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(54) Mixing device, and relative method, for mixing a substance with a pressurized fluid

(57) Mixing device for mixing at least a substance and a fluid. The device comprises a container (12, 16) with a compartment (18), a first feeding member (20) to feed the substance from above into the compartment (18), a second feeding member (22) to feed the fluid into the compartment (18), and an outlet pipe (24), through which a mixture of the substance and the fluid emerges from the lower part of the compartment (18). The compartment (18) comprises at least a first part (17) having a gradual widening in section from the bottom towards the top. The second feeding member (22) is arranged in an intermediate zone between the first feeding member (20) and the outlet pipe (24) and is able to feed the fluid into the compartment (18) at a determinate pressure, so as to create a vortical motion upwards of the fluid in the first part (17), in a direction opposite that of the feed of the substance into the compartment (18).

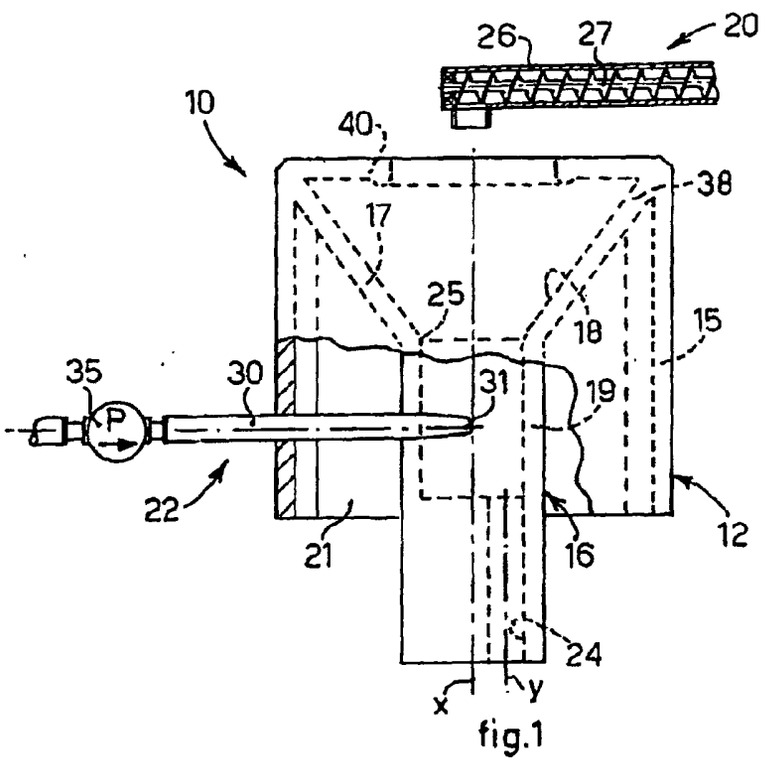

fig.1

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Description

FIELD OF THE INVENTION

[0001] The present invention concerns a mixing device, and the relative method, for the homogeneous mixing of a substance with a pressurized fluid. The device is able to be associated with an apparatus for preparing any mixture of a substance and a fluid, such as for example a solution, an emulsion, a suspension or suchlike, both of a food type, such as for example a hot or cold drink, such as coffee, tea, barley drink, tisane, and also of other nature, for example pharmaceutical or otherwise. The device can be used in an automatic drinks dispenser, in a domestic apparatus for preparing drinks and foodstuffs, on a coffee machine, in a laboratory or other.

BACKGROUND OF THE INVENTION

[0002] Various mixing devices are known, which are associated with an apparatus for preparing a product automatically by mixing a substance, such as for example a soluble powder, like coffee, tea, barley, or other, with a pressurized fluid, for example hot water.

[0003] A known device comprises as its essential parts a container, inside which a compartment is made for mixing the substance and the fluid, a distributor to feed the powdered substance and a distributor to feed the hot water.

[0004] The distributors are arranged above the container to pour from above, respectively, the soluble substance and the hot water into the mixing compartment. In the lower zone of the compartment there is a hole through which the mixture obtained emerges.

[0005] In order to mix the products, in a lower zone of the compartment, upstream of the outlet hole, a rotating screw is arranged, driven by a drive member, which is made to rotate when the water and the substance to be mixed are poured in.

[0006] Another mixing device is also known wherein, unlike the previous one, in order to mix the products during the delivery thereof, the fluid distributor is made to rotate. To be more exact, the distributor is driven by a motorized arm which makes it turn, at a high speed, in a circular trajectory.

[0007] Consequently, turbulence is created in the mixing compartment which allows to dissolve and mix the substance rapidly, as soon as it is poured.

[0008] Both known devices have the disadvantage, however, that in order to carry out the mixing, they require the aid of a drive member to move, respectively, the rotating screw or the fluid distributor.

[0009] Consequently, the apparatus to prepare the mixture, with which one or the other of the known devices is associated, must be provided with housings for the drive member and relative connection elements for the transmission of the rotary motion. This entails high production costs and also occupies a great deal of space inside the apparatus itself, limiting the possibility of reducing its overall dimensions.

[0010] Moreover, the energy consumption of the drive member of known mixing devices considerably affects the overall energy consumption of the apparatus.

[0011] Another disadvantage is that, to be able to verify the correct functioning and detect possible anomalies of the drive member and of the transmission of the rotary motion, it is also necessary to provide automatic control devices and periodic reviews of the functioning thereof.

[0012] One purpose of the present invention is to achieve a mixing device by means of which it is possible to perform an effective and rapid mixing of the products, without the aid of a drive member being necessary.

[0013] Another purpose of the present invention is to achieve a mixing device by means of which the times and functioning modes of the members that feed the fluid and the substances to be mixed therewith can easily be varied, according to the mixture to be obtained.

[0014] Applicant has devised, tested and embodied the present invention to achieve these and other purposes and obtain other advantages and to overcome the shortcomings of the state of the art.

SUMMARY OF THE INVENTION

[0015] The present invention is set forth and characterized in the main claims, while the dependent claims describe other characteristics of the present invention or variants of the main inventive idea.

[0016] In accordance with the above purposes, a mixing device for mixing at least a substance and a fluid comprises: a container with a mixing compartment; first feeding means able to feed said substance from above into the compartment; second feeding means able to feed the fluid into the compartment; and outlet means able to make the mixture of the substance and the fluid emerge from the lower part of the compartment. According to the invention, the compartment comprises at least a first part having a gradual widening in section from the bottom towards the top. The second feeding means are arranged in an intermediate zone between the first feeding means and the outlet means, and are able to feed the fluid into the compartment at a determinate pressure, so as to create a vortical motion, or vortex, of the fluid towards the top in the first part, in the opposite direction to the feed of the substance into the mixing compartment.

[0017] The pressure at which the fluid is fed and the gradual widening in section of the first part of the compartment are exploited to create a vortex which has high speed and which develops upwards, and continuously. When the substance is poured into the compartment, it comes into contact with the vortex of the fluid, and in this way dissolves and mixes with it in an effective manner, without the aid of drive members.

[0018] In a preferential embodiment the substance is

poured directly into the first part of the compartment.

[0019] In one embodiment of the invention, the second fluid feeding means are arranged in the lower zone of the mixing compartment, in proximity with the outlet means, so that most of the compartment is free for the vortical rise of the fluid.

[0020] The substance that is mixed with the fluid is advantageously, but not exclusively, of the type that is soluble in the fluid; it can be in the form of powder, also lyophilized, in the form of granules or paste, or a concentrated solution, a syrup or other. By means of the device according to the invention, therefore, by pouring the substance into the mixing compartment, it is possible to obtain quickly, and with a minimum energy consumption, a solution, a dispersion, an emulsion or any other type of mixed product.

[0021] Another advantage of the mixing device according to the present invention is that the mixing of the fluid and the substance can be easily regulated by operating on the time and mode of functioning of the relative feeding means.

[0022] In a preferential embodiment of the invention, the fluid is fed tangentially into the mixing compartment, so as to create a vortex, which extends peripherally upwards in the aforesaid first part of the compartment.

[0023] According to a variant, the fluid feeding means are associated with means able to induce a vortical motion in the mixing compartment, such as for example spiral-shaped grooves or pipes, facing upwards.

[0024] In a preferential form of embodiment, the mixing compartment is funnel-shaped and comprises a first upper portion shaped like a truncated cone, and a second cylindrical lower portion. The fluid is fed under pressure into the cylindrical portion, so that the vortical motion reaches its maximum speed in a zone connecting the cylindrical portion and the truncated cone portion.

[0025] According to a variant, to obtain a different mixing ratio between the substance and the fluid, the latter is fed under pressure directly into the conical portion.

[0026] According to another variant, the compartment is shaped like a truncated cone shape, or is goblet shaped.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] These and other characteristics of the present invention will become apparent from the following description of a preferential form of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a lateral view, partly in section, of a mixing device according to the present invention;
- fig. 2 is a view from above, partly in section, of the device in fig. 1;
- fig. 3 is a section from III to III of fig. 2.

DETAILED DESCRIPTION OF A PREFERENTIAL FORM OF EMBODIMENT OF THE INVENTION

[0028] With reference to the attached figures, a mixing device 10 according to the present invention is able to be assembled inside an automatic dispenser of hot or cold drinks, to mix at least a substance, such as for example powdered coffee, with a fluid, in this case hot or cold water.

[0029] The device 10 comprises a container 12, made for example of ABS (acrylonitrile butadiene styrene), inside which is made a mixing compartment 18 which in this case has an internal volume of about 50 ml.

[0030] The device 10 also comprises a first feeding assembly 20, able to feed the substance into the compartment 18 from above, and a second feeding assembly 22, able to feed the hot or cold water into an intermediate zone of the compartment 18.

[0031] The container 12 comprises a cylindrical outer wall 15 and an inner wall 16, shaped like a funnel, which defines the compartment 18.

[0032] To be more exact, the inner wall 16 comprises in the upper zone a truncated cone portion 17, with its taper facing downwards and, in the lower zone, a cylindrical portion 19.

[0033] Below the cylindrical portion 19, the container 12 is provided with an outlet pipe 24, through which the mixture of substance and water emerges towards a delivery device, not shown in the drawings. The outlet pipe 24 has a reduced diameter with respect to the cylindrical portion 19, and is arranged offset along an axis Y with respect to the axis X of the compartment 18.

[0034] In the solution shown here, moreover, on one side of the container 12 there is a hole 14 (fig. 2), where a screw is screwed in in order to attach the device 10 to the drinks dispenser.

[0035] The first feeding assembly 20 is substantially of a known type and comprises a conveyor pipe 26 (figs. 1 and 3), arranged above the container 12 from which, by means of a feeding-screw 27 located inside, the substance to be mixed emerges. The substance is able to fall in this case towards a connection zone 25 between the cylindrical portion 19 and the truncated cone portion 17.

[0036] The functioning of the feeding-screw 27 can be regulated according to pre-set modes.

[0037] The second feeding assembly 22 comprises a pipe 30, provided with a nozzle 31 (fig. 1), which is arranged substantially horizontal on one side of the inner wall 16, in correspondence with the cylindrical portion 19, in order to feed the water tangentially therein. The pipe 30 is connected to a pump 35, which feeds the water under pressure at about 1-15 bar.

[0038] The tangential and pressurized feed of the water determines, due to the high kinetic energy of the latter, a vortical motion, or whirlpool, which extends vertically along the inner side of the cylindrical portion 19, reaching its maximum speed in correspondence with

the aforesaid connection zone 25.

[0039] According to the invention, the upward development of the whirlpool is also facilitated by the widening in section, from the bottom towards the top, of the truncated cone portion 17.

[0040] Consequently, by pouring the substance to be mixed precisely into the connection zone 25 where the whirlpool reaches its maximum speed, the substance dissolves immediately and, at the same time, is mixed with the water.

[0041] During mixing, the vortex of the mixture of water and substance continues to rise towards an upper zone 38 of the truncated cone portion 17, until it loses speed. In this condition the mixture flows due to gravity into the central zone of the compartment 18 and falls, more or less directly, as far as the outlet pipe 24.

[0042] An annular platelet 40 partly closes the container 12, to prevent the leakage of water in the event of considerable intensity.

[0043] The device 10, creating an upward vortical motion of the water, and in the direction opposite that of the introduction of the substance, allows to obtain a dissolution and homogeneous mixing of the substance or, in the case of an insoluble substance, a dispersion or an emulsion, without the assistance of drive members.

[0044] The upward vortical motion of the water, or of other fluid, is also facilitated both by the reduced diameter of the outlet pipe 24, with respect to the diameter of the cylindrical portion 19, and also by its offset position with respect to the aforesaid axis X.

[0045] Moreover, in the embodiment shown here, the outlet pipe 24 is arranged substantially in correspondence with, and below, the nozzle 31 of the water pipe 30; but it is clear that any other offset position of the outlet pipe 24 with respect to the axis X can be provided, for example on the opposite side with respect to the nozzle 31.

[0046] Another advantage of the device 10 is the fact that the introduction pressure and the vortical motion of the water allow to create bubbles of water in the mixture of substance and water, giving rise to a frothy appearance which, for example in the case of preparing coffee or barley drink, gives a pleasant effect.

[0047] The mixing device 10 as described heretofore functions as follows.

[0048] When the pump 35 is driven, according to predefined functioning modes, the hot or cold water is introduced into the cylindrical portion 19 at a pressure of about 5-10 bar, and continuously, at a constant flow and for a determinate period of time.

[0049] In a first step, only water is introduced into the compartment 18, so as to obtain a whirlpool which develops upwards as far as the truncated cone portion 17.

[0050] In a second step, the substance is poured into the compartment 18 in a constant flow and is mixed in the whirlpool.

[0051] The mixture of substance and water rotates vertically in the aforesaid connection zone 25 and then flows towards the center of the compartment 18 and falls into the outlet pipe 24, possibly mixing with another substance which, in the same step, is poured from the pipe 26. Descending along the cylindrical portion 19, the mixture passes in proximity with the nozzle 31 and is partly hit by the jet of water so as to be further mixed, and possibly transported upwards by the vortical motion.

[0052] The jet of the nozzle 31 facilitates the formation of more bubbles of water inside the mixture, accentuating the frothy effect.

[0053] In a third step the feed of the substance is interrupted, while the feed of the water is continued, to allow a complete cleaning of the compartment 18 and to complete the preparation of the final product.

[0054] It is clear that the delivery times of the substance and the water can vary according to the type of substance and the mixture to be obtained and are not restrictive for the invention.

[0055] Modifications and/or additions of parts may be made to the device 10 as described heretofore, without departing from the field and scope of the present invention.

[0056] For example, in the embodiment shown here, radial ribs 21 are provided for stiffening purposes, located between the inner wall 16 and the outer wall 15.

[0057] According to a variant, the inner wall 16 of the container 12, instead of being funnel-shaped, is simply shaped like a truncated cone. In this case, the pipe 30 that feeds the water is arranged in correspondence with the lower zone of the inner wall 16, in proximity with the outlet pipe 24.

[0058] It is clear however that, although the present invention has been described with reference to specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of mixing device 10, all of which shall come within the field and scope of the present invention.

Claims

1. Mixing device for mixing at least a substance and a fluid, comprising a container (12) with a compartment (18), first feeding means (20) able to feed said substance from above into said compartment (18), second feeding means (22) able to feed said fluid into said compartment (18), and outlet means (24) able to make a mixture of said substance and said fluid emerge from the lower part of said compartment (18), **characterized in that** said compartment (18) comprises at least a first part (17) with a gradual widening in section from the bottom towards the top, and **in that** said second feeding means (22) are arranged in an intermediate zone between said first feeding means (20) and said outlet means (24) and are able to feed said fluid into said compartment (18) at a determinate pressure, so as to create a vortical motion upwards of said fluid in said first part

(17), in a direction opposite that of the feed of said substance into said compartment (18).

2. Device as in claim 1, **characterized in that** said second feeding means (22) are able to introduce said fluid tangentially into said compartment (18).

3. Device as in claim 1, **characterized in that** said second feeding means (22) are associated with means to induce said vortical motion.

4. Device as in any claim hereinbefore, **characterized in that** said second feeding means (22) are arranged in the lower part of said compartment (18) in proximity with said outlet means (24).

5. Device as in any claim hereinbefore, **characterized in that** said first part (17) is shaped substantially like a truncated cone.

6. Device as in claim 5, **characterized in that** said compartment (18) is shaped substantially like a funnel and comprises, in the upper zone, said first part (17) and, in the lower zone, a second part (19) substantially cylindrical in shape.

7. Device as in claim 6, **characterized in that** said second feeding means (22) are able to introduce said fluid in correspondence with said second part (19), so that said vortical motion reaches its maximum speed in a connection zone (25) between said first part (17) and said second part (19).

8. Device as in any claim hereinbefore, **characterized in that** said first feeding means (20) are able to introduce said substance directly into said first part (17) of said compartment (18), where said vortical motion occurs.

9. Device as in any claim hereinbefore, wherein said compartment (18) is symmetrical with respect to an axis (X), **characterized in that** said outlet means (24) are arranged in an offset position with respect to said axis (X) of said compartment (18).

10. Device as in any claim hereinbefore, **characterized in that** said outlet means comprise a pipe (24) with a reduced section with respect to the section of said compartment (18).

11. Method for mixing at least a substance and a fluid in a container (12) with a compartment (18), wherein are provided: first feeding means (20) to feed said substance from above into said compartment (18); second feeding means (22) to feed said fluid into said compartment (18); and outlet means (24) able to make a mixture of said substance and said fluid emerge from the lower part of said compartment (18), **characterized in that** said fluid is fed at a determinate pressure into an intermediate zone of said compartment (18) between said first feeding means (20) and said outlet means (24), **in that** the pressurized feed of said fluid determines a vortical motion upwards of the fluid in a direction opposite that in which said substance is poured into said compartment (18), and **in that** said vortical motion develops towards a first part (17) of said compartment (18), having a gradual widening in section from the bottom towards the top.

12. Method as in claim 11, **characterized in that** said second feeding means (22) feed said fluid tangentially into said compartment (18).

13. Method as in claim 11 or 12, **characterized in that** said second feeding means (22) feed said fluid into a second portion (19) of said compartment (18) arranged below said first portion (17) so that said vortical motion rises towards said first portion (17).

14. Method as in claim 11, 12 or 13, **characterized in that** it comprises a first step wherein only said fluid is fed into said compartment (18).

15. Method as in claim 14, **characterized in that** it comprises a second step, subsequent to said first step, wherein both said fluid and said substance are fed into said compartment (18).

16. Method as in claim 15, **characterized in that** it comprises a third step, subsequent to said second step, wherein only said fluid is fed into said compartment (18).

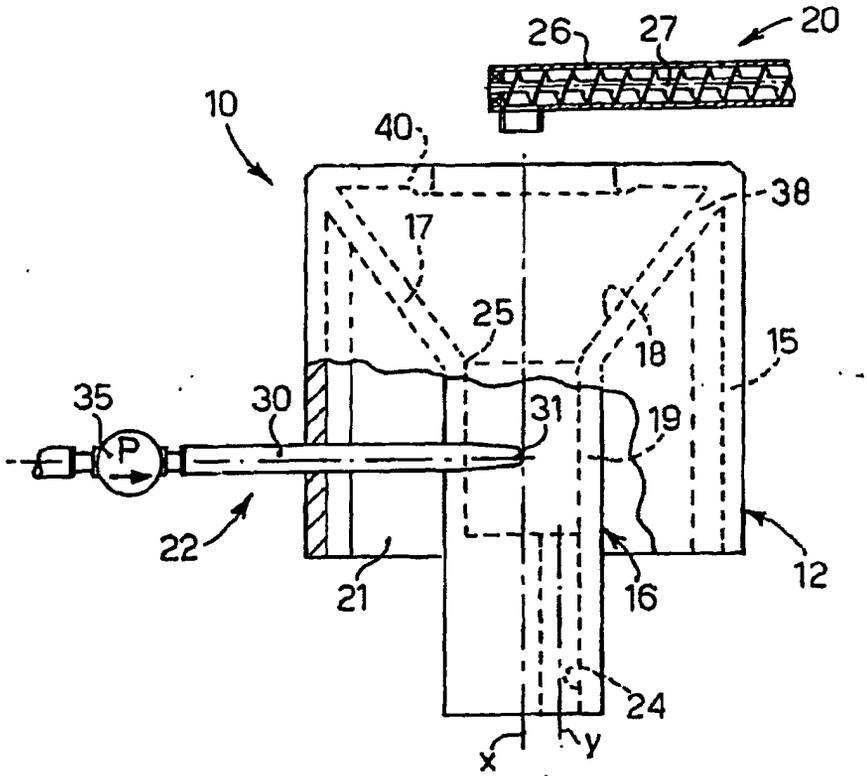
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fig.1

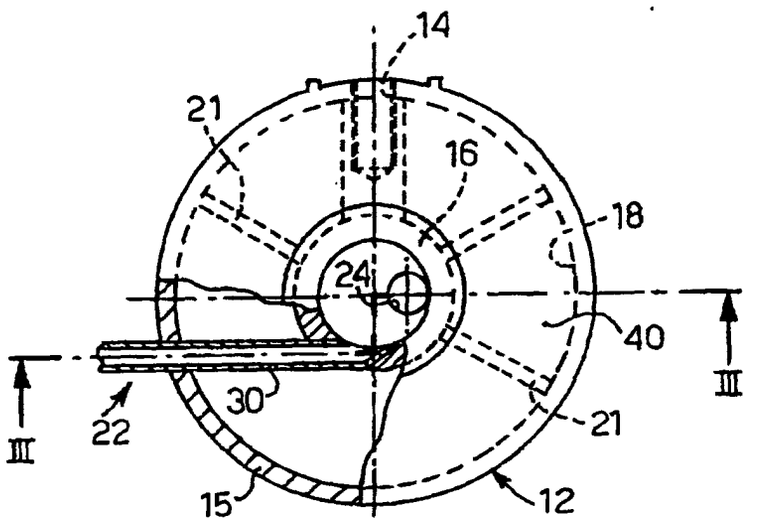
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fig. 2

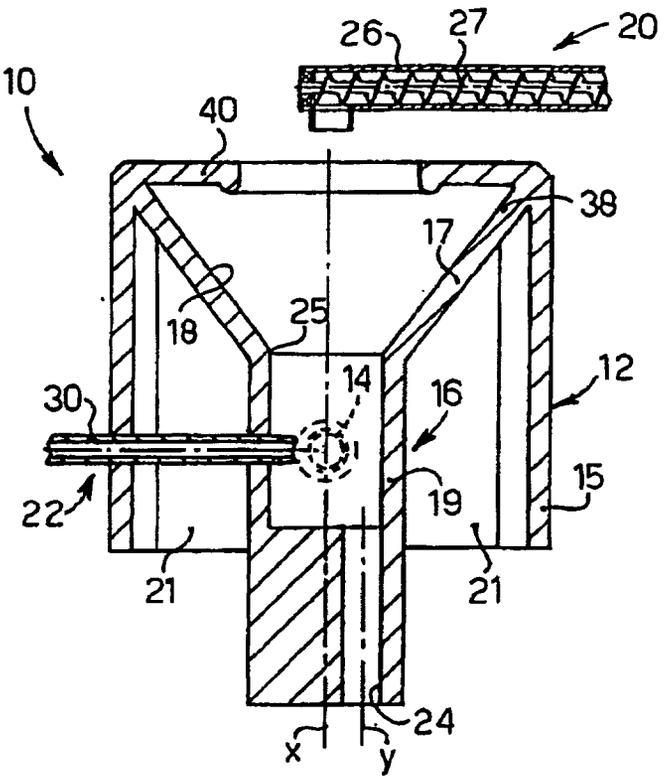

fig. 3