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FUJITA(10) **Pub. No.: US 2019/0216128 A1**(43) **Pub. Date: Jul. 18, 2019**(54) **METHOD AND APPARATUS FOR
MANUFACTURING A LIQUID-FILLED
CAPSULE***B65B 3/04* (2006.01)*B65B 43/54* (2006.01)*B65B 57/10* (2006.01)(71) Applicant: **JT INTERNATIONAL S.A.**, Geneva
(CH)(52) **U.S. Cl.**CPC *A24D 3/061* (2013.01); *A24D 3/048*(2013.01); *B65B 57/10* (2013.01); *B65B 43/54*(2013.01); *B65B 3/04* (2013.01)(72) Inventor: **Noritoshi FUJITA**, Luxembourg (LU)(73) Assignee: **JT International S.A.**, Geneva (CH)

(57)

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A method of manufacturing liquid-filled capsules for use in smoking articles includes providing a capsule shell defining a cavity and having an open end; dispensing a volume of liquid into the cavity through the open end of the shell, whereby a clearance is left between an upper surface of the liquid dispensed into the cavity and the open end of the shell and sealing the open end of the shell with a portion of sheet material to provide a liquid-filled capsule containing the volume of liquid. An apparatus for manufacturing liquid-filled capsules includes a holder for holding one or more capsule shells; a conveyor for moving or transporting the holder; a filling station for dispensing a liquid into a cavity of each of the capsule shells; and a sealing station for covering and sealing an open end of each capsule shell. A liquid-filled capsule is also provided.

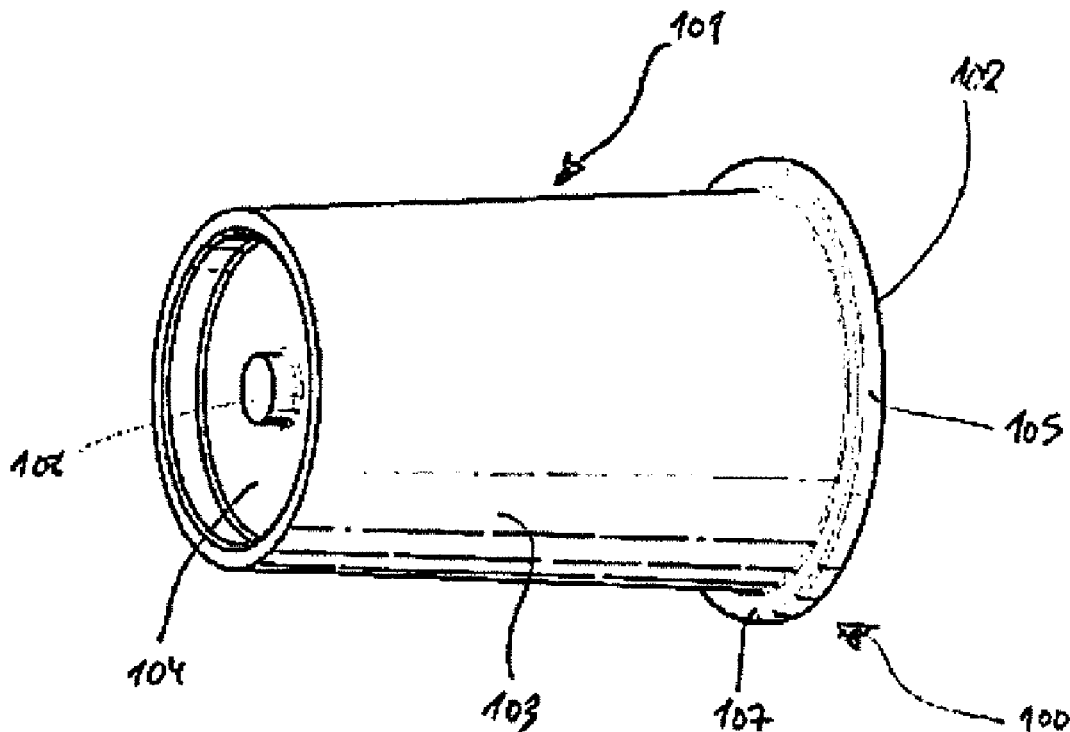


Fig. 2a

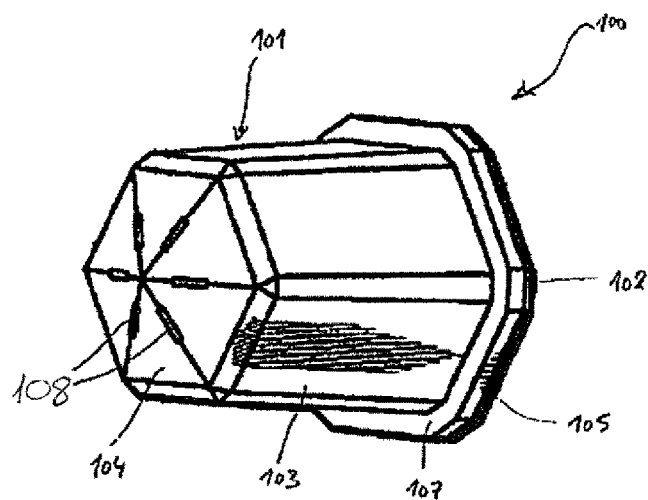


Fig. 2b

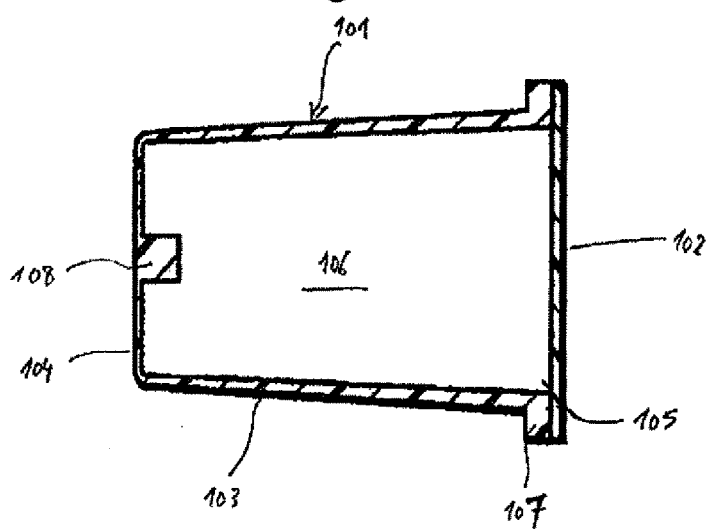


Fig. 2c

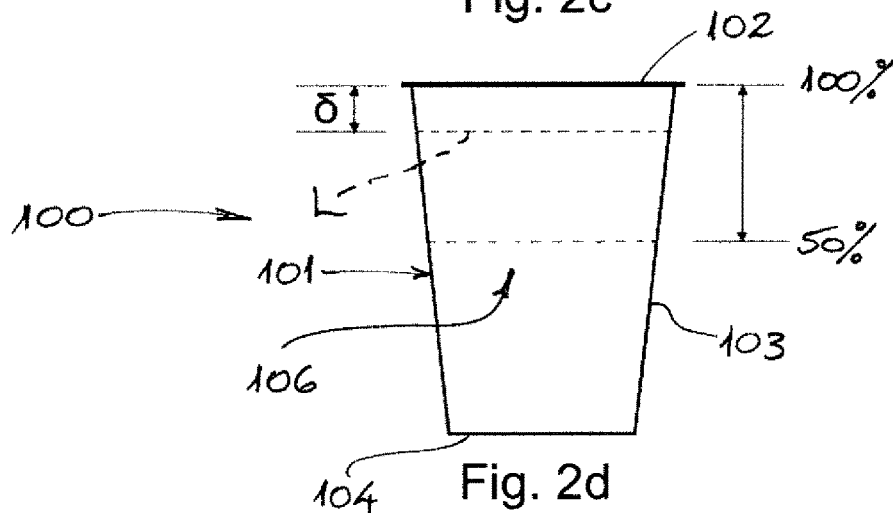


Fig. 2d

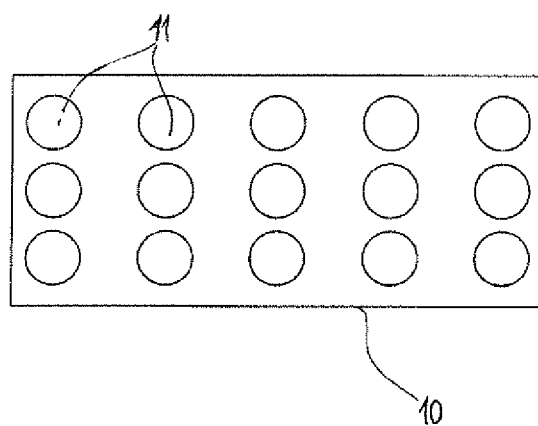


Fig. 3

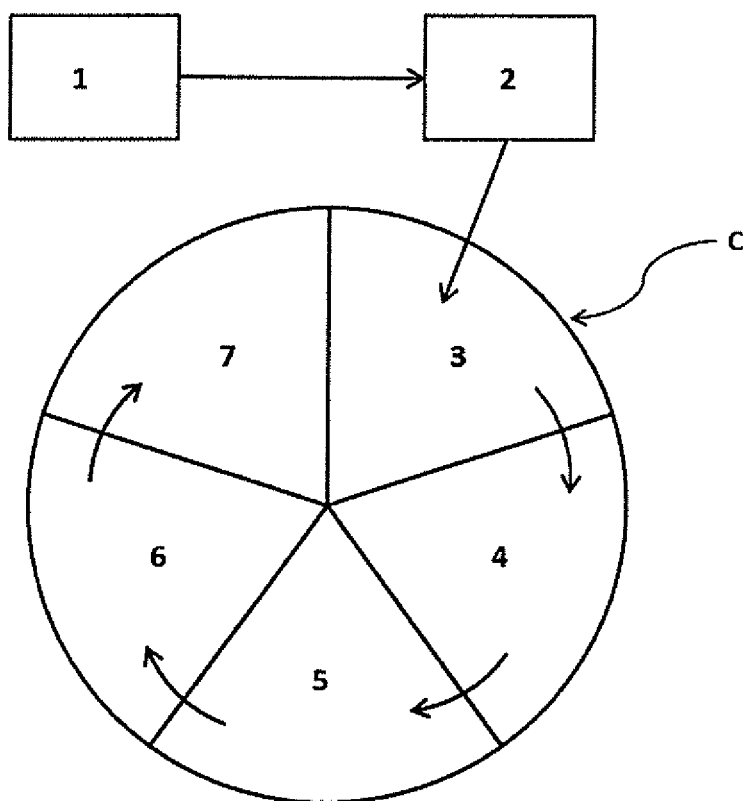


Fig. 4

METHOD AND APPARATUS FOR MANUFACTURING A LIQUID-FILLED CAPSULE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a national phase entry under 35 U.S.C. § 371 of International Application No. PCT/EP2017/068846, filed Jul. 26, 2017, published in English, which claims priority to European Application No. 16181524.6 filed Jul. 27, 2016, the disclosures of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] The present invention relates to a method and an apparatus for manufacturing a liquid-filled breakable capsule for use in a smoking article, such as a cigarette or the like, as well as to a liquid-filled breakable capsule itself.

[0003] Smoking articles, such as cigarettes or the like, are popular consumer products that typically have a generally cylindrical rod shaped configuration and include a charge, roll, or column of a smokable material, such as shredded tobacco (e.g. in cut filler form), surrounded by a paper wrapper forming a so-called “tobacco rod”. A cigarette will also usually have a cylindrical filter element aligned in end-to-end relationship with the tobacco rod. The filter element may, for example, comprise cellulose acetate tow, and the tow is circumscribed by a paper material known as “plug wrap”. Typically, the filter element is attached to one end of the tobacco rod using a circumscribing wrapping material known as “tipping paper”.

[0004] In recent years there has been increasing consumer demand for smoking articles providing modified sensory attributes, and particularly for cigarettes incorporating filter elements which may act as vehicles for adding flavour to mainstream smoke of the cigarettes. Specifically, these smoking articles have included flavour-altering substances in breakable pellets or capsules. During cigarette manufacture, the filter material is formed into a continuous filter rod having such pellets or capsules positioned within that rod; e.g., along a longitudinal axis thereof. The continuous filter rod is then divided or cut at predetermined intervals to form a plurality of filter elements, such that each filter element includes at least one of the capsules. The capsules are then manually broken by the consumer to release a substance into the filter material which, in turn, may act to alter the flavour or taste of the main-stream smoke during smoking.

[0005] For this purpose, a breakable capsule having a shell or casing containing a liquid is used. The shell or casing defines a cavity for receiving and holding the liquid and includes an open end, which is typically sealed or covered with a cap. The casing or shell may include a predefined rupture region such that, when the consumer applies pressure to the capsule, the casing or shell breaks preferentially in the rupture region. In this manner, it is possible to control release of the liquid to ensure that it is directed to a desired area.

[0006] Japanese unexamined patent application published as JP H 05-330503 discloses a manufacturing process for mass-producing such liquid-filled breakable capsules. As shown in FIG. 4 of that Japanese patent application (included as FIG. 1 of the present application), a tray feed zone B supplies a tray 3 upon which a plurality of capsule shells

2 are arranged and positioned under a sheet 1 fed or supplied from a sheet feed zone A. A heat seal apparatus C hot welds the sheet 1 to each of the shells 2 on the tray 3 and a cross-feed device D cuts the sheet 1 welded to each of the shells 2 to form a square cover on each shell 2. Top-cover wrap equipment E then bends an edge region of the cover to an outer peripheral surface of the shell. A discharge device G discharges the tray 3 with the finished capsules and a sheet winding portion F winds up remaining sheet 1 from which the covers were cut.

[0007] It has been found that the known techniques for manufacturing such liquid-filled capsules produce an excessive number of capsules which do not meet the desired operating or use requirements; for example, with respect to the amount of liquid contained within the capsule and/or the sealing efficacy. It is therefore an object of the invention to provide an improved method and apparatus for manufacturing a liquid-filled capsule for use in a smoking article. In particular, it is an object of the invention to increase a yield of the manufacturing process for this type of capsule with adequate capsule filling and/or sealing.

BRIEF SUMMARY OF THE INVENTION

[0008] In accordance with this invention, a method and an apparatus for manufacturing a liquid-filled capsule for use in a smoking article is provided having the features as recited in claim 1 and claim 9, respectively. Furthermore, in accordance with this invention, a liquid-filled capsule for use in a smoking article is provided having the features recited in claim 13. Advantageous or preferred features of the invention are recited in the dependent claims.

[0009] Thus, according to one aspect, the invention provides a method of manufacturing breakable capsules for use in smoking articles, comprising the steps:

[0010] providing a capsule shell defining a cavity and having an open end;

[0011] dispensing a volume of liquid into the cavity through the open end, whereby a space or clearance is provided between an upper surface of the liquid dispensed into the cavity and the open end of the shell; and

[0012] sealing the open end of the shell with sheet material, such as polymer sheet or film, to provide a breakable capsule containing the volume of liquid.

[0013] In this regard, the inventors have ascertained that the amount of liquid within the cavity has a significant impact or influence upon the production and performance characteristics of the capsule. For example, the ability to seal the open end of the shell can be compromised, especially when the speed of the production process is increased. On the one hand, if the filling ratio of the capsule is less than a pre-defined threshold value, the capsule will generally not contain sufficient liquid and a consumer may experience an unsatisfactory smoking experience. On the other hand, if the space or clearance between the open end of the shell and the liquid is less than a predefined threshold value, the capsule may not seal properly and may leak in situ before the smoking article reaches a consumer.

[0014] It will be noted that the term “filling ratio” as used herein refers to a ratio of volume of liquid contained in the capsule to a filling capacity of the capsule cavity. It will also be noted that the term “filling capacity” as used herein refers to a nominal value of the volume of the cavity defined by the shell and not to a real value of the volume of the cavity that takes into account accepted manufacturing tolerances.

[0015] In a preferred embodiment, the space or clearance is a linear dimension measured from an upper surface of the liquid dispensed into the cavity and the open end of the capsule shell. That is, the clearance is typically measured between the upper surface of the liquid and a rim or an edge of the open end of the shell. In this regard, it will be appreciated that this measurement is typically performed with the capsule positioned in an upright orientation; that is, with the sealed open end (i.e. the filling end) of the capsule facing upwards. The space or clearance is preferably at least 0.4 mm, but is more preferably at least 0.6 mm, and further preferably at least 0.8 mm.

[0016] The clearance may be measured, for example, using a laser measuring device that makes two relative distance measurements from a reference position. In this regard, a first relative distance corresponds to a distance between the sealed end (excluding a thickness of the sealing sheet or “cap”) and the reference position, while a second relative distance corresponds to a distance between the upper surface of the liquid and the reference position. The clearance is then calculated as the absolute value of the subtraction of the first and second relative distances.

[0017] In a preferred embodiment, the liquid dispensed may comprise purified water or a water-based liquid which contains a dissolved or suspended flavouring substance. Such a liquid typically generates a negative meniscus and, thus, the upper surface of the liquid would be located at a position where the liquid in the cavity contacts a side wall of the shell.

[0018] In a preferred embodiment, the step of dispensing the volume of liquid into the shell comprises providing the capsule with a filling ratio above a predetermined minimum, and preferably within a pre-defined range. As noted above, the filling ratio of the capsule is a ratio of the volume of liquid dispensed to a filling capacity of the cavity. The predetermined minimum of the filling ratio is preferably 0.5. The pre-defined range of the filling ratio is preferably from 0.5 to 0.9, more preferably from 0.75 to 0.9, and most preferably 0.8 to 0.9. A filling ratio of 0.88 has been found to provide exceptionally good production and performance characteristics of the capsule.

[0019] In a preferred embodiment, the step of sealing the open end of the shell includes: covering the open end of the capsule shell with a section of the sheet material; fusing or bonding the section of sheet material to seal said end of the shell; and cutting excess sheet material from the section of sheet material at the sealed end of the shell, especially from a rim. Preferably, the step of sealing the open end of the shell comprises substantially contouring or shaping the end of the shell during cutting of the excess sheet material from the sealed end of the shell. The cover or closure formed by the sheet material over the end of the shell may be referred to as a cap. The sheet material is preferably cut with a rotary blade cutter due to the relatively small size of the capsules, which typically have a diameter in the range of between 2.5 mm and 8.0 mm. Alternatively, however, a laser or a punch may be used to cut the sheet material.

[0020] In a preferred embodiment, the method further comprises the steps of: inspecting the liquid-filled capsule or a component thereof (e.g. the capsule shell, the cover, or the liquid contained in the shell) for a manufacturing defect; and identifying the capsule as defective if a manufacturing defect is detected. Possible manufacturing defects may, for example, include a deviation or discrepancy in shell dimen-

sions, a misalignment of the cover and shell, a deviation or discrepancy in the capsule dimensions, and/or liquid leakage. The term “manufacturing defect” used herein is understood as an unacceptable deviation or discrepancy from a target or desired manufacturing parameter, i.e. outside a predetermined tolerance band. Preferably, the method comprises the step of rejecting a capsule which has been identified as defective. In this way, a defective capsule can be ejected or removed from further processing in the production of the smoking articles. This, in turn, avoids wasting manufacturing effort on capsules which are unsatisfactory for use in the smoking article (e.g. which will not operate satisfactorily for a consumer in use) or are likely to break during production of the smoking article (i.e. creating waste and/or soling of equipment).

[0021] In a preferred embodiment, the method comprises the steps of: providing a holding device to hold the capsule shell; and conveying the holding device together with the capsule shell during and/or between one or more of the steps of: introducing a liquid into the cavity, sealing the open end of the shell, inspecting the capsule or a component thereof, identifying the capsule as defective, and rejecting a capsule identified as defective. In a particularly preferred embodiment, the holding device is configured to hold a plurality of capsule shells. Thus, the holding device may be configured as a tray having a plurality of cells or receptacles, each of which is adapted or designed to hold a respective capsule shell, which is conveyed along or between two or more of the dispensing, sealing, inspecting, identifying and rejecting steps.

[0022] As will be appreciated, the step of dispensing the liquid into the cavity through the open end of the capsule shell involves substantially filling the cavity of the shell with the liquid. In the event that a holding device configured to hold a plurality of capsule shells is employed, the step of dispensing the liquid or of filling the cavity may occur for the plurality capsule shells simultaneously. In this regard, a liquid dispensing device may be employed which is configured to dispense or inject the liquid into a plurality of shell cavities simultaneously.

[0023] In the event that a holding device configured to hold a plurality of capsule shells is employed, in a preferred embodiment the method includes the steps of:

[0024] positioning a plurality of capsule shells on the holding device;

[0025] referencing a position of each individual shell relative to the holding device; and

[0026] conveying the holding device with a position reference conveyor system between at least two steps selected from the steps of: introducing or dispensing a liquid into the cavity, sealing the open end of the shell, inspecting the capsule or a component thereof, identifying the capsule as defective, and rejecting a capsule identified as defective.

[0027] By referencing the position of each individual shell relative to the holding device and conveying the holding device with a position reference conveyor system, the relative position of each individual shell can be known and tracked along a path of the manufacturing process. As a result, when a defective capsule is identified and/or rejected, it is possible to trace the origin of the capsule, thereby reducing maintenance time.

[0028] In the event that a holding device configured to hold a plurality of capsule shells is employed in the method

of this invention, the step of sealing the open end of the shell may include: covering the open end of each a plurality of capsule shells with the sheet material; fusing or bonding the sheet material to seal said end of each of the plurality of shells; and cutting excess sheet material from the sheet material at the sealed end of each shell. As noted above, the step of sealing the open end of the shells may comprise substantially contouring or shaping the ends of the shells, which may occur during cutting of the excess sheet material from the sealed ends of the shells.

[0029] According to another aspect, the present invention provides an apparatus for manufacturing a liquid-filled capsule for use in a smoking article, comprising:

[0030] a holder for holding one or more capsule shells;

[0031] a conveyor for moving or transporting the holder with the one or more capsule shells;

[0032] a filling station for dispensing a liquid into a cavity of each of the capsule shells held by the holder, wherein the filling station is configured to provide a pre-defined space or clearance between the liquid dispensed into the cavity and the open end of each shell; and

[0033] a sealing station for covering and sealing an open end of each capsule shell with a sheet material to form a capsule.

[0034] As noted above, in a preferred embodiment the pre-defined space or clearance is at least 0.4 mm, more preferably at least 0.6 mm, particularly preferably at least 0.8 mm.

[0035] In a preferred embodiment, the holder for holding the one or more capsule shells comprises a tray having a plurality of cells, each of which is configured to receive and hold a respective capsule shell. The conveyor for moving or transporting the holder may comprise one or more of a conveyor arm, a conveyor belt, and a turntable. The filling station preferably comprises one or more nozzles in fluid connection with a supply reservoir of the liquid. Each nozzle is configured to dispense a predetermined volume of the liquid into a respective one of the shells via an open end of each shell.

[0036] In a preferred embodiment, the sealing station comprises a supply roll of the sheet material, a heat-sealing device for fusing the sheet material to a rim at the open end of each capsule, and/or a cutting device for cutting excess sheet material from the rim at the end of each capsule. The sheet material is preferably drawn from the supply roll by a feed roller. The cutting device is preferably configured to cut the excess sheet material and to contour or shape the rim at the end of each capsule.

[0037] In a preferred embodiment, the apparatus further comprises a discharge conveyor for discharging the capsules from an inspecting station to a delivery station. The discharge conveyor is preferably configured as a vacuum conveyor that suction or draws (via suction) the capsules from the holder.

[0038] In a preferred embodiment, the apparatus further comprises a rejecting station at which a defective capsule is removed.

[0039] According to a further aspect, the present invention provides a liquid-filled capsule for use in a smoking article, the capsule comprising: a capsule shell defining a cavity and having an end with a filling opening; a volume of liquid contained within the cavity; and a cap which covers and seals the filling opening. The capsule has a pre-defined space

or clearance provided between an upper surface of the liquid contained in the cavity and the end of the shell.

[0040] In a preferred embodiment, a maximum diameter of the capsule is in the range from 2.5 mm to 8.0 mm, preferably from 3.0 mm to 7.5 mm, more preferably from 3.5 mm to 7.0 mm. In this regard, a maximum capsule diameter at the lower end of the range is naturally preferred for fat slim cigarettes and super slim cigarettes.

[0041] In a preferred embodiment, a height of the capsule is in the range from 3 mm to 17 mm, preferably from 6 mm to 14 mm, further preferably from 8 mm to 12 mm, and particularly preferably from 9 mm to 11 mm.

[0042] In a preferred embodiment, the pre-defined space or clearance is at least 0.4 mm, preferably at least 0.6 mm, more preferably at least 0.8 mm; e.g. about 1.0 mm.

[0043] In a preferred embodiment, a filling ratio of the capsule is above a predetermined minimum, and preferably within a pre-defined range. The predetermined minimum of the filling ratio is 0.5, and the pre-defined range of the filling ratio is from 0.5 to 0.9, preferably from 0.75 to 0.9, and more preferably 0.8 to 0.9. In this regard, the filling capacity of the cavity may be in the range of 50 μ l to 300 μ l, preferably in the range of 75 μ l to 250 μ l, and optionally in the range of 100 μ l to 200 μ l.

BRIEF DESCRIPTION OF THE DRAWINGS

[0044] For a more complete understanding of the invention and the advantages thereof, exemplary embodiments of the invention are explained in more detail in the following description with reference to the accompanying drawing figures, in which like reference characters designate like parts and in which:

[0045] FIG. 1 is a schematic illustration of a known manufacturing method and apparatus from the prior art;

[0046] FIG. 2a is a perspective side view of a capsule manufactured according to one preferred embodiment of the invention;

[0047] FIG. 2b is a perspective side view of a capsule manufactured according to another preferred embodiment of the invention;

[0048] FIG. 2c is a cross-sectional view of a capsule manufactured according to a further preferred embodiment of the invention;

[0049] FIG. 2d is a schematic side view of a capsule manufactured according to a preferred embodiment of the invention;

[0050] FIG. 3 shows a schematic example of a holding device used to convey shells in a manufacturing method and apparatus according to an embodiment of the invention; and

[0051] FIG. 4 is a diagram schematically illustrating an apparatus for performing a method of manufacturing a capsule according to an embodiment of the invention.

DETAILED DESCRIPTION

[0052] The accompanying drawings are included to provide a further understanding of the present invention and are incorporated in and constitute a part of this specification. The drawings illustrate particular embodiments of the invention and together with the description serve to explain the principles of the invention. Other embodiments of the invention and many of the attendant advantages of the invention will be readily appreciated as they become better understood with reference to the following detailed description.

[0053] It will be appreciated that common and well understood elements that may be useful or necessary in a commercially feasible embodiment are not necessarily depicted in order to facilitate a more abstracted view of the embodiments. The elements of the drawings are not necessarily illustrated to scale relative to each other. It will further be appreciated that certain actions and/or steps in an embodiment of a method may be described or depicted in a particular order of occurrences while those skilled in the art will understand that such specificity with respect to sequence is not actually required. It will also be understood that the terms and expressions used in the present specification have the ordinary meaning as is accorded to such terms and expressions with respect to their corresponding respective areas of inquiry and study, except where specific meanings have otherwise been set forth herein.

[0054] With reference now to FIGS. 2a, 2b, 2c and 2d of the drawings, three embodiments of a liquid-filled breakable capsule 100 according to the invention are illustrated. In each case, the capsule 100 comprises an open-ended shell 101 which is closed and sealed with a cap 102. The shell 101 has a side wall or lateral wall 103 that extends from an end wall 104 to an open end 105 and thus surrounds or defines a cavity 106 in the shell 101. Preferably, the lateral wall 103 ends in a rim 107 at the open end 105 to facilitate application of the cap 102. The lateral wall 103 may be generally cylindrical (cf. FIGS. 2a and 2c) or may be faceted (cf. FIG. 2b). The side or lateral wall 103 may taper or narrow from the open end 105 towards the end wall 104.

[0055] The end wall 104 of each shell 101 may include one or more lines of weakness or one or more stress concentrator elements 108 to create a weakened region, in which the shell 101 is configured to break preferentially upon application of a compressive force to its side wall or lateral wall 103. In other words, the shell 101 includes a predefined rupture region such that, when the consumer compresses the sides of the capsule 100, the shell 101 will break preferentially in the rupture region. The shell 101 is typically made from a resiliently deformable material, such as a polymer material. The cap 102 is typically formed and cut from a section or an expanse of sheet material, such as a laminated plastic sheet material. The liquid L in the capsule may comprise purified water or a water-based liquid which contains a dissolved or suspended flavouring substance. As shown schematically in FIG. 2d, a volume of liquid L dispensed into the cavity 106 through the open end 105 of each shell 101 is selected to provide a pre-defined space or clearance δ between an upper surface of the liquid L and the end 105 of the shell 101. The pre-defined space or clearance δ may, for example, be selected to be in the range of about 0.8 to about 2.0 mm, and preferably in the range of about 0.9 mm to about 1.5 mm.

[0056] An example of a breakable capsule 100 that can be adequately manufactured with the method of the invention comprises a shell 101 made of LDPE and a cap 102 made of a plastic laminate having a layer of PE and a layer of PET, where the PE layer is the layer that is in contact with the rim 107 of the shell 101 in the finished capsule 100. The thickness of such a laminate layer is typically about 0.05 mm; i.e. 50 μ m. The liquid dispensed into the capsule 100 comprises purified water with a flavouring substance.

[0057] The target height of the shell 101 is 10.0 mm and the target outer diameter of the shell 106 is 6.28 mm. Such a shell 101 has a filling capacity of 131 μ l. The target height

of the capsule 100 is 10.0 mm, whereas the target outer diameter of the shell 101 is 6.70 mm. The target volume of retained liquid is 115 μ l and the target weight of the capsule 100 (shell 101, cap 102, and water) is 195 mg. In this case, this exemplary capsule 100 has a clearance δ of about 0.95 mm and a filling ratio of about 0.88.

[0058] With reference now to FIG. 3 and FIG. 4 of the drawings, an embodiment of the method and apparatus of the invention will be described. The shells 101 may be moulded, preferably injection-moulded, in a moulding station 1 with a pair of dies (not shown) configured to produce a batch of shells 101. The shells 101 are then positioned on a tray 10 having a plurality of cells 11 configured to receive and hold the shells 101, preferably arranged in an array. The cells 11 are referenced such that their position within the tray 10 is known. As a result, each individual shell 101 has a known position within the tray 10. The tray 10 may have capacity for holding one or more batches of multiple moulded shells 101.

[0059] Once the tray 10 is fully loaded with shells 101, a conveyor arm (not shown) picks up the tray 10 and conveys it to a shell inspection station 2. The conveyor arm moves or transports the tray 10 while maintaining the positioning reference of the individual shells 101. At the shell inspection station 2, the height and diameter of each shell 101 is measured, preferably optically measured by means of an optical measuring device, such as a camera. If the measured height and/or the measured diameter of any one of the shells 101 deviate(s) from a target value such that it is not within an established or predetermined tolerance band, that shell 101 is then identified as defective. This is an optional inspection step that can also be omitted without departing from the invention.

[0060] Thereafter, the conveyor arm again picks up the tray 10 holding the shells 101 and conveys or transports it to a filling station 3 located on a turntable C. As before, the conveyor arm conveys the tray 10 while maintaining the positioning reference of the individual shells 101. The filling station 3 includes a liquid reservoir connected to a plurality of nozzles, which are configured and arranged to dispense the liquid into the cavities 106 of all the shells 101 on the tray substantially simultaneously. As an alternative, however, the filling station 3 could include a reduced number of nozzles configured and arranged to dispense to, and to fill, only a selection of the shells 101 at any given time. Each of the nozzles is adapted to dispense a volume of liquid to fill the respective shell cavity 106. In this connection, the shells 101 are desirably supported and held on the tray 10 such that the open ends 105 of the shells 101 face upwards towards the nozzles, which fill the shells 101 from above.

[0061] After the shell cavities 106 have been filled with the liquid at filling station 3, the turntable C is rotated (in the clockwise direction, as shown in FIG. 4) to move the tray 10 to a sealing station 4 where a sheet material is provided to cover and seal all of the open ends 105 of the shells 101. The sheet material is typically supplied or fed from a supply roll, preferably via a feed roller (not shown), such that the open ends 105 of all the shells 101 are covered simultaneously. Next, the sheet material is heat-sealed to the rim 107 of each shell 101.

[0062] The turntable C is then rotated further (in the clockwise direction, shown in FIG. 4) to move the tray 10 to a cutting station 5 where the sheet material sealed over the now covered ends 105 of the shells 101 is cut around each

rim **107** to form an individual cap **102** on each capsule **100**. The cutting station **5** preferably includes a rotary blade cutter (not shown), which may be embodied as a roller having blades shaped to contour the shell rims **107**. In this way, a batch of liquid-filled breakable capsules **100** is obtained at this stage, with each capsule **100** containing a volume of dispensed liquid.

[0063] Further rotation of the turning table C (in the clockwise direction, shown in FIG. 4) causes the tray **10**, now containing a batch of liquid-filled breakable capsules **100**, to rotate to a capsule inspection station **6**. Here the height and diameter of each capsule **100** is measured or assessed. Additionally, any misalignment of the cap **102** to the shell **101** can be measured. It is also possible to inspect an aspect of the liquid L at the capsule inspection station **6**, especially an opacity of the liquid L. These parameters are desirably measured optically, e.g. via an optical measuring device, such as a camera. If any of the measured parameters of a specific capsule **100** is determined to deviate from a target value such that it is not within a specific predetermined tolerance band, that capsule **100** is identified as defective.

[0064] The turning table C is then rotated further (in the clockwise direction in FIG. 4) to move the tray **10** to a rejecting station **7** at which any defective capsules are able to be rejected and removed. In this regard, defective capsules **100** may preferably be ejected from the tray **10** by a jet of compressed air. The defective capsules **100** removed or ejected may be collected for disposal or recycling.

[0065] In an alternative embodiment, a vacuum discharge conveyor (not shown) may be employed to remove a batch of the liquid-filled breakable capsules **100** from the tray **10** by applying a suction force and to convey them to a discharge area. During this transport of the capsules **100**, any defective capsules may be ejected from the batch by discontinuing the suction force exerted on the defective capsules **100**, thus allowing them to drop from the conveyor at a rejection station.

[0066] Instead of employing a turn-table in this embodiment, it will be appreciated that the filling, sealing, cutting, inspection and rejecting stations could be provided along a belt-type conveyor without departing from the invention.

[0067] Although specific embodiments of the invention have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that a variety of alternate and/or equivalent implementations exist. It should be appreciated that the exemplary embodiment or exemplary embodiments are only examples, and are not intended to limit the scope, applicability, or configuration in any way. Rather, the foregoing summary and detailed description will provide those skilled in the art with a convenient road map for implementing at least one exemplary embodiment, it being understood that various changes may be made in the function and arrangement of elements described in an exemplary embodiment without departing from the scope as set forth in the appended claims and their legal equivalents. Generally, this application is intended to cover any adaptations or variations of the specific embodiments discussed herein.

[0068] In this document, the terms “comprise”, “comprising”, “include”, “including”, “contain”, “containing”, “have”, “having”, and any variations thereof, are intended to be understood in an inclusive (i.e. non-exclusive) sense, such that the process, method, device, apparatus or system

described herein is not limited to those features or parts or elements or steps recited but may include other elements, features, parts or steps not expressly listed or inherent to such process, method, article, or apparatus. Furthermore, the terms “a” and “an” used herein are intended to be understood as meaning one or more unless explicitly stated otherwise. Moreover, the terms “first”, “second”, “third”, etc. are used merely as labels, and are not intended to impose numerical requirements on or to establish a certain ranking of importance of their objects.

LIST OF REFERENCE SIGNS

[0069]	1 moulding station
[0070]	2 shell inspection station
[0071]	3 filling station
[0072]	4 sealing station
[0073]	5 cutting station
[0074]	6 capsule inspection station
[0075]	7 rejecting station
[0076]	10 tray
[0077]	11 cell
[0078]	100 capsule
[0079]	101 shell
[0080]	102 cap
[0081]	103 side wall or lateral wall
[0082]	104 end wall
[0083]	105 open end
[0084]	106 cavity
[0085]	107 rim
[0086]	108 line of weakness or stress concentrator
[0087]	δ space or clearance
[0088]	L liquid
[0089]	C turntable

1. A method of manufacturing liquid-filled capsules for use in smoking articles, the method comprising the steps of:
 - providing a capsule shell defining a cavity and having an open end;
 - dispensing a volume of liquid into the cavity through the open end of the shell, whereby a space or clearance is provided between an upper surface of the liquid dispensed into the cavity and the open end of the shell; and
 - sealing the open end of the shell with a portion of sheet material to provide a liquid-filled capsule containing the volume of liquid.
2. A method according to claim 1, wherein the clearance is at least 0.4 mm.
3. A method according to claim 1, wherein the step of dispensing the liquid into the shell comprises providing the capsule with a filling ratio above a predetermined minimum, whereby the filling ratio of the capsule is a ratio of the volume of liquid dispensed to a filling capacity of the cavity, and wherein the predetermined minimum of the filling ratio is 0.5.
4. A method according claim 1, wherein the step of sealing the open end of the shell comprises:
 - covering the open end of the capsule shell with the portion of sheet material;
 - fusing or bonding the portion of sheet material to seal said end of the shell; and
 - cutting excess sheet material from the portion of sheet material at the sealed end of the shell.
5. A method according to claim 1, further comprising the steps of:

inspecting the liquid-filled capsule or a component thereof for a manufacturing defect;
 identifying the capsule as defective if a manufacturing defect is detected; and
 rejecting a capsule identified as defective.

6. A method according to claim 5, further comprising the steps of:
 providing a holding device to hold the capsule shell; and
 conveying the holding device together with the capsule shell between at least two steps selected from the steps of: dispensing the liquid into the cavity, sealing the open end of the shell, inspecting the capsule or a component thereof, identifying the capsule as defective, and rejecting a capsule identified as defective.

7. A method according to claim 6, wherein the holding device is configured to hold a plurality of capsule shells and wherein the method includes the steps of:
 positioning a plurality of capsule shells on the holding device;
 referencing a position of each individual shell relative to the holding device; and
 conveying the holding device with a position reference conveyor system between at least two steps selected from the steps of: dispensing the liquid into the cavity, sealing the open end of the shell, inspecting the capsule or a component thereof, identifying the capsule as defective, and rejecting a capsule identified as defective.

8. A method according to claim 1, wherein the step of sealing the open end of the shell comprises the steps of:
 covering the open end of each of a plurality of capsule shells with the portion of sheet material;
 fusing or bonding the portion of sheet material to seal said end of each of the plurality of shells; and
 cutting excess sheet material from the portion of sheet material at the sealed end of each shell.

9. An apparatus for manufacturing liquid-filled capsules for use in smoking articles, comprising:
 a holder for holding one or more capsule shells;
 a conveyor for moving or transporting the holder with the one or more capsule shells;
 a filling station for dispensing a liquid into a cavity of each of the capsule shells held by the holder, wherein the filling station is configured to leave a pre-defined space or clearance between the liquid dispensed into the cavity and an open end of each shell; and
 a sealing station for covering and sealing the open end of each capsule shell with a sheet material to form a capsule.

10. An apparatus according to claim 9, wherein the filling station comprises one or more nozzles in fluid connection with a supply reservoir of the liquid, wherein each nozzle is configured to dispense a predetermined volume of the liquid to a respective one of the shells.

11. An apparatus according to claim 9, wherein the sealing station comprises: a supply roll of the sheet material, a heat-sealing device for fusing the sheet material to a rim at the open end of each shell, and a cutting device for cutting excess sheet material from the rim at the end of each capsule.

12. An apparatus according to claim 9, wherein the holder for holding one or more capsule shells comprises a tray.

13. A liquid-filled capsule for use in smoking articles, the capsule comprising: a capsule shell defining a cavity and having an end providing a filling opening; a volume of liquid contained within the cavity; and a cap which covers and seals the end;

wherein a pre-defined clearance is provided between an upper surface of the liquid contained in the cavity and the end of the shell.

14. A capsule according to claim 13, wherein the pre-defined clearance 49 is at least 0.5 mm.

15. A capsule according to claim 13, wherein an end region of the shell comprises a pre-defined rupture region at which the shell is configured to break preferentially.

16. A method according to claim 3, wherein the step of dispensing the liquid into the shell further comprises providing the capsule with the filling ratio within a pre-defined range from 0.5 to 0.9.

17. An apparatus according to claim 11, wherein the sealing station further comprises a feed roller to drive the supply roll of the sheet material.

18. An apparatus according to claim 9, wherein the conveyor for moving or transporting the holder comprises one or more of a robotic conveyor arm, a conveyor belt, and a turntable.

19. An apparatus according to claim 9, further comprising a rejecting station at which any defective capsule is able to be removed.

20. A capsule according to claim 13, wherein a filling ratio of the capsule is above a predetermined minimum, whereby the filling ratio of the capsule is a ratio of the volume of liquid contained to a filling capacity of the cavity, and wherein the predetermined minimum of the filling ratio is 0.5.

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