponding to the amount of rotation of the control element. The control element 103 includes volume indicators corresponding to the stroke length of the pump 110 which in turn dictates the amount of constituent fluids that are extracted from each container. The volume indicators provide a guide for users to rotate

the control element to the desired volume of constituent fluid to be extracted. In this way, the stroke length of the pumps are calibrated to extract the desired amount of constituent fluid from each container.

[0060] To determine the amount of constituent fluids to be extracted from each container to achieve a desired result from the mixed formulation, a user may refer to a guide for reference. Alternatively, an online algorithm may help the user to establish the amount of constituent fluids to be extracted from each container into the mixed formulation to achieve the desired result. When the control element 103 of each container 102 has been set to their corresponding volume indicators, the user first depresses the plunger 105 which causes the plunger 105 to engage with all the pumps 110 of the respective pump housings 109 and pushes the pumps 110 to the end of each of the pump housings. When the plunger 105 is released, the spring-biased pumps 110 return to their original positions and in doing so, causes the constituent fluids from each of the containers to be extracted from each container through the intake pipe 107 to the pump housing. Since the spring-biased pumps 110 are only able to return to a specific position as set by the user, the pumps 110 only extract the predetermined amounts of constituent fluids from each container. Each of the intake pipes 107 in fluid communication with the container at one end of the intake pipe 107 and with the pump housing at the opposed end of the intake pipe inclues a first valve (not shown) to prevent any constituent fluid from being pushed back into the container. In some embodiments, the first valve is a one-way valve. Once the control element of each container is predetermined, they do not have to be reset unless a user wants to revise the mixed formulation to be dispensed for their needs. Typically, in the initial setup, a user pushes a plunger 105 several times to fill each of the pump housings with constituent fluids.

[0061] FIG. 5 illustrates a bottom view of the fluid dispensing system 100. the pumps 110 are in fluid communication with a central connecting pipe system 120. The central connecting pipe system 120 includes outlet pipes 117 in connection with an outlet opening of each pump 110 and these outlet pipes 117 merge to define a mixing chamber

121 before the mixed formulation is discharged from the outlet 104. Each of the outlet pipes 117 include a second valve (not shown) to prevent the constituent fluid from being pushed back into the pump 110. When the pumps 110 are filled with constituent fluids and the user actuates the plunger 105 again, the pumps 110 are pushed to the ends of the respective pump housings. This pushes the constitent fluids into the central connecting pipe system 120. The first valve within each respective inlet pipe 107 prevents any constituent fluids from being pushed back into the containers. The central connecting pipe system 120 leads to the mixing chamber 121 where the constituent fluids mix uniformly before dispensing via the outlet 104 to the user. When the plunger 105 is released, the spring-biased pumps 110 return to their original positions and in doing so, a second valve (not shown) in each outlet pipe 117 prevents back flow of the constituent fluid from the outlet pipe 117 into the pumps 110.

[0062] FIG 6A and FIG 6B illustrate exemplary embodiments of a control element that uses gears to dispense different predetermined volumes of constituent fluids from the containers into a mixing chamber. FIG 6A shows a system 500 comprising a first container 51 having a first plunger 53 and a second container 52 having a second plunger 54. The system includes a control element comprising a first conical-shaped gear 55 and a second conical-shaped gear 56 controlling the first plunger 53 and second plunger 54 of the first container 51 and the second container 52 respectively. The control element further includes a central gear 57 operably engaging with a first intermediate gear 58 and a second intermediate gear 59. The system further includes an outlet 60 that directs the predetermined volumes of constituent fluids into the mixing chamber. The first intermediate gear 58 can be manually adjusted to dispense different volumes of constituent fluids from the first container 51. If the intermediate gear 58 is manually adjusted such that it engages the first conical-shaped gear 55 at a position closer to the top of the first conical-shaped gear, it will engage with the first conical-shaped gear 55 at the point where the diameter of the gear 55 is smaller. If the intermediate gear is manually adjusted such that it engages the first conical-shaped gear 55 at a position closer to the bottom of the conical-shaped gear 55, it will engage with the conical-shaped gear

55 at the point where the diameter of the gear is greater. In this way, adjusting the intermediate gear 58 will result in different gear ratios. The gear ratio will determine the stroke length of the pump which in turn determines how much the plunger moves down the pump housing and in turn determines how much volume is dispensed from the container.

[0063] FIG 6A illustrates the initial gear ratio where the first and second conical-shaped gears 55 and 56, the central gear 57 and the intermediate gears 58 and 59, have 45 teeth each. In this gear ratio, one rotation of the central gear 57 will cause one rotation of the intermediate gears 58 and 59, and one rotation of the first and second conical-shaped gears 55 and 56. This will cause the first and second plungers 53 and 54 to get displaced by the same distance and hence, the same volume of constituent fluids will be extracted from each of the containers. However, if the gear ratio is altered as shown in FIG 5B, different volumes of the sub-formulations will be extracted from the containers. If the number of teeth in sub-formulation gear 55 is changed to 90 and the number of teeth in second conical-shaped gear 56 is changed to 15, then one rotation of the central gear will cause one rotation each of the intermediate gears, but the first conical-shaped gear 55 will turn half rotation and the second conical-shaped gear 56 will turn three rotations. Hence the second plunger 54 will get displaced six times more than the first plunger 53, resulting in extraction of different volumes of constituent fluids in the mixing chamber.

[0064] FIG. 7 illustrates another embodiment of the fluid dispensing system for mixing and dispensing a uniformly mixed formulation. The fluid dispensing system 200 can be adapted for use as a dispenser that is ideal for dispensing a mixed formulation for cosmetic, skin or hair care applications or epoxy systems. The fluid dispensing system 200 may be used to generate a mixed formulation of a desired formula based on mixing constituent fluids combined in various proportions to generate a mixed formulation. The fluid dispensing system 200 includes a housing 201 for holding a plurality of containers 202. The fluid dispensing system 200 includes three containers 202 each of which is configured to store different constituent fluids that can be combined in various

proportions to provide a mixed formulation. In other words, the fluid dispensing system 200 is intended to store a supply of up to three different constituent fluids that can be combined in varying proportions to generate the mixed formulation. In some embodiments, the fluid dispensing system may include two containers or more than three containers. In some embodiments, it may be desirable in some applications for the constituent fluids to have similar viscosities for ease of mixing. In some embodiments, although the containers may contain different constituent fluids, it may be desirable in some applications for two or more containers to contain the same constituent fluid.

[0065] The housing 201 includes openings for partially receiving each container in the housing 201 of the dispensing system 200 so that the top of each container 202 can be inserted into the openings of the housing and the containers are transparent and visible to the user. Each container 202 is removable from the housing 201 so that a user can easily wash the containers 202 or to replace it with other containers. The housing 201 includes a dispensing mechansim (not shown) located within the housing 201 that is in fluid communication with the plurality of containers 202 and an outlet 204 where the mixed formulation is dispensed to the user. The housing 201 includes a plurality of control elements 203 to allow a user to preset an amount of constituent fluid for extraction from each container 102. Each control element 103 is partially located outside of the housing 201 and has a portion located within the housing 201 that is operably engaging with a pump and a valve in fluid communication with each container 202. The control element 203 is configured to allow a user to preset a desired the amount of constituent fluid to be mixed with one another to generate a mixed formulation. The housing 201 further includes a plunger 205 for dispensing the mixed formulation to the user through the outlet 204. The plunger 205 operably engages with the pumps and first valves of the containers simultaneously for directing the preset amounts of constituent fluids from the containers 102 to the respective pumps.

[0066] FIG. 8 illustrates another embodiment of the fluid dispensing system for mixing and dispensing a uniformly mixed formulation. As previouly described, the fluid dispensing system 300 can be adapted for use as a dispenser that is ideal for dispensing a

mixed formulation for cosmetic, skin or hair care applications or epoxy systems. The fluid dispensing system 300 may be used to generate a mixed formulation of a desired formula based on mixing constituent fluids combined in various proportions to generate a mixed formulation. While the dispensing mechanism is located on top of the containers as shown in FIG. 7, the dispensing mechanism is located behind the containers as shown in FIG. 8. The fluid dispensing system 300 includes a housing 301 for partially receiving a plurality of containers 302. In some embodiments, the housing includes openings at the top portion and bottom portion of the housing 301 that complementary receives each container so that the containers are securely fastened within the housing 301. The housing 301 includes a window that allows the containers to be visible to the user. The fluid dispensing system 300 includes three containers 302 each of which is configured to store different constituent fluids that can be combined in various proportions to provide a mixed formulation. In other words, the fluid dispensing system 200 is intended to store a supply of up to three different constituent fluids that can be combined in varying proportions to generate the mixed formulation. In some embodiments, the fluid dispensing system may include two containers or more than three containers. In some embodiments, it may be desirable in some applications for the constituent fluids to have similar viscosities for ease of mixing. In some embodiments, although the containers may contain different constituent fluids, it may be desirable in some applications for two or more containers to contain the same constituent fluid.

[0067] The housing 301 includes a dispensing mechansim (not shown) located behind the containers within the housing 301 that is in fluid communication with the plurality of containers 302 and an outlet 304 where the mixed formulation is dispensed to the user. The housing 301 includes a plurality of control elements 303 to allow a user to preset an amount of constituent fluid for extraction from each container 302. Each control element 303 is partially located outside of the housing 301 and has a portion located within the housing 301 that is operably engaging with a pump and a valve in fluid communication with each container 302. The control element 303 is configured to allow a user to preset a desired the amount of constituent fluid to be mixed with one another to generate a mixed formulation. The housing 301 further includes a plunger 305 for dispensing the mixed

formulation to the user through the outlet 304. The plunger 305 operably engages with the pumps and first valves of the containers simultaneously for directing the preset amounts of constituent fluids from the containers 302 to the respective pumps.

[0068] Each container 302 is removable from the housing 301 so that a user can easily wash the containers 302 or to replace it with other containers. Each container 302 includes an opening at the top portion of the container 302 to allow a user to refill the the container with the constituent fluids. The opening includes a cap 308 that allows a user to easily pull out the container from the opening of the housing or to open the cap so that the user can easily pour constituent fluids into the container without removing the container from the housing.

[0069] The constituent fluids are pre-formulated and pre-packaged in each container to achieve one or more functions or desired effects. In some embodiments, a specific constituent fluid is pre-packaged into each container 302 for mixing with other containers containing other constituent fluids and for placement in the housing 301 of the dispensing system 300. In order to achieve one or more desired effects, a shampoo may include one or more constituent fluids for cleansing, conditioning, strengthening, scalp health. In other examples, a conditioner may include one or more constituent fluids for conditioning, hydration and damage repair. In other embodiments, an epoxy system comprising a first predetermined amount of a first epoxy resin and a second predetermined amount of a second epoxy resin can be mixed together to form a mixed formulation. The combination of the first and second epoxy resins react with each other to create a resulting hard product for use in several industrial and commercial applications such as work repairs, protective coating or lining applications, building and repairing of boats, runways, damaged concrete, etc.

[0070] FIG. 9 illustrates a front view of the fluid dispensing system of FIG. 7. The control element 303 allows the user to preset an amount of constituent fluid to be dispensed from each container 302 that corresponds to the stroke length of the pump. In

this embodiment, the control element 303 includes a rotary dial or a rotary knob operably communicative with a pump and stopper 315 within the housing.

[0071] FIG. 10 illustrates a cross-sectional front view of the fluid dispensing system of FIG. 7 with a portion of the housing 301 removed to reveal the dispensing mechanism. To preset an amount to be extracted for each container 302, the user sets the amount of constituent fluid to be included in the mixed formulation by rotating the control element 303 to a desired volume indicator indicated on the control element 303, which in turn movably displaces the stopper 315 longitudinally within the pump 310. For example, a clockwise rotation of the control element 103 may cause the stopper 315 to move closer to one end of the pump 310 which leads to a corresponding smaller volume of constituent fluid. An anti-clockwise rotation of the control element 103 may cause the stopper 115 to move closer to the opposite end of the pump 310 (closer to the plunger 305) which leads to a corresponding larger volume of constituent fluid. Each stopper 315 alters the stroke length of the pump. Since each control element 303 is preset to a different volume indicator, the stoppers 315 are movably displaced to either the same or different positions within the pump 310 depending on the desired mix of constituent fluids, and consequently the stroke-length of each of the pumps are varied corresponding to the amount of rotation of the control element. The control element 303 includes volume indicators corresponding to the stroke length of the pump 310 which in turn dictates the amount of constituent fluids that are extracted from each container. The volume indicators provide a guide for users to rotate the control element 303 to the desired volume of constituent fluid to be extracted. In this way, the stroke length of the pumps are calibrated to extract the desired amount of constituent fluid from each container.

[0072] When the user first actuates the plunger 305, the plunger operably engages all the pumps 310 connected to the respective containers simultaneously. The plunger 305 is connected to a connecting element 309 that engages the pumps 310. When the user actuates the plunger 305, the plunger engages the connecting element 309 and pushes the pumps 310 to the bottom end of the housing 301. The pumps 310 are spring-loaded to enable the pumps to return to their original position after actuation. In some

emebodiments, one or more springs biased towards the plunger 305 may be located between the connecting element of the plunger 305 and the control element 303 in order for the pumps 310 to return to their original position after actuation. When the plunger 305 is released, the pumps 310 return to their original positions and in doing so, the suction force created causes the pre-set amount of constituent fluid to be directed from each container into the respective pumps 310. Each container has an intake pipe (not shown) in fluid communication with the pump. The intake pipe includes includes a valve (not shown) to prevent any constituent fluid from being pushed back into the container. In some embodiments, the first valve is a one-way valve. Once the control element of each container is predetermined, they do not have to be reset unless a user wants to revise the mixed formulation to be dispensed for their needs. Typically, in the initial setup, a user pushes a plunger 105 several times to fill each of the pump housings with constituent fluids.

[0073] The pre-set amount of constituent fluids from each container can vary and differ from another container or the pre-set amount of constituent fluids from each container can be the same as another container. Since the pumps are only able to return to a specific position as set by the user, the pumps only extract a certain preset amount of constituent fluid from the container. When the pumps are filled with the constituent fluids, the user actuates the plunger again to move the pumps 310 to the ends of the pump housings. so as to cause the respective predetermined amounts of constituents fluids to be directed from the respective pumps into a mixing chamber (not shown) via a central connecting pipe system (not shown) through the suction force generated. The pumps 310 are in fluid communication with the central connecting pipe system. The central connecting pipe system includes outlet pipes in connection with an outlet opening of each pump 310 and these outlet pipes 310 merge to define a mixing chamber before the mixed formulation is discharged from the outlet 304. The central connecting pipe system leads to the mixing chamber where the constituent fluids mix uniformly before dispensing via the outlet 304 to the user. The constituent fluids flow from the pumps into the mixing chamber for mixing evenly and uniformly to generate the uniform mixed formulation and dispenses the mixed formulation to the user from an outlet of the mixing chamber.

[0074] The above embodiments as shown in FIGS 1 to 10 describe a fluid dispensing system with a two step actuation, i.e., a first actuation that causes the predetermined amounts of constituent fluids to be directed from the plurality of containers into the respective pumps and a second actuation that causes the respective predetermined amounts of constituents fluids to be directed from the respective pumps into the mixing chamber to generate the mixed formulation for dispensing via an outlet of the mixing chamber. As will be appreciated by one skilled in the art, it is envisaged that other embodiments utilising a one step actuation of the plunger that operably engages the pumps and valves of the respective one or more containers simultaneously to cause the predetermined amounts of constituent fluids to be directed from the containers into a mixing chamber to generate a mixed formulation for dispensing via an outlet of the mixing chamber is possible. For example, utilising an electrical pump within the housing that is communicately connected with the plunger, containers and the pump housing containing the constituent fluid can replace the first actuation by causing the predetermined amounts of constituent fluids to be directed from the plurality of containers into the respective pumps. The electrical pump will facilitate the continuous flow of constituent fluids within the containers to the pumps for a certain period of time. In other embodiments, a one step actuation can be achieved if the pumps have a longer stroke length so that one actuation is sufficient to fill the pumps and to dispense in one step.

[0075] FIG. 11 illustrates a flowchart for preparing a customized formulation for hair and skin care applications. At step 901, a user installs one or more containers on a fluid dispensing system as previously described. Each of the one or more containers is configured to contain a constituent fluid. Each container contains a pre-formulated and pre-packed constituent fluid which may include a base formulation or a combination of a base formulation and a functional ingredient. These containers may be sold to the user or the the user may prepare the constituent fluids in each container by pouring in the constituent fluids into the container. In some embodiments, the constituent fluids have

similar viscosities so that the constituent fluids can be mixed easily without using any active mixing technique involving heating or blending equipment. The containers are part of a fluid dispensing system for on-site preparation of a uniform mixed formulation for consumer products. At step 902, the user manually adjusts a control element corresponding to each container. The control element allows the user to pre-set the amount of constituent fluid to be extracted from each container into a pump disposed witin a pump housing. Each control element is connected to a stopper that alters the stroke length of the pumps.

[0076] At step 903, the user actuates a plunger that operably engages all the pumps of the containers simultaneously and pushes the pumps to the end of the respective pump housings. When the plunger is released, the pumps return to their original positions and in doing so, causes the pre-set amount of constituent fluid to be directed from each container into the respective pumps. The pumps are spring-loaded to enable the pumps to return to their original position after actuation. The pre-set amount of constituent fluids from each container can vary and differ from another container. Since the pumps are only able to return to a specific position as set by the user, the pumps only extract a certain preset amount of constituent fluid from the container. When the pumps are filled with the constituent fluids, the user actuates the plunger again at step 904 to move the pumps to the ends of the pump housings. so as to cause the respective predetermined amounts of constituents fluids to be directed from the respective pumps into a mixing chamber to generate the mixed formulation for dispensing via an outlet of the mixing chamber. The constituent fluids flow from the pumps into the mixing chamber for mixing evenly and uniformly to generate the uniform mixed formulation and dispenses the mixed formulation to the user from an outlet of the mixing chamber.

[0077] FIGS 12A and 12B illustrate embodiments of the mixing chamber where different internal structures are utilized to bring about uniform mixing of the constituent fluids from the respective plurality of containers. The internal structure is disposed within the mixing chamber leading to the outlet. In some embodiments, the internal structure can be disposed in the fluid passage leading to the mixing chamber. In other embodiments,

the internal structure can be disposed in the fluid passage after the mixing chamber. The fluid dispensing system utilizes a passive mixing mechanism. The internal structure includes a micro channel structure spread across the diameter of the mixing chamber or the fuid passage leading to or after the mixing chamber. In some embodiments, the micro channel structure is packed densely across the diameter of the fluid passage. The constituent fluids are forced into the the micro channel structure to bring about even distribution of the constituent fluids and mix them uniformly. FIG. 12A and FIG. 12B illustrates two ways of implementing the internal structure. FIG. 12A shows a micro channel structure which includes steel wool 11 and FIG. 12B shows a micro channel structure including micro-beads 12 inserted into the fluid passage. The micro-beads may be made of steel or any other suitable material. These and other methods can be utilized for realizing a micro-channel structure that is densely packed within the fluid passage. Since fluid flow adopts the path of least resistance, under the pressure exerted by the pump, the constituent fluids will flow into the mixing chamber and some of the constituent fluids will move along the wall and will not come into contact with other constituent fluids to be mixed, eventually creating an uneven formulation. The internal structures comprising of either the steel wool or the micro-beads achieve the functions of creating densely packed micro channels as well as being able to spread widely across and be in contact with the walls of the fluid passage to break the flow of the constituent fluids along the walls of the fluid passage.

[0078] As will be appreciated by a person skilled in the art, other embodiments of a passive mixing mechanism can be achieved by altering the structure or configuration of the fluid passage. One such embodiment is illustrated in FIG 13 where the internal structure of the fluid passage is shown based on fluid being channelled into smaller cavities 13 along the fluid passage. The wall of the fluid passage is lined with an incongruent structure. In some embodiments, the incongruent structure includes an array of substantially triangular profiles with its peaks pointed towards the centre of the fluid pasage and its base attached to the wall of the fluid passage. The constituent fluids flow in the direction marked by the arrow. In some embodiments, FIG 14 illustrates the use of

membranes 14 together with the incongruent structure to achieve mixing in multiple dimensions. The membranes are disposed transversely within the fluid passage. The first arriving volume of the constituent fluids is spread across the membrane. The increase in width and the use of the membrane to spread the constituent fluids across the fluid passage allows the constituent fluids further behind in the tube to be brought into the mixing chamber to be uniformly mixed with the constituent fluids ahead in the fluid passage. The dimensions of the fluid passage or the mixing chamber can be determined based on the volume of customized formulation to be dispensed to the user.

[0079] While the invention has been particularly shown and described with reference to specific embodiments, it should be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention as defined by the appended claims. The scope of the invention is thus indicated by the appended claims and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced.