(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 July 2024 (25.07.2024)

WIPO | PCT

(10) International Publication Number
WO 2024/153505 A1

(51) International Patent Classification:
A47J 31/40 (2006.01)

(21) International Application Number:
PCT/EP2024/050437

(22) International Filing Date:
10 January 2024 (10.01.2024)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
23151719.4 16 January 2023 (16.01.2023) EP

(71) Applicant: **SOCIÉTÉ DES PRODUITS NESTLÉ S.A.** [CH/CH]; Avenue Nestlé 55, 1800 Vevey (CH).

(72) Inventors: **ELLIOTT, Gareth**; Route de Pomy 12, 1400 Yverdon-Les-bains (CH). **DUBEI, Mia**; Ch. des Clairieres 21, 1066 Epalinges (CH). **REGNIER, Timothée**; 9 rue Bellevue l'escale, 25370 Métabief (FR). **RAMQAJ, Sylvie**; 20 rue du Doubs, 25370 Longevilles Mont d'Or (FR).

(74) Agent: **DUCREUX, Marie**; Avenue Nestlé 55, 1800 Vevey (CH).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:
— *with international search report (Art. 21(3))*
— *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

(54) Title: MIXING DEVICE FOR BEVERAGE PREPARATION

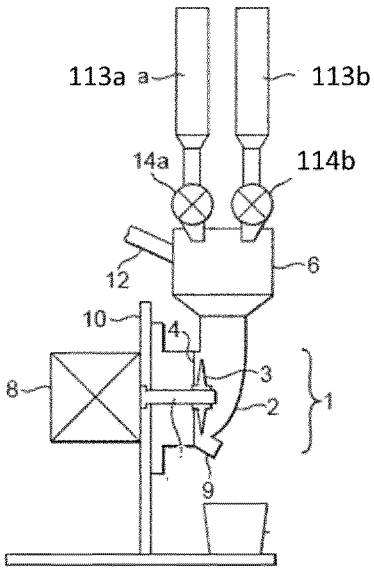

FIG. 1

(57) Abstract: The invention concerns a mixing device (1) comprising : - a whipper housing (2), a whipper (3) and a back wall (4), - a drive shaft (81) for driving the whipper, - the whipper housing comprising a front wall (21), said front wall facing the radial front surface (32) of the whipper, and wherein said whipper (3) is disc shaped, and wherein at least a part of the surface of the radial front surface (32) of the whipper is rough and presents an arithmetic maximum surface roughness (Sz) of at least 200 μm.

WO 2024/153505 A1

MIXING DEVICE FOR BEVERAGE PREPARATION

Field of the invention

The present invention relates to a plant-based milk and its use in its use in coffee beverages.

Background of the invention

Many frothy beverages like milk beverages, chocolate beverages, ... are often prepared by mixing a food soluble powder or a food liquid concentrate with a diluent. Mixing devices are known for speedier preparation of such beverages by mixing the soluble food component with the diluent, such as water. These devices typically comprise a mixing chamber in which the soluble component and the diluent are fed. The diluent can be introduced into the dissolution chamber in order to create a whirlpool to efficiently dissolve the soluble component in the hot water or the hot diluent can be introduced under the form of jets that provides mixing, dissolving and frothing. The mixture is then usually frothed by a whipper in a whipping chamber to reconstitute the beverage and produce foam. The beverage is then evacuated from the whipping chamber through the bottom of the chamber and dispensed into a receptacle for drinking.

In the prior art different types of whipping chambers have been developed for improving the quality of the foam of beverages. EP 1 476 060 and EP 1 639 924 describe similar whipping chambers in which the whippers present a tapered shape. Grooves or ribs are present on the whippers surfaces whereas the back wall of the whipping chamber can present protrusions or ribs. These whipping chambers were conceived for frothing various soluble powder ingredients ; in particular these chambers were configured for frothing milk beverages as well as coffee beverages depending on the speed of actuation of the whipper. Consequently, these whipping chambers are not particularly optimized for the frothing of milk. Besides due to the presence of fine grooves on the whipper and ribs on the back wall these whipping chambers cannot be easily rapidly cleaned.

WO 2003/005868 describes a whipping chamber wherein the internal wall surface of the chamber comprises indentations. Due to these indentations cavitations are created when the whipper is activated. The whipper can also present breakers. This whipping chamber can be indifferently used for the preparation of lattes, cappuccinos or espressos and consequently this whipping chamber is not particularly optimized for the frothing of milk.

WO 2013/149942 describes a whipping chamber wherein the whipper housing front wall presents flat bumps with sharp edges elevating from the surface of the front wall. This whipping chamber enables the preparation of a high volume of dense milk foam from a milk powder and water.

Today there is an increasing demand of the customers for plant-based or non-dairy milks such as oat milk, almond milk, soy milk, coconut milk. These milks are hardly foamable and the use of above-described whipping chambers with powders of these plant-based milks do not enable the preparation of a high volume of dense milk foam. Yet, the properties of the milk foam are important in the preparation of specialty beverages based on milk and especially based on frothed milk like cappuccino, latte macchiato or cocoa based beverages. The properties of the milk foam of these beverages play an important role in the quality of the final beverage shall it concerns the visual aspect or the mouthfeel of the beverage.

But none of the whipper chambers of the prior art has been able to provide a real high quality foamed milk.

The object of the present invention is to propose a mixing device dedicated to the foaming of milk in order to provide a high quality plant-based milk foam for the preparation of frothed milk beverages.

It would be advantageous to provide a new mixing device that can be easily implemented in the current existing beverage dispensers, for example by replacing existing mixing devices with the new one.

Summary of the invention

In a first aspect of the invention, there is provided a mixing device comprising :

- a whipper housing, a whipper and a back wall, the whipper housing and the back wall forming a whipper chamber in which is lodged the whipper,
- the whipper housing comprising a beverage inlet and a beverage outlet,
- a drive shaft for driving the whipper, said drive shaft being supported by the back wall,
- the whipper presenting a radial back surface facing the whipper housing back wall and a radial front surface opposed to the radial back surface
- the whipper housing comprising a front wall, said front wall facing the radial front surface of the whipper, and

wherein said whipper is disc shaped, and

wherein at least a part of the surface of the radial front surface of the whipper is rough and presents an arithmetic maximum surface roughness (Sz) of at least 200 µm, preferably at least 400 µm.

The mixing device of the present invention comprises a whipper housing and a back wall configured for forming a whipper chamber when they are assembled together. The device also comprises a whipper or whipper for whipping the beverage to be prepared such as an impeller or a rotating disk. The whipper is driven by a driveshaft supported by the back wall of the whipper assembly. The whipper housing presents a front wall that faces the radial front surface

of the whipper. The whipper housing comprises a beverage inlet through which the different components of the beverage are introduced for being whipped by the whipper. The beverage inlet is generally present in the front wall of the whipper housing. The front wall preferably presents the form of a truncated cone tapering from the beverage inlet to the peripheral edge of the front wall. The whipper housing also presents a peripheral side wall globally parallel to the drive shaft. This peripheral side wall globally presents the form of a cylinder. It surrounds the peripheral edge of the whipper. The whipper housing also comprises a beverage outlet through which the beverage whipped by the whipper is evacuated. A conduit or nozzle can be attached to the beverage outlet for dispensing in a drinking cup.

In the present invention :
- the term "back" refers to the parts of the mixing device positioned near the back wall supporting the whipper drive shaft,
- the term "front" refers to the parts of the mixing device positioned near the whipper housing beverage inlet,
- the terms "radial" and "axial" are defined in relation to the axis of rotation of the whipper.

According to the invention, the whipper is disc shaped and the material surface of the radial front surface of the whipper is not smooth but rough. This roughness can be quantified by :
- an arithmetic maximum surface roughness (Sz) at least 200 µm, preferably at least 400 µm, even more preferably comprised between 400 and 750 µm.
- an arithmetic mean surface roughness (Sa) comprised of at least 30 µm, preferably at least 40 µm, even more preferably comprised between comprised between 40 and 100 µm.

This roughness increases the foaming a foamable beverages and in particular of hardly foamable beverage like plant-based milks.

In one preferred embodiment, the rough surface of the radial front surface of the whipper presents a pattern, preferably a geometric pattern, said pattern being engraved on the surface of the radial front surface of the whipper.
In this embodiment, the radial front surface combines a continuous rough surface and a pattern engraved in the rough surface. Usually, the design of the pattern results from lines engraved in the rough surface and presenting largest pit depth than the pit of the continuous rough surface.

Preferably, the front surface of the whipper comprises grooves radially extending on said surface.
Usually, these grooves are equally distanced one from the other.

Preferably these grooves extend from the centre of the disc to the periphery of the disc and present a depth comprised between 1 and 2 mm and a width comprised between 2 and 6 mm. Preferably, these grooves present a smooth surface contrary to the front surface of the whipper that extends between the grooves and that is rough.

Preferably, the whipper housing front wall presents bumps elevating from the surface of the front wall, the upper surface of each bump being flat and the edges of said upper surface being sharp. Such a whipper housing is similar to the housing described in WO 2013/149942.

These bumps elevate from the whipper housing front wall surface that faces the front surface of the whipper. Then these bumps face the front surface of the whipper too. The upper surface of each bump - that is the most elevated part of the bump above the whipper housing front wall surface - is flat and the edges of said upper surface are sharp.

According to the preferred embodiment the beverage outlet is positioned at the lowest position of the whipper housing front wall.

Preferably the bumps are regularly radially disposed on the whipper housing front wall around the whipper central axis, except in the area of the beverage outlet. In particular it is preferred that the edges of both bumps surrounding the beverage outlet are positioned at more than 2 mm from the edge of the beverage outlet, preferably at more than 5 mm, even more preferably at a distance of 9 mm.

Preferably all the bumps present the same shape and the same size.

It is preferred that each bump extends along the whole radial length of the front wall. As the beverage inlet of the mixing device usually corresponds to an axial opening in the whipper housing front wall it means that the bumps can radially extend on the front wall surface from the front wall opening corresponding to the inlet of the mixing device up to the peripheral edge of the front wall.

Preferably the upper surface of each bump is parallel to the front wall surface. Each bump appears like a local elevation of the front wall surface.

Preferably for each bump, its width is greater than its height.

According to the preferred embodiment the bumps present the shape of a quadrilaterally-faced hexahedra solid, such as a trapezoidal solid, a cuboid or a cube. It has been noticed that such solids presenting a flat upper side, flat elevating faces and straight edges efficiently improved the formation of foam of quality. The bumps preferably present the shape of a cuboid that is a quadrilaterally-faced hexahedra solid composed of three pairs of rectangles.

The width and the number of bumps on the whipper housing front wall can vary. The sum of the surfaces of all the bumps is generally comprised between 20 and 75 % of the whipper housing front wall surface, preferably between 25 and 50 %, even more preferably between 30 and 40 %.

The front wall can comprise 3 to 11 bumps, preferably between 5 and 11 bumps, and according to the preferred embodiment 6 to 8 bumps.

The bumps can rise up between 0,5 and 2 mm above the front wall surface, preferably between 0,8 and 1,3 mm.

According to a specific embodiment the mixing device can comprise a dissolution chamber attached to the beverage inlet of the whipper housing. The dissolution chamber and the whipper housing can be moulded in one single piece. The outlet of the dissolution chamber comes out in the whipper housing. Preferably the dissolution chamber comprises at least an inlet for a beverage ingredient and an inlet for a diluent.

Preferably the whipper has a radial front surface with a shape substantially corresponding to the whipper housing front wall surface. The shear gap between the whipper radial front surface and the whipper housing front wall surface is preferably comprised between 0.4 and 1.4 mm.

Particular good results have been obtained for a mixing device such as described hereabove wherein :

- the beverage outlet is positioned at the lowest point of the whipper housing front wall surface, and
- the whipper housing front wall presents 6 to 8 bumps equally positioned on the front wall surface around the beverage outlet, and
- the seven bumps present the same cuboid shape, and
- the seven bumps rise up between 0,6 and 1,3 mm above the front wall surface, and
- the whipper is a disc presenting six grooves radially extending on its radial front surface, said grooves being equally distanced one from the other,
- the surfaces of the grooves are smooth,
- the surface of the whipper between the grooves is rough and presents an arithmetic maximum surface roughness (Sz) of at least 400 µm, and an arithmetic mean surface roughness (Sa) of at least 30 µm.

The whipper housing front wall of the mixing device presents a truncated cone shape tapering from a diameter of about 40 mm to about 31 mm and wherein the whipper presents a diameter of about 30 mm. Yet any other smaller or bigger mixing device presenting the same proportional ratio between the different diameters of the front wall truncated cone and the whipper are covered by the present invention.

According to a second aspect, there is provided a whipper for a mixing device, wherein said whipper is disc shaped and presents :

- a central hole configured to cooperate with a drive shaft,

- a back side surface and a front surface,

wherein the surface of the radial front surface (32) of the whipper is rough and presents an arithmetic mean surface roughness (Sa) of a at least 40 µm, and

an arithmetic maximum surface roughness (Sz) of at least 400 µm.

Preferably the radial front surface comprises grooves radially extending on the front surface, said grooves being equally distanced one from the other.

This whipper device can be used in the mixing device described in WO 2013/149942 in order to improve the foaming function of the whipping device, in particular when soluble plant-based milk powder are mixed with a diluent like water for dissolution and foaming. The corresponding beverage machine holding such type of mixing device can be retrofitted with this new impeller.

According to a third aspect, there is provided a beverage preparation machine comprising :

- a mixing device such as described above,
- a diluent supply, preferably water supply, configured for delivering diluent to the mixing device,
- a beverage ingredient container configured for delivering ingredient to the mixing device, preferably through the opened top,
- a motor with a drive shaft connected to the whipper through the back wall of the whipper housing.

The machine can comprise a device to restrict the cross section of the beverage outlet downstream the mixing chamber.

The machine can comprise a device for opening or closing the beverage outlet, such as a pinching valve cooperating with a deformable tube attached to the beverage outlet.

According to a fourth aspect, there is provided a method for preparing a beverage with the beverage preparation machine such as described above, said method comprising the steps of :

- introducing a diluent and a beverage ingredient in the mixing device, and
- rotating the whipper,

wherein the method comprises the steps of :

- closing the beverage outlet before the diluent is introduced in the mixing device and keeping the beverage outlet closed during the rotation of the whipper.

Preferably the beverage ingredient is a soluble beverage powder such as milk powder, a plant-based milk powder, a cocoa powder. Other soluble powders like soluble coffee, soluble fruit powder.

Preferably the diluent is water.

According to the preferred method the whipper is rotated at a speed of at least 9000 rpm, preferably at least 10000 rpm.

In an alternative embodiment, the beverage ingredient can be a liquid such a liquid concentrate that requires dilution and foaming or frothing, such a liquid concentrate (milk concentrate or chocolate concentrate or syrup).

In another alternative embodiment, the beverage ingredient can be a liquid that requires foaming or frothing such as milk or plant-based milk.

According to another aspect, the invention concerns the use of a mixing device such as described hereabove for preparing a frothed cocoa beverage or a frothed milk or plant-based milk beverage.

The above aspects of the invention may be combined in any suitable combination. Moreover, various features herein may be combined with one or more of the above aspects to provide combinations other than those specifically illustrated and described. Further objects and advantageous features of the invention will be apparent from the claims, from the detailed description, and annexed drawings.

Brief description of the drawings

The characteristics and advantages of the invention will be better understood in relation to the following figures :

- Figure 1 represents a beverage dispenser comprising a mixing device,
- Figure 2 represents a mixing device in which the features of the present invention can be implemented,
- Figures 3 and 4 are back and perspective views of the whipper housing of the mixing device according to the preferred embodiment of the present invention,
- Figures 5A and 5B illustrate whippers according to the present invention,
- Figure 6 illustrates a device for opening or closing the beverage outlet,
- Figure 6 illustrates a device to restrict the cross section of the beverage outlet.

Detailed description of exemplary embodiments

With reference to **Figure 1** the beverage dispenser comprises two food ingredient storing units 113a, 113b connected to respective dosing units 114a, 114b able to provide food ingredient doses to a common dissolution chamber 6. According to another embodiment the beverage dispenser can comprise a single dosing unit connected to the different storing units. The storing units can be a disposable tank like a cartridge, a can or tin, a pouch, ... or it can be a non disposable canister that is refilled with powder food ingredients.

The food ingredient can be any ingredient that forms a beverage when mixed with a liquid diluent. It can be a soluble powder or a soluble liquid concentrate. According to the invention it is preferably chocolate or milk. When different storing units are present, they preferably contain different food ingredients.

The dosing units comprise means for dosing the food ingredient. This means can be a dosing screw, a dosing auger, perforated discs or a peristaltic pump for a beverage concentrate. The dosing units are placed at the bottom of the storing units to receive the beverage ingredient therefrom by gravity.

The dose of food ingredient issued from a dosing unit 13a, 13b is delivered to the dissolution chamber 6 where it is mixed with a diluent, usually water, introduced from a diluent inlet 12. The mixture is mixed by the mixing device 1 attached to the dissolution chamber comprising a whipper housing 2 and a back wall 4. The assembly of the whipper housing 2 and the back wall 4 forms a chamber in which is lodged a whipper 3 such as an impeller. The whipper is connected to a drive shaft 41 fixed to the frame 10 of the dispenser. The drive shaft is actuated by a motor 8. The whipped beverage leaves the mixing device 1 through an outlet 7 that can be connected to an outlet tube 9 and is delivered in a cup 15.

Figure 2 is a more detailed view of a mixing device 1 susceptible to be implemented in the dispenser of Figure 1. The mixing device 1 comprises the whipper housing 2, the whipper 3 and the back wall 4. The whipper housing and the back wall forms a whipper chamber in which is lodged the whipper. The whipper 3 is attached to the drive shaft 81 and the drive shaft is supported by the back wall 4. The drive shaft 81 is actuated by a motor 8. The whipper 4 presents a radial back surface 33 that faces the whipper housing back wall 4 and a radial front surface 32 opposed to the radial back surface. The whipper front surface 32 faces the inlet of the mixing device 11. The whipper housing comprises a front wall 21 (underlined by a dotted line) at the inlet of the mixing device. The front wall presents an opening 22 corresponding to the inlet 11 of the mixing device. The front wall 21 radially tapers from its peripheral edge to the edge of the opening 22 ; preferably the front wall presents the shape of a truncated cone. The whipper housing comprises a peripheral side wall that extends from the peripheral edge of the front wall and parallel to the axis XX'. The end of the peripheral side wall leans on the

back wall 4 to close the mixing chamber. The inlet 11 of the whipper housing is attached to the dissolution chamber 6. The whipper housing and the dissolution chamber can be made of one integral single piece of material.

Figures 3 and 4 illustrate a whipper housing 2 presenting the preferred features. The front wall 21 presents several bumps 5 elevating from its surface 211. The upper surface of each bump is parallel to the front wall surface so that each bump appears like a local elevation of the front wall surface.

In the illustrated preferred embodiment, the front wall present six bumps. All the bumps present the same shape of a cuboid with a flat top surface 51 and flat side surfaces with sharp edges between said different surfaces. For the best foaming function, the edges of the bumps must not be curved or smooth. All the bumps preferably present the same size. The bumps preferably extend from the whole axial length of the whipper housing front wall surface 211 that is from the opening 22 to the peripheral edge of the front wall. According to the invention no bump is present on the whipper housing peripheral side wall that is parallel to the axis XX'. For each bump, its width is greater than its height. Due to the small height of the bumps above the front wall surface 211 (between 0,5 and 2 mm, preferably between 0,8 and 1,3 mm), the bumps present the shape of rectangular plates elevating from the surface 211 of the whipper housing front wall. The outlet 7 of the whipper housing is positioned at the lowest part of the front wall and the bumps 5 are equally positioned on the front wall surface 211 around the outlet 7. Globally the sum of the surfaces of all the bumps is around 35 % of the whipper housing front wall surface. According to the preferred embodiment the two bumps surrounding the beverage outlet must not be directly adjacent to said outlet. Preferably these two bumps are positioned at a distance d of at least 2 mm, preferably at least 5 mm, from the beverage outlet. The outlet 7 of the whipper housing comprises a tube that is slightly oriented downwards to help for the evacuation of the beverage.

Figures 5A and 5B illustrate whippers 3 that are preferably used with the mixing device of the present invention and in particular with the whipper housing of Figures 3 and 4. The whipper is a disc presenting a diameter of 31 mm and of which front face 32 comprises six grooves 31. These grooves are equally distanced one from the other. Preferably these grooves extend from the centre of the disc to the periphery of the disc and present a depth comprised between 1 and 2 mm and a width comprised between 2 and 6 mm. The surface of these grooves is smooth.

In the whipper of Figure 5A, the surface of the radial front surface 32 of the whipper is rough except the surfaces of these grooves are smooth.

In the whipper of Figure 5B, except the surfaces of these groove, the surface of the radial front

surface 32 of the whipper is rough and in addition presents a geometrical pattern (snake skin type).

Both whippers are made of plastic and were produced by injection moulding. A part of the surface of the mould was texturized to provide the final rough surface and. the geometrical pattern, Texturization of the mould was obtained by laser surface texturing. Yet other process can be used like chemical etching.

For both whippers the surface roughness of the radial front surface 32 between two grooves 32 (as illustrated by the surface A1 in Figure 5B) was analysed with a non-contact roughness meter system Keyence VR5200 3D Profilometer.

The whipper of Figure 5A showed :

- an arithmetic mean surface roughness Sa of 37 µm, and
- an arithmetic maximum surface roughness Sz 220 µm.

The whipper of Figure 5B showed :

- an arithmetic mean surface roughness Sa of 85 µm, and
- an arithmetic maximum surface roughness Sz 740 µm.

By comparison, a whipper with a smooth surface, that is to say no surface texturizing at all in the mould presented :

- an arithmetic mean surface roughness Sa of 24 µm, and
- an arithmetic maximum surface roughness Sz 139 µm.

The different whippers were used in the whipper housing of Figures 3 and 4 of the beverage dispenser of Figures 1 and 2 and cappuccinos were prepared from coffee and frothed rice milk. 30 ml of coffee was produced by extraction of roast and ground coffee in a specific brewing chamber and 130 ml of rice milk was produced from 30 g of soluble rice powder in the mixing device of Figures 2, 3, 4 with types of different whippers. Frothed milk was dispensed in a container and then coffee was dispensed in frothed milk. The whipper rotated at a speed of about 10000 rpm.

The height of the rice milk foam above the liquid mixture of coffee and milk was measured in the final drinking cup with the following results :

	Height of the rice milk foam
Whipper of Figure 5A	5.42 mm
Whipper of Figure 5B	9.20 mm
Whipper with smooth surface	4.45 mm

As schematically illustrated in **Figure 6**, the beverage outlet 7 can be connected to an outlet tube 9 and the beverage preparation machine can comprise a closing device 10 for either opening or closing the tube. This closing device can comprise a movable pinching valve 141 lodged in a valve assembly body 142. The pinching valve 141 is made movable to pinch the tube 31, that is a deformable tube. Accordingly, the tube can be pinched and closed or not pinched and opened.

In the process of preparation with this configuration of the machine, the following steps are preferably implemented :

- first the beverage outlet 7 is closed.
- then diluent and beverage ingredient are introduced in the mixing chamber and the whipper is rotated.

When the beverage is well frothed, the whipper is stopped and the beverage outlet 7 is opened to dispense the beverage.

Figure 7 illustrates the presence of a restrictor 91 inside the tube 9 attached to the beverage outlet off the mixing device. The restrictor is a mean to restrict the diameter of the outlet tube. In the preferred embodiment, the restrictor can be a tapered portion of the outlet conduit. Tapered portion is configured to restrict the flow of the fluid therethrough, which can reduce the velocity of the flow of the liquid product through output conduit, which, in turn, prolongs the exposure of the fluid to the whipper.

Although the invention has been described with reference to the above illustrated embodiments, it will be appreciated that the invention as claimed is not limited in any way by these illustrated embodiments.

Variations and modifications may be made without departing from the scope of the invention as defined in the claims. Furthermore, where known equivalents exist to specific features, such equivalents are incorporated as if specifically referred in this specification.

As used in this specification, the words "comprises", "comprising", and similar words, are not to be interpreted in an exclusive or exhaustive sense. In other words, they are intended to mean "including, but not limited to".

List of references in the drawings :

mixing device	1
beverage inlet	11
diluent inlet	12
whipper housing	2
front wall	21
whipper	3
groove	31
front surface	32
back surface	33
hole	34
back wall	4
bump	5
upper surface	51
edge	52
dissolution chamber	6
beverage outlet	7
motor	8
drive shaft	81
tube	9
restrictor	91
pinching valve	10
storing unit	113a, 113b
dosing unit	114a, 114b

CLAIMS

1. Mixing device (1) comprising :
- a whipper housing (2), a whipper (3) and a back wall (4), the whipper housing and the back wall forming a whipper chamber in which is lodged the whipper, and the whipper housing comprising a beverage inlet (11) and a beverage outlet (7),
- a drive shaft (81) for driving the whipper, said drive shaft being supported by the back wall,
and wherein :
- the whipper presents a radial back surface (33) facing the whipper housing back wall (4) and a radial front surface (32) opposed to the radial back surface,
- the whipper housing comprises a front wall (21), said front wall facing the radial front surface (32) of the whipper, and
wherein said whipper (3) is disc shaped, and
wherein at least a part of the surface of the radial front surface (32) of the whipper is rough and presents an arithmetic maximum surface roughness (Sz) of at least 200 µm, preferably at least 400 µm.

2. Mixing device according to Claim 1, wherein the rough part of the surface of the radial front surface (32) of the whipper presents an arithmetic mean surface roughness (Sa) of at least 30 µm, preferably at least 40 µm.

3. Mixing device according to Claim 1 or 2, wherein the rough surface of the radial front surface (32) of the whipper presents a pattern, preferably a geometric pattern, said pattern being engraved on the surface of the radial front surface (32) of the whipper

4. Mixing device according to Claim 3, wherein the arithmetic maximum surface roughness (Sz) relates to the engraved pattern

5. Mixing device according to any one of the precedent claims, wherein the front surface (32) of the whipper comprises grooves (31) radially extending on said surface.

6. Mixing device according to the precedent claim, wherein the surfaces of the grooves (31) are smooth.

7. Mixing device according to any one of the precedent claims, wherein the whipper housing front wall (21) presents bumps (5) elevating from the surface (211) of the front wall, the upper surface (51) of each bump being flat and the edges (52) of said upper surface being sharp.

8. Whipper for a mixing device, wherein said whipper (3) is disc shaped and presents :
- a central hole (34) configured to cooperate with a drive shaft,
- a back side surface (33) and a front surface (32)
wherein the surface of the radial front surface (32) of the whipper is rough and presents an arithmetic maximum surface roughness (Sz) of at least least 200 µm, preferably at least 400 µm.

9. Whipper according to Claim 8, wherein the radial front surface (32) comprises grooves (34) radially extending on the front surface (32), said grooves being equally distanced one from the other.

10. Beverage preparation machine comprising :
- a mixing device according to any one of Claims 1 to 7,
- a diluent supply, preferably water supply, configured for delivering diluent to the mixing device (1)
- a beverage ingredient container configured for delivering ingredient to the mixing device (1), preferably through the opened top,
- a motor (8) with a drive shaft (81) connected to the whipper (3) through the back wall (4) of the mixing device,
- optionally a device (91) to restrict the cross section of the beverage outlet downstream the chamber,
- optionally a device (10) for opening or closing the beverage outlet (3).

11. Method for preparing a beverage with the beverage preparation machine according to Claim 10, said method comprising the steps of :
- introducing a diluent and a beverage ingredient in the mixing device, and
- rotating the whipper,
wherein the method comprises the steps of :
- closing the beverage outlet (7) before the diluent is introduced in the mixing device and keeping the beverage outlet closed during the rotation of the whipper (3).

12. Method according to the precedent claim, wherein the diluent is introduced in the mixing device before the beverage ingredient.

13. Method according to Claim 11 or 12, wherein the beverage ingredient is milk powder, a plant-based milk powder, a cocoa powder.

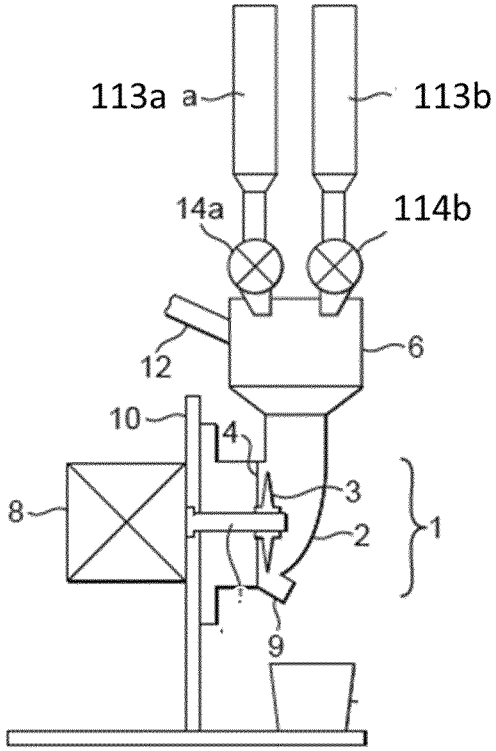

FIG. 1

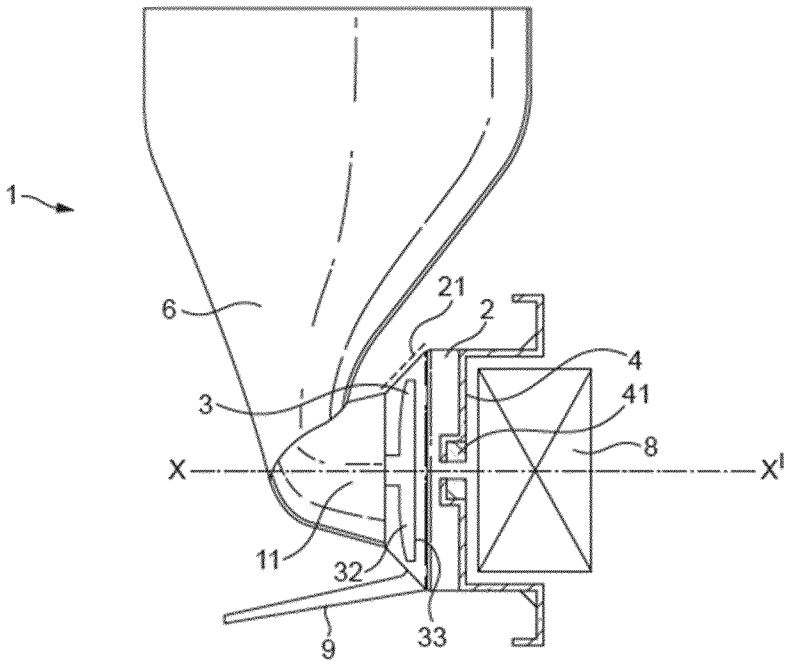

FIG. 2

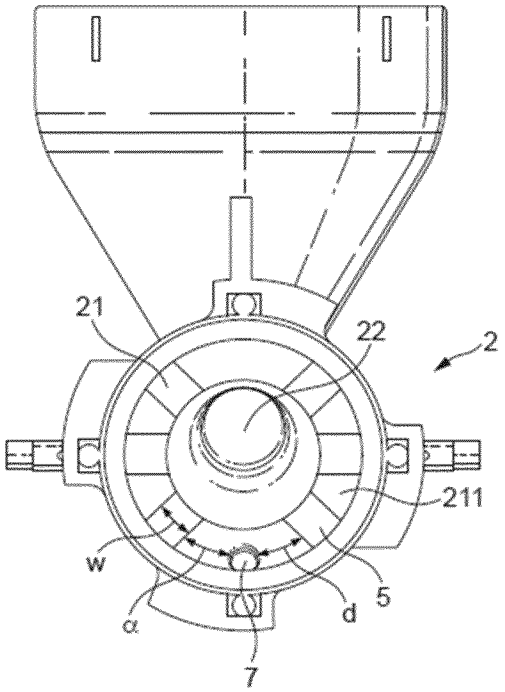

FIG. 3

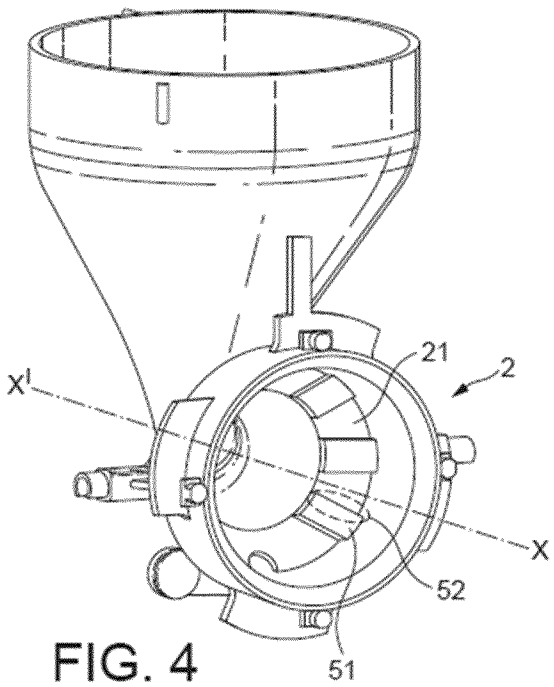

FIG. 4

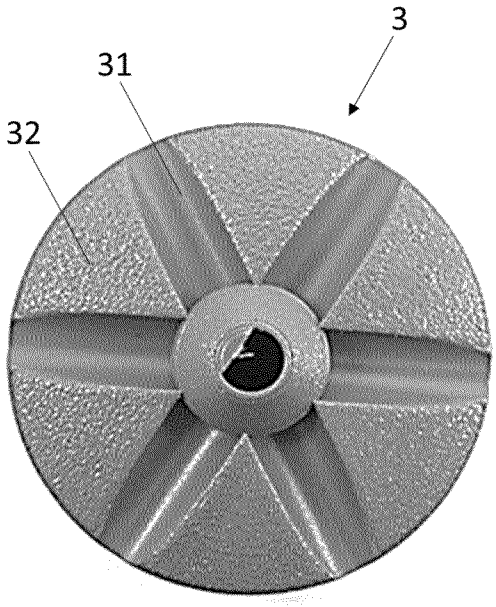

FIGURE 5A

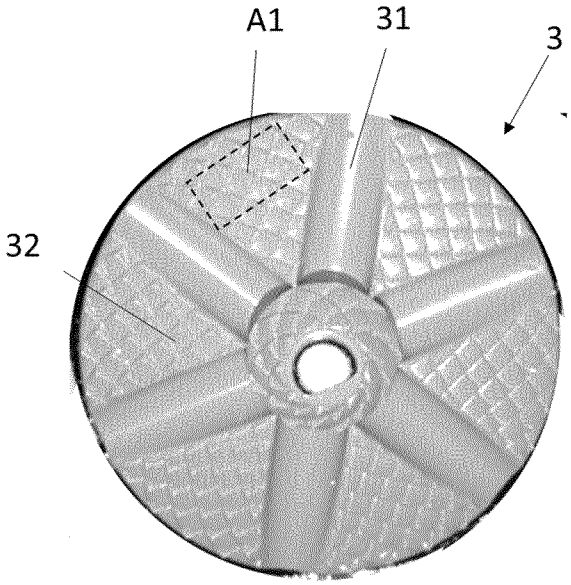

FIGURE 5B

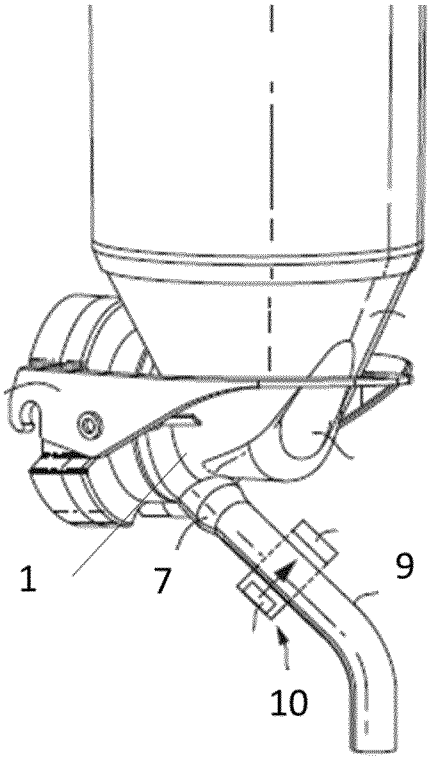

FIGURE 6

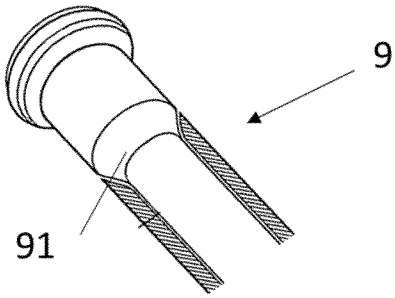

FIGURE 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/050437

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47J31/40
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)
A47J

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 9 962 032 B2 (NESTEC SA [CH]) 8 May 2018 (2018-05-08) column 2, line 65 - column 3, line 38; figures 2, 5 column 4, line 37 - line 43 column 5, line 50 - column 6, line 10	1-13
A	US 2008/163760 A1 (STETTES GREGORY G [US]) 10 July 2008 (2008-07-10) paragraph [0005]; figures 3, 4, 5A, 5B, 6A, 6B paragraph [0053] - paragraph [0060]	1-13
A	WO 2017/076997 A1 (NESTEC SA [CH]) 11 May 2017 (2017-05-11) page 7, line 7 - line 16; figures 4a-4d	1-13

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

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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
31 January 2024	15/02/2024

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	Lopes Margarido, C

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2024/050437

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 9962032 B2	08-05-2018	AR 090612 A1	26-11-2014
		AU 2013245068 A1	23-10-2014
		BR 112014024740 B1	05-01-2021
		CA 2869509 A1	10-10-2013
		CN 104379032 A	25-02-2015
		EP 2852309 A1	01-04-2015
		ES 2727793 T3	18-10-2019
		JP 6169163 B2	26-07-2017
		JP 2015512727 A	30-04-2015
		MX 355970 B	07-05-2018
		PH 12014502231 A1	15-12-2014
		RU 2014144402 A	27-05-2016
		SG 11201406319P A	27-11-2014
		US 2015079257 A1	19-03-2015
		WO 2013149942 A1	10-10-2013
		ZA 201408025 B	29-06-2016
US 2008163760 A1	10-07-2008	US 2008163756 A1	10-07-2008
		US 2008163760 A1	10-07-2008
		US 2008164274 A1	10-07-2008
		US 2008164284 A1	10-07-2008
WO 2017076997 A1	11-05-2017	CN 108348099 A	31-07-2018
		EP 3370584 A1	12-09-2018
		JP 6986512 B2	22-12-2021
		JP 2018533406 A	15-11-2018
		US 2018325304 A1	15-11-2018
		WO 2017076997 A1	11-05-2017