

Field of the invention

The present invention concerns a system for beverage preparation from various portioned ingredients, said system comprising a machine
5 and one or more ingredient package(s).

Background of the invention

Beverage preparation systems for portioned beverage are well
10 known in the art. They are also widely available commercially. They comprise usually a machine into which one or more ingredient containers are inserted. The machine is able to pass a fluid, typically hot water through an ingredient contained in the container, so as to produce a beverage by dissolution (from e.g. milk or chocolate soluble powders), low-pressure infusion (from e.g. leaf tea, loose coffee
15 powder), or high-pressure extraction (from e.g. roast and ground coffee in loose or compacted form). The machine comprises one fluid system with fluid-conducting pipes, a fluid-conducting pump, a fluid source (e.g. a water tank, or a direct plumbing connection valve), and a so-called brewing chamber which is adapted to accommodate said ingredient container and prepare a beverage by mixing said
20 ingredient and said fluid according to the methods described above.

In order to produce more varieties of beverages with one single system, a certain number of systems have been proposed, as follows.

US 2010/0162898 is a US patent application to Mahlich,
25 assigned to Eugster Frismag AG, and published July 1st 2010. It discloses a machine for preparing beverages and comprising a combination of a first coffee brewing unit able to adapt loose coffee powder or a portion of coffee or cocoa, together with a second docking device for plugging a multi-portion container for milk powder. Mahlich describes that multi-ingredient beverages (e.g. cappuccinos) can

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be prepared thereof, by extracting coffee in the brewing unit by passing hot water under pressure through the coffee, and then reconstituting milk from the powder that falls from the multi-portion container into a conveying track that conveys said powder into a milk frother wherein said powder is mixed with water and steam (no
5 injection of water is made directly into the milk powder container).

In this document, the machine is complex as it requires a milk powder doser and conveyor to convey the milk powder that falls from the multi-portion container by gravity, towards an additional unit wherein the milk powder is mixed to water. This requires a bulky machine (the multi-portion milk container
10 has a great volume) and its complexity (doser, conveyor, milk frother) is an additional element which make the whole machine expensive, complex to maintain, and difficult to handle for the user. Furthermore, the milk component cannot be dispensed directly to the end-user (direct flow to the cup), because the ingredient is prepared in a mixing chamber. This requires a lot of cleaning of
15 structural parts of the machine (at least the mixing chamber itself, as well as the product dispensing pipes that convey the reconstituted milk from the mixing chamber to the cup of the end-user), in order to avoid development of bacteria in such a biological medium as milk.

A similar disclosure is provided in **US 2002/0145010 A1**, a US
20 patent application to Ufheil, assigned to Nestlé and published October 10th, 2002.

EP 125215 B1 is a European patent to Tuttoespresso S.R.L., published September 7th, 1988. It describes a manually operated hot drink dispenser machine using single-use ingredient cartridges. It comprises a first
25 chamber for housing a cylindrical small-sized cartridge for percolation of a drink and a second cylindrical chamber communicating with said first chamber to form a bicylindrical chamber for housing a bicylindrical large-sized cartridge for a solution or suspension drink.

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the same brewing chamber of a beverage preparation machine. Each of these systems however, requires handling of a spare part by the user, correct selection of the adapter specifically required by each type of container, and then proper positioning of the container inside the adapter and then of the adapter inside the machine brewing chamber. Such adapters are therefore not user-friendly at all.

Yet, another beverage preparation system is disclosed commercially which is brand-named "Twìn" and available on the Swiss market since 2016. This system is manufactured by the Swiss company DELICA, and comprises a beverage preparation machine and a set of capsules of different types. The machine comprises a brewing chamber having a stationary fluid injection portion, and a removable capsule holder having two insertion slots for accommodating two capsules of different types at a time. By switching an actuator, the user is able to manually brew an ingredient from one, then the other capsule. The machine comprises in the same brewing chamber, two different kinds of injection devices, each one adapted for one type of capsules. Similar to the Tuttoespresso system described above, this machine, although providing some benefits, has the disadvantage that it offers a limited variety of possibilities to accommodate various types of ingredient containers, due to the fact that all of the types of containers have to fit into a common brewing chamber. Furthermore, this machine is limited by a fixed size of the capsules holder. This calls for a pre-determined size of the ingredient containers, and it also limits greatly the flexibility in size, shape, or structure of the containers inserted therein: basically, only different capsules having limited differences in size and shape can be inserted in the same capsule holder. This leads to at least two main drawbacks.

First of all, the type of technology that is used for mixing, extraction, infusion or dissolution of the ingredient is very close. Therefore, whatever the differences in the type of ingredient which is contained in one or the other container inserted in the capsule holder, the injection of water will be about

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the mechanical set-up that allows mixing of the fluid with the ingredient contained therein, are specific to the amount and composition of the beverage ingredient.

By “kinematic”, it is meant all the mechanical movements that are necessary to hold a container in place in the container holder during the preparation of a beverage (or component of a beverage) therein. It is also meant the relative movements between the container and the fluid interface that interacts therewith, to ensure that said fluid delivery interface adapts functionally to the container it delivers fluid to, so as to be able to establish a fluid connection with said container. Such movements also encompass, if necessary, providing said container with appropriate movements to mix the fluid with the beverage ingredient. For instance, such movements are opening and closing movements of said container at its fluid entry side, and/or at its beverage delivery side. Such movements can also encompass mechanical actuation of a mixing device inside the container, if necessary.

15

Brief description of the drawings

Additional features and advantages of the present invention are described in, and will be apparent from, the description of the presently preferred embodiments which are set out below with reference to the drawings in which:

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Figure 1 is a schematic representation of a beverage machine according to the invention;

Figure 2A and **2B** are respectively side, and bottom perspective views of a pod for use in a beverage machine of the invention;

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Figure 3A is a front cut view of a sachet for use in a beverage machine according to the invention;

Figure 3B is a perspective front view of a rigid spout for the sachet illustrated in figure 3A;

Figure 3C is a perspective front cut view along A-A of figure 3B;

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bottle connection, for instance. In case of a water reservoir 2 as described above, a water filter (not illustrated in the drawing) can be included in the reservoir, to filter water that is pumped from said reservoir towards the fluid system pipes 6.

5 Preferably, the ingredients are chosen within the list of: roast and ground coffee, compacted or not, soluble powdered coffee, or leaf tea. It can also be dairy ingredients (e.g. milk or creamer), tea, chocolate, fruit juices, soups, vegetable juices, bouillons, tea, smoothies, purees, coulis, creams or a combination thereof, in powdered soluble form, liquid concentrated form having
10 various viscosities, or in gel form having thixotropic properties.

 All of these ingredients are in a form which is compatible with a dissolution, extraction or infusion in a liquid fluid, typically water, at cold state (between 4 and 20°C), ambient state (from 20°C to 35°C), or hot state (between 35°C and 95°C, preferably at a temperature comprised between 40°C and 90°C).
15 The mixing fluid used is typically water.

 More precisely, roast and ground coffee requires high fluid pressure for extraction of the coffee substances, in the form of a water film that passes evenly through the coffee bed. Further, long coffee cups such as “Grande” and “long cups” require bigger particles, and a longer volume of water passing
20 through at a lower pressure (typically, a pressure comprised between 6 bar and 16 bar, preferably between 8 and 14 bar, and a volume comprised for a “long cup” between: 100 ml and 150 ml, and for a “Grande” between 150 ml and 500 ml, preferably between 160 ml and 300 ml). Instead, shorter coffee cups such as “Espresso” and “Ristretto” require less volume of water passing through, at a
25 higher pressure (pressure comprised between 10 and 20 bar, preferably between 12 and 18 bar, and a volume comprised between 15 and 30 ml for “Ristretto”, and comprised between 30 and 60 ml, preferably between 40 and 50 ml for “Espresso”).

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On the other hand, when the food or beverage ingredient is a soluble food or beverage ingredient, it is selected in the list of:

- instant coffee powder, milk powder, cream powder, instant tea powder, cocoa powder, soup powder, fruit powder or mixture of said powders,

5 - a coffee concentrate, a milk concentrate, a syrup, a fruit or vegetable concentrate, a tea concentrate, a fruit or vegetable puree.

The powders can be agglomerated or sintered. The powders or liquid concentrates can be mixed with solid pieces for example for preparing soups with solid pieces. The food or beverage ingredient can also be an infusible food or
10 beverage ingredient like a roast and ground coffee or tea leaves. In that embodiment water extracts the infusable ingredient.

Soluble products require low pressure dissolution with a high speed jet to ensure a dynamic dissolution of powder particles with the fluid (in case the ingredient is under powder form). Depending on the type of ingredient
15 (soluble powder or liquid concentrate) and its composition (e.g. milk, chocolate, soup, with or without particles, etc.) and more generally, depending on the chemical composition, viscosity of the liquid concentrate, and size of powder particles, the ingredient may require different types of preparation sequence, that is to say, variations of fluid pressure, and/or flowrate of the fluid injected into the
20 container can be modulated during the same dissolution cycle, to ensure full and even dissolution of the liquid concentrate, or powder particles, into the mixing fluid (e.g. hot water).

The fluid that is circulated through the fluid system of the
25 machine according to the invention is preferably water. However, alternative fluids could be used, such as milk, juice and other edible liquids. Such fluid may or not contain gas in an amount sufficient for creating a sparkling beverage. Such gas is either naturally present in said fluid, or is added from an independent gas source, either independently, or directly within the machine by an in-built gas-mixing

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system. Such gas-mixing systems, using a gas-pump, or pressurized gas containers, are known in the art.

The beverage machine 1 further comprises at least two
5 container holders 7 adapted for receiving corresponding beverage ingredient
containers, as illustrated in **figure 1**. According to the invention, the container
holders 7 differ from one another, so that they are adapted to hold ingredient
containers of different sizes and/or types. The two different container holders for
use in machine according to the embodiment described herein, will be described
10 further below.

A container holder 7 is a mechanical element adapted for
ensuring static positioning of the container within the machine 1, at least during
the time it actually functions to prepare a beverage, so that the corresponding
fluid interface 9 can be connected to the container in a functional manner for
15 injecting fluid therein or therethrough.

In the embodiment illustrated in **figure 4**, the container holder
takes the form of a groove into which the container is deposited (e.g. manually, or
slid by gravity, or transferred mechanically from another location).

In another embodiment (not illustrated), the container holder is
20 a more complex element such as a capsule holder, of the type described for
instance in Applicant's European patent EP 1967100 B1. Optionally, the container
holder comprises means to assist in the container opening (e.g. comprises means
for piercing, tearing, or generally actuating opening of the container at its
dispensing side, by effect of a mechanical, thermal, or chemical activation). In
25 some instances, the container holder comprises means for assisting delivery of the
beverage component to the consumer (e.g. it comprises a channel that guides the
flow of beverage component towards the consumer cup). However, such a feature
is optional.

One example of a pump that is suitable for use in a machine according to the invention is a standard piston pump delivering a maximum output pressure of 20 bar.

5 However, as described above, the beverage preparation machine according to the invention comprises separate fluid injection interfaces 9 having different structural and kinematic configurations, and arranged for independently injecting (or more generally delivering) fluid in one of the corresponding ingredient containers; each interface being connected to the fluid
10 system and being adapted to a different container. Therefore, there is a technical constraint of injecting fluid, e.g. water, in different types of containers containing different types of ingredients, from one single fluid system comprising one pump 3. This creates the need for a versatile pump, able to deliver a large span of pressures and flowrates, either sequentially, or simultaneously.

15 According to the invention, the fluid system's pump 3 delivers fluid in one or the other of the ingredient containers, at either low or high pressure, and at either low or high flowrate. The pressure range that is achieved by the pump in the context of the invention is comprised typically between 0 and 25 bar, preferably between 5 and 20 bar. The flowrate delivered by the pump to the
20 container is comprised between 0 and 900 ml/min, preferably between 150 ml/min and 650 ml/min.

Typically, a fluid system of a conventional low-pressure machine, for example a coffee machine, delivers between 350 and 600 ml/min of water under a pressure comprised between 0 and 5 bars. A fluid system of a high-
25 pressure espresso coffee machine delivers between 150 and 300 ml/min of water under a pressure comprised between 15 and 25 bars.

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The pod interface 9a in its storage and inactive position is illustrated in **figure 5B**, **figure 5C** and **figure 5D**. In this position, the movable part 30 and cladding structure 31 are moved away from the stationary part 28, such that the brewing chamber is open. In this position, a coffee pod 11 can be inserted
5 from above, sliding it into the grooves 41 towards the brewing chamber as shown by an arrow. In this position, the nut 37 is at the uppermost position along the screw 36.

At any time during insertion, an identification code, for instance a code as described above can be read by a sensor (not depicted in the drawing),
10 which will set the beverage preparation parameters automatically.

When the pod 11 is fully inserted within the machine and in alignment with the brewing chamber as illustrated in **figure 5E**, the latter is closed by moving the cladding structure 31 and movable part 30 towards the stationary part 28 of the fluid delivery interface 9a, as shown by an arrow in **figure 5E**. The
15 movement is actuated by the motor 34 which rotates the screw 36 through gears 38, such that the nut 37 moves downwards along said screw. The movement of the nut actuates the movement of the movable part 30 and cladding structure 31, through the crank's arms 35, by bringing movable point 35a closer towards stationary point 35b, which simultaneously drives movable points 35c and 35d,
20 away from point 35e, as illustrated in **figure 5E**.

As the movement continues, the movable part 30 comes into contact with the pod 11 as illustrated in **figure 5F** and the fluid injection needles 40 pierce through the surface of the coffee pod 11.

Finally, as the nut 37 is moved in its lowermost position along the screw 36, as depicted in the **figure 5G**, the cladding structure 31 moves even
25 further, as it is moved at crank's point 35c by the actuation system (at this stage, point 35d remains stationary, despite the movement of nut 37, because of the geometry of the partially uncoupled crank mechanism). Once the nut 37 has reached its lowermost position along the screw 36, the sealing ring 39 of the

The soluble fluid delivery interface 9b comprises a first set of elements, which holds firmly the sachet within said assembly when the latter is functioning. As illustrated in **figure 6B**, a set of two centring pins 45 (only one is represented in the drawing which is a cut view) is arranged within the interface 9b, which are movable in horizontal translation between a position (as shown in **figure 6B**) wherein the pins are retracted within the machine, and a position (not shown) wherein the centring pins 45 are moved towards the sachet 17 and inserted within the centring sockets 25.

The soluble fluid delivery interface 9b further comprises a second element which allows injection of fluid within the sachet 17. More precisely, as illustrated in **figures 6A** and **figure 6C**, the fluid inlet 20 of the sachet's fitment assembly 19, is pierceable by injecting and piercing means of the machine 1, preferably a fluid hollow needle 46 of the fluid dispensing interface 9b, called in what follows "injection needle", through which high pressure fluid is injected in the fluid inlet 20 of the sachet 17. However, it is also possible that the fluid inlet is directly accessible by injecting means which will inject fluid directly without the need to pierce any external lid or membrane. In a preferred configuration of the invention is that a flexible sheet of material which configures the container is also arranged covering the fluid inlet, this sheet being then pierced by the needle as it has just been described.

Preferably, water is injected at a pressure higher than 2 bars, more preferably higher than 3 bars, preferably comprised between 2 and 10 bars, more preferably of around 7 bars. This pressure is measured at the entry point, and is higher than the actual pressure within the sachet. The fluid inlet 20 is configured in such a way that the high pressure fluid injected through it by the injecting and piercing means is converted into a high velocity jet, which is driven into the container or containers. Typically, the diameter of the fluid inlet is comprised between 1 mm and 4 mm, more preferably between 1.5 mm and 3 mm

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and comprises a yieldable cover over it which can be pierced by the injecting and piercing means.

5 The injection needle 46 also comprises a toroidal ring (not depicted in the drawing), preferably made of rubber, ensuring that there is no leakage of fluid outside the fluid inlet while the injecting and piercing means are injecting fluid into the fluid inlet. The fluid inlet is communicated with the inside volume of the container through at least one injection hole, having a diameter of at most 1 mm, preferably of at least 0.24 mm, preferably comprised between 0.3 mm and 1 mm, preferably between 0.3 and 0.5 mm, more preferably of about 0.4
10 mm. With such a configuration, when high pressure fluid is injected by the injection needle 45 through the fluid inlet 20 of sachet 17, it is conveyed internally towards the injection hole 21, from which it is converted into a high velocity jet of fluid injected inside the sachet's internal compartment.

The fluid inlet can also be configured for providing an orientable
15 high velocity jet into the container, preferably at about 90° with respect to the fluid supply provided into the fluid inlet by the injecting and piercing means, though any other angle would be possible and comprised within the scope of the present application.

By "jet" it is understood a stream of liquid or fluid that comes
20 out of the fluid inlet and into the inner volume of the food or beverage container quickly and with force.

The fluid inlet 20 is configured for introducing fluid in the inner volume of the container with a high velocity, this fluid jet preferably presenting a velocity of at least about 20 m/s, preferably at least 30 m/s. As previously
25 described, such a configuration is preferably obtained in the present invention by placing a constriction (that of the injection hole) in the fluid path in the fluid inlet to reduce the size of the section of the fluid inlet.

For the same fluid to be provided through the fluid inlet, the surface of the injection hole can vary according to the nature of the food and

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height wherein the centring sockets 25 of the sachet are aligned with the centring pins 45 of the interface 9b.

As illustrated in **figures 6B** and **6C**, the centring pins 45 and the fluid injection needle 46 are borne by a horizontally movable driving frame 52. The driving pins 47 are borne by a horizontally and vertically movable driving frame 53 which is engaged to the frame 52 in a vertically displaceable manner as shown in **figure 6B**, so that frame 53 moves horizontally together with frame 52, and is further able to move vertically relatively to frame 52. Driving frame 52 is attached to the upper arm 54 of a Y-shaped drive rocking member 55 through connecting pivot point 57. Driving frame 53 is attached to the lower arm 56 through lower connecting pivot point 58. Upper and lower arms are attached together to the horizontally displaceable driving frame 50, through a common pivot point 59.

In use, the soluble interface 9b has a first open position illustrated in **figure 6B**, wherein the movable frame 50 is located close to the motor 48 and gear mechanism 49. The guiding and driving pins 45 and 47, and the injection needle 46 are retracted away from the sachet holder 7b.

A sachet is inserted in the sachet 17 holder 7b, and the machine 1 is then actuated either manually, or by detection of a sachet identification code read by a sensor during insertion (sensor not represented in the drawing). Alternatively, if a code is present on the sachet, the code can be read even before insertion of the sachet in holder 7b, or after its complete insertion therein (the same alternatives are possible for the pod described herein before in relation to fluid delivery interface 9a).

Once a beverage preparation cycle is started, the motor 48 actuates the movement of the frame 50 through gear 49. The Y-shaped rocking member 55, and driving frames 52 and 53 are moved forward towards the sachet holder 7b and sachet 17 held therein, until the centring pins 45, the driving pins 47 and the water injection needle 46 are inserted respectively in the sachet's centring

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sockets 25, the guiding sockets 26 and the fluid injection socket of the sachet's spout 19, as illustrated in **figure 6C**.

As the sachet spout 19 is very well held in place by the centring pins 45, injection of fluid can start by circulating fluid (typically water) from the machine fluid system through the needle 46 into the sachet, where it is mixed with the ingredient, for instance a powder or a liquid concentrate.

Then, as frame 50 continues its movement along shaft 51, the Y-shaped rocking member is also moved forward until it reaches its foremost position close to (or in contact with) the sachet holder 7b. As frame 50 continues to move forward, the movement is then transmitted to the vertically movable driving frame 53. Precisely, the horizontal movement of common pivot point 59 transforms into a downward vertical movement of lower pivot point 58 which is driven farther away from upper pivot point 57. The driving frame 53, and the driving pins 47 attached thereto are moved downward vertically as illustrated in **figure 6D**. Moving downward, the driving pins displace the movable part 24 of the sachet downwards too, which opens the dispensing outlet of the sachet 17. The beverage prepared therein flows out of the sachet through delivery spout 60 into a cup placed under the sachet (not shown).

Depending on the type of ingredient, the opening and closing position of the movable part 24 can be actuated at any time during preparation of a beverage, which allows to fill or empty the sachet more or less during mixing of the ingredient with water, according to pre-determined sequences that are programmed in the machine's control unit, or encoded into a code borne by the sachet and read before the sequence is started. For instance, water injection into the sachet can be started before or after the sachet is open. The sachet can be open from the beginning during the entire sequence, or it can be closed one or several times during mixing, in order to enhance the dissolution of powder in water. Temperature of water can vary or remain stable during the dissolution cycle.