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(54) **CONTAINER CLOSURE HAVING A SPOUT AND MEANS FOR INTRODUCING AN ADDITIVE INTO THE CONTENTS OF THE CONTAINER**

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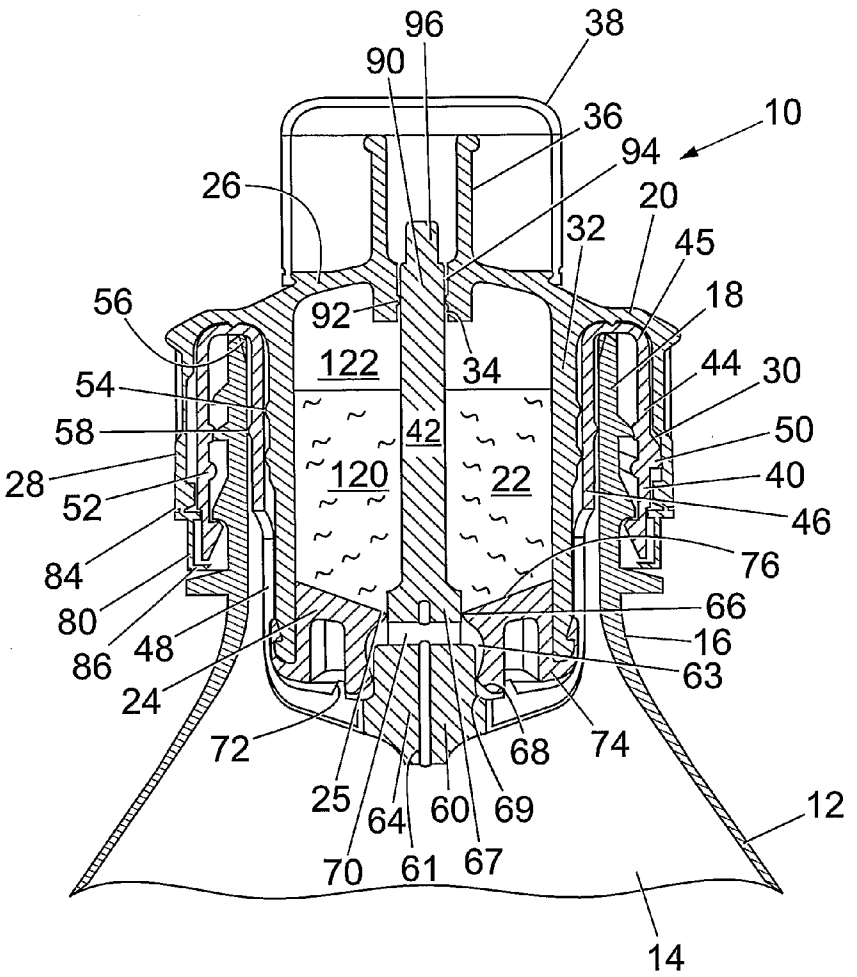
(57) **ABSTRACT**

A closure device which includes a fluid chamber containing an additive such as a liquid and a housing having a plug member. The cap member is provided with a primary engagement means, such as an internal thread, which engages with a corresponding primary engagement means provided on the housing, such as an external thread, to allow the cap member to be lifted relative to the housing from a closed position in which the plug member closes a bottom aperture and a spout aperture in the fluid chamber, through a first open position in which the plug member is at least partially withdrawn from the bottom aperture while still closing the spout aperture, thereby allowing the additive to pass from the fluid chamber, and to a second open position in which the spout aperture is at least partially open.



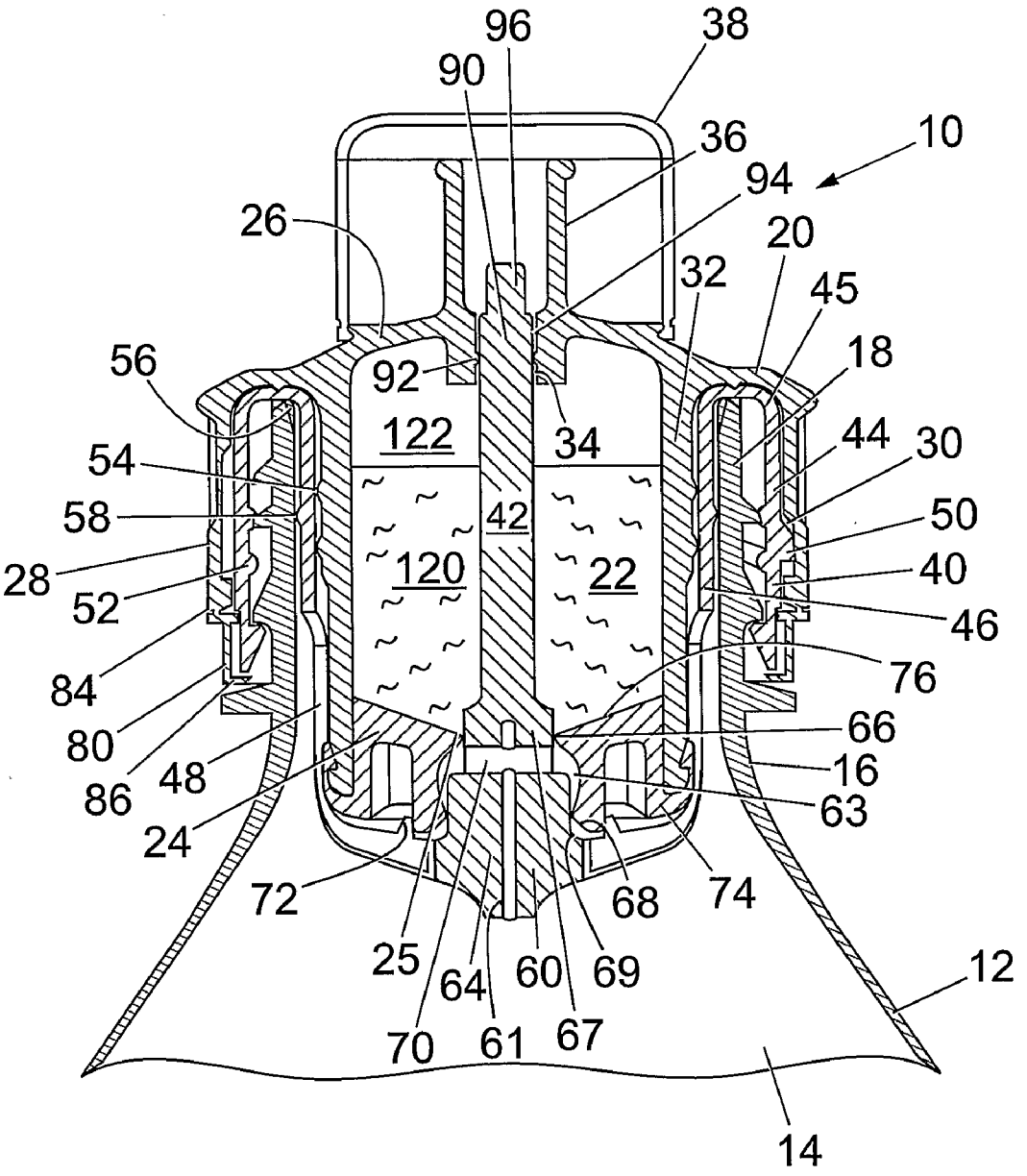

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Fig. 1

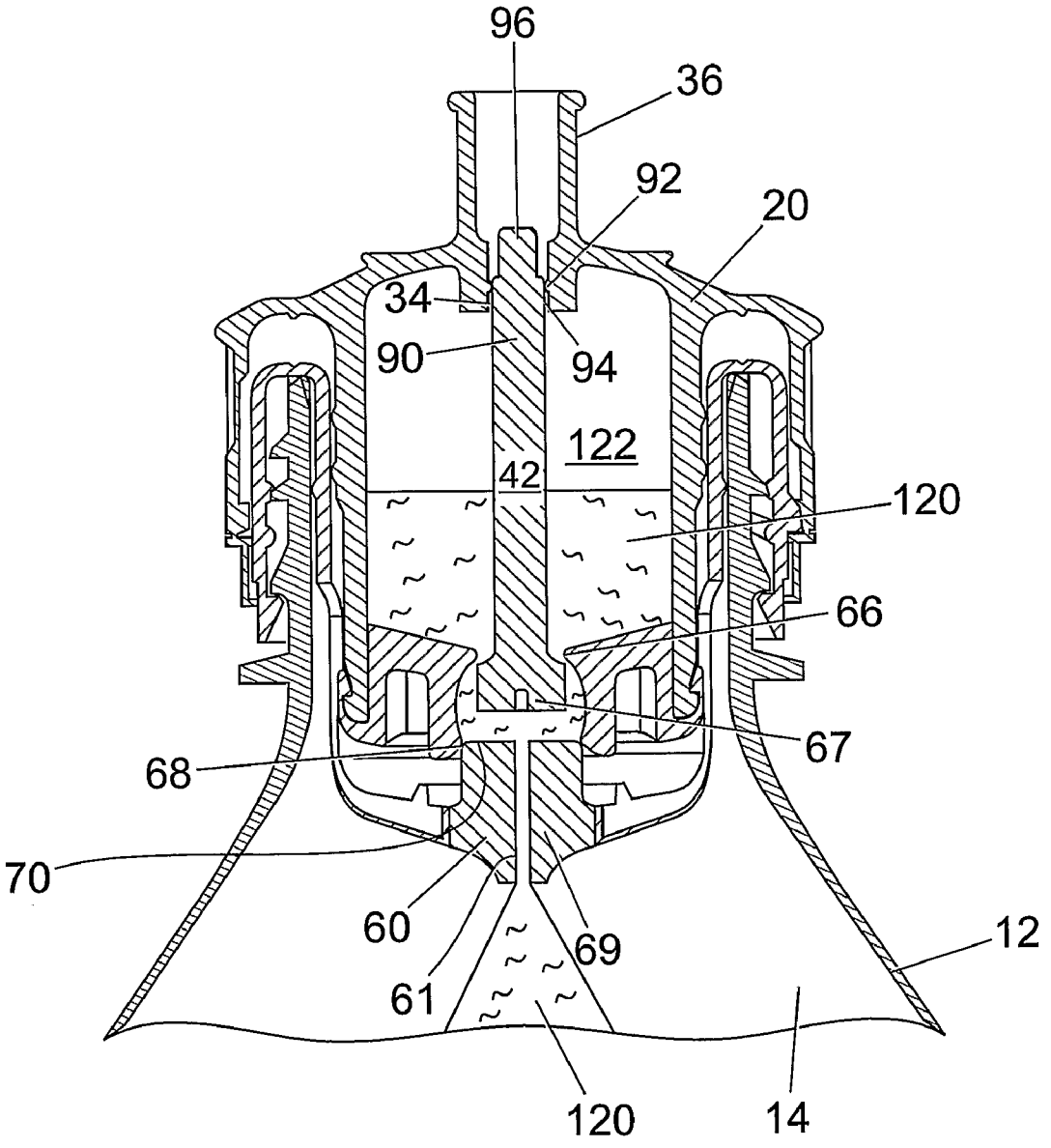

Fig. 2

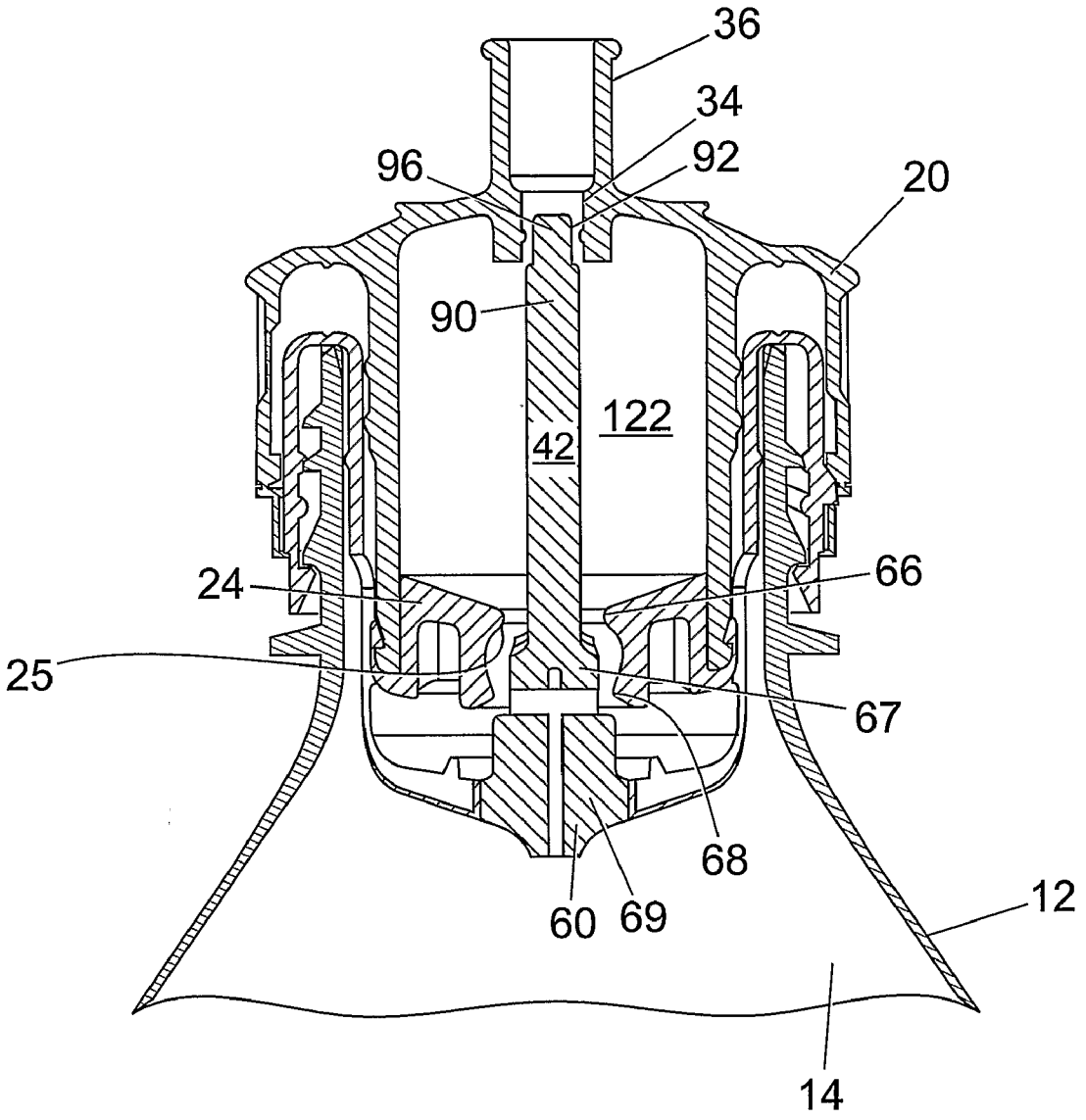

Fig. 3

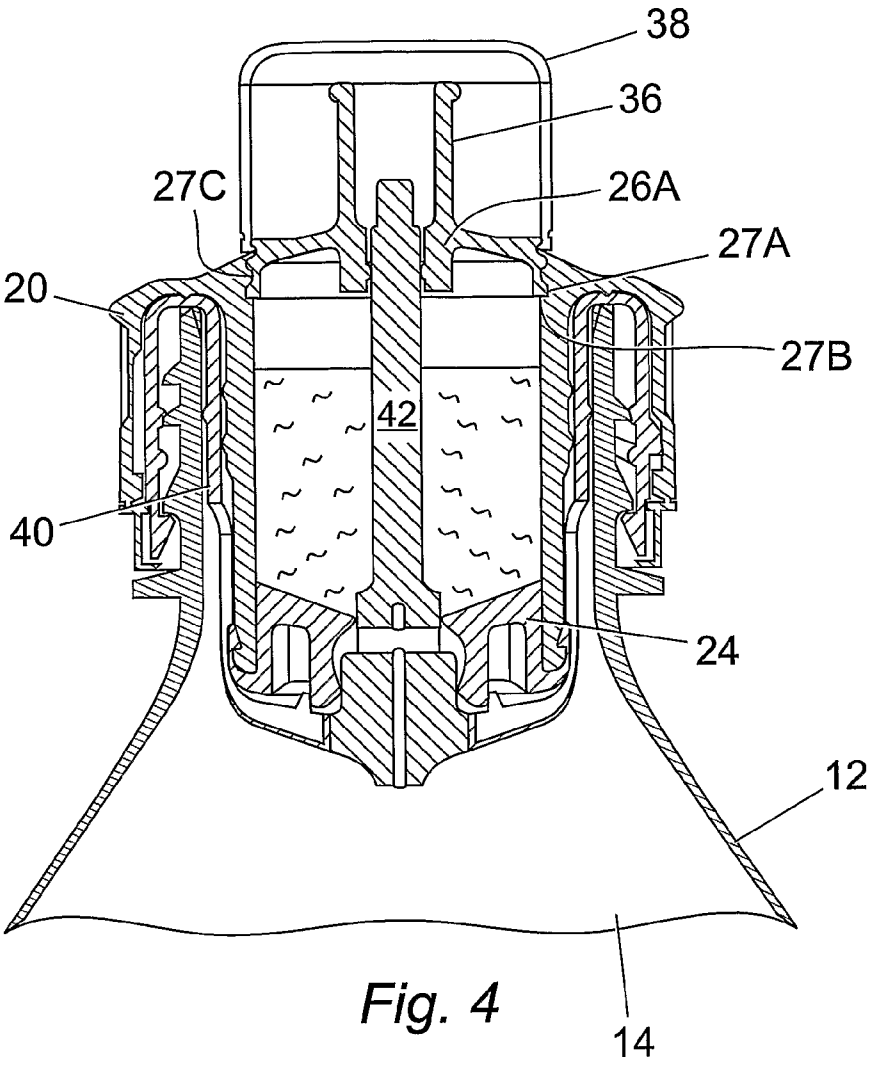

Fig. 4

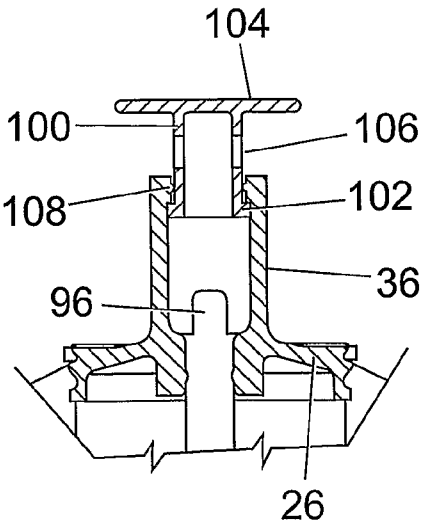

Fig. 5

CONTAINER CLOSURE HAVING A SPOUT AND MEANS FOR INTRODUCING AN ADDITIVE INTO THE CONTENTS OF THE CONTAINER

[0001] The present invention relates to a closure device for releasing an additive liquid into a liquid in a container by operation of the closure device, which allows the contents of the container to be reached without removal of the closure device. The invention also relates to a container including such a closure device and to a method of introducing an additive liquid by means of operating such a closure device.

[0002] In a number of applications, such as mixtures of different liquids, it may be necessary to release and mix an additive liquid into another liquid shortly before the liquid mixture is used. It may not be possible or desirable to store the liquids in a premixed form, as they may react undesirably with each other when stored as the mixture for a period of time. An example of this may be two component pharmaceuticals which have a longer shelf life when unmixed than they do when mixed. However, it can also apply to other liquids or to mixtures of liquids and gases, such as water, alcoholic beverages, other beverages, and other solvents or solutions. The liquid to which the additive liquid is introduced may be a carbonated or a non-carbonated liquid.

[0003] An assembly for releasing an additive liquid into a liquid in a container upon release of a closure from the container is known from the prior art. International Patent Application WO97/05039 discloses a device for releasing a liquid into another liquid held in a container. The known device is for use with containers having releasable closures. The device according to the prior art comprises a fluid chamber for storing a fluid. The fluid chamber is positioned adjacent an opening in the container. The fluid chamber comprises a fluid outlet for releasing fluid into the liquid.

[0004] The known device has the disadvantage that the closure must be at least partially opened to enable the mixing of the fluid stored in the fluid chamber with the liquid in the container. Moreover the closure must be completely removed to allow access to the mixed contents of the container.

[0005] According to a first aspect of the present invention there is provided a closure device for use with a container having a main liquid compartment and an opening with a neck,

[0006] the closure device comprising a cap member defining a fluid chamber and a plug member having a first plug portion sealingly engageable in an aperture in a bottom wall of the fluid chamber and a second plug portion sealingly engageable in a spout aperture, wherein the cap member is movable relative to the plug member

[0007] from a closed position in which the first plug portion closes the bottom wall aperture and the second plug portion closes the spout aperture,

[0008] through a first open position in which the first plug portion is at least partially withdrawn from the bottom wall aperture to provide a communication path in use from the fluid chamber to the main liquid compartment and in which the second plug portion closes the spout aperture,

[0009] to a second open position in which the second plug portion is at least partially withdrawn from the spout aperture.

[0010] The term "bottom wall" includes any wall of the fluid chamber in which a bottom wall aperture can be provided to allow additive fluid in the fluid chamber to be ejected under pressure into the main liquid compartment.

[0011] The term "plug member" includes any member capable of closing an aperture. The plug member may be a unitary or composite member on which are formed the first and second plug portions. Alternatively the first and second plug portions may be formed on separate elements.

[0012] The plug member may be provided on a housing having an inner housing wall adapted to fit inside the neck of the opening and the closure device may include sealing means which seals between the fluid chamber and the inner housing wall. This maintains a seal between the fluid chamber and inner housing wall, and therefore between the fluid chamber and the neck as the cap member and fluid chamber are lifted relative to the housing and container, in both the closed and open positions. The contents of the fluid chamber can thus pass into the main liquid compartment and be mixed, for example by shaking the container, while the container is still sealed closed by the closure member, so that there is no risk of the contents escaping between the closure member and the container.

[0013] In one embodiment the cap member may include an internal thread which engages with an external thread on the housing, so that the cap member is lifted relative to the housing by rotation of the cap member. However other forms of engagement are possible, for example a bayonet type engagement or a friction pull engagement or a longitudinal sliding engagement, or any other suitable form of engagement. The engagement means may prevent the cap member and the housing from being completely separated from each other.

[0014] The cap member may include a top cap wall, an outer cap wall on which is provided the internal thread and an inner cap wall extending from the top cap wall to the bottom wall and arranged inside the outer cap wall. The bottom wall may be formed separately from the remainder of the cap member, which may be formed as a single moulding.

[0015] The fluid chamber may be defined by the top cap wall, the inner cap wall and the bottom wall.

[0016] The housing may comprise an outer housing wall on which is provided the external thread. The thread may have a relatively steep angle, so that the cap member rises quickly when rotated. However the external thread may instead be provided on the neck of the container, and the housing may be secured inside the neck of the container by any suitable means, such as bonding.

[0017] The outer housing wall may be provided with an internal secondary thread adapted in use to engage with an external secondary thread provided on a neck of an opening of the container. Thus in use the outer housing wall may be screwed onto outside of the neck.

[0018] The housing further may comprise an inner housing wall arranged inside the outer housing wall and provided with internal sealing means to seal against an outer surface of the inner cap wall-and external sealing means to seal against an internal surface of the neck of the opening. The inner housing wall may be connected to the outer housing wall by a web which sits on top of the neck in use.

[0019] The housing may further comprise a frame which supports the plug member so that the plug member is arranged inside the inner housing wall and extends upwardly into the fluid chamber in use. The frame may include apertures allowing fluid passage therethrough, to avoid the creation of a

vacuum between the fluid chamber and housing, so that the housing is free to slide relative to the cap member when the cap member is inserted into or withdrawn from the housing.

[0020] The plug member may include a nozzle directed away from the fluid chamber.

[0021] The first or lower plug portion may include a cylindrical outer surface which engages with a sealing means provided in the bottom wall. Such a sealing means must be capable of holding pressurised fluid in the fluid chamber when this fluid is at higher pressure than the contents of the container.

[0022] The sealing means may comprise an upper seal which seals against an upper part of the cylindrical outer surface of the first plug portion when the cap member is in the closed position and which allows the passage of fluid between the upper seal and the plug member when the cap member is in the first open position.

[0023] The sealing means may comprise a lower seal which seals against a lower part of the cylindrical outer surface of the first plug portion when the cap member is in the closed and first open positions. This ensures that in the first open position pressurised fluid can only escape into the container through the communication path and nozzle, and does not leak around the plug member. The lower part of the cylindrical outer surface may have a greater diameter than the upper part of the cylindrical outer surface.

[0024] The plug member may include an internal fluid passage which extends to the cylindrical outer surface at a position below the upper seal when the cap member is in the closed position, the internal fluid passage being in communication with the nozzle.

[0025] The closure device may include a spout connected to the spout aperture. In one embodiment the spout includes a drinking tube and a closeable cap. This allows a user to drink from the spout aperture upon removal of a spout cap or dust cap when the cap member is in the second open position.

[0026] The spout aperture may be provided in a top cap wall of the cap member and the second plug portion includes a second cylindrical outer surface which engages with a sealing means provided in the top wall. The plug member may include a reduced portion above the second plug portion having a cross-sectional area smaller than that of the second plug portion, such that in the second open position the reduced portion extends through the spout aperture to provide a communication path in use from the fluid chamber through the spout aperture.

[0027] The cap member may include an anti-tamper strip provided on the cap member to prevent rotation of the cap member relative to the housing without at least partial removal of the anti-tamper strip.

[0028] The anti-tamper strip may comprise an extension of the outer cap wall connected to the outer cap wall by a neck portion thinner than the outer cap wall, the extension being provided with a flange which engages beneath a detent means provided on the neck of the container to prevent lifting of the cap member relative to the housing. The detent means may be provided on the housing. The strip may have a tab which can be pulled to tear the strip from the outer cap wall along the neck.

[0029] The primary engagement means of the cap member and housing may include mutually engageable detent means to prevent the rotation of the cap member relative to the housing beyond a predetermined limiting angle of rotation, corresponding to the second open position.

[0030] The fluid chamber may contain an additive liquid and a head space of pressurised gas.

[0031] According to a second aspect of the present invention there is provided a container having a main liquid compartment, an opening having a neck, and a closure device closing said opening,

[0032] wherein the closure device comprises a cap member defining a fluid chamber and plug member provided in the neck of the container, the plug member having a first plug portion sealingly engageable in an aperture in a bottom wall of the fluid chamber and a second plug portion sealingly engageable in a spout aperture,

wherein the cap member is moveable relative to the plug member

[0033] from a closed position in which the first plug portion closes the bottom wall aperture and the second plug portion closes the spout aperture,

[0034] through a first open position in which the first plug portion is at least partially withdrawn from the bottom wall aperture to provide a communication path from the fluid chamber to the main liquid compartment and in which the second plug portion closes the spout aperture,

[0035] to a second open position in which the second plug portion is at least partially withdrawn from the spout aperture.

[0036] The plug member may be provided on a housing having an inner housing wall arranged inside the neck of the opening and wherein the closure device includes sealing means which seals between the fluid chamber and the inner housing wall. This maintains a seal between the fluid chamber and inner housing wall in both the closed and open positions.

[0037] The cap member may include an internal thread and the housing may include an external thread, to allow the cap member to be lifted relative to the housing by rotation of the cap member.

[0038] The main liquid compartment may contain a primary liquid, which may contain water or be a beverage. However the primary liquid could be an alcoholic beverage, a cosmetic preparation, a pharmaceutical product, a dairy product or an agricultural feed or other product, or any other suitable liquid or semi-liquid substance.

[0039] The fluid chamber may contain an additive liquid and may contain a head space of pressurised gas.

[0040] The cap member may include a top cap wall, an outer cap wall on which is provided the internal thread and an inner cap wall extending from the top cap wall to the bottom wall and arranged inside the outer cap wall.

[0041] The fluid chamber may be defined by the top cap wall, the inner cap wall and the bottom wall.

[0042] The housing may comprise an outer housing wall on which is provided the external thread. The outer housing wall may be located outside the neck of the container and may be provided with an internal secondary thread engaged with an external secondary thread provided on the neck of the container.

[0043] The housing may comprise an inner housing wall arranged inside the neck of the container and provided with internal sealing means to seal against an outer surface of the inner cap wall and external sealing means to seal against an internal surface of the neck of the opening.

[0044] The housing may further comprise a frame which supports the plug member so that the plug member is arranged inside the inner housing wall and extends upwardly into the fluid chamber in use.

[0045] The plug member may include a nozzle directed away from the fluid chamber.

[0046] The first or lower plug portion may include a cylindrical outer surface which engages with a sealing means provided in the bottom wall. Such a sealing means must be capable of holding pressurised fluid in the fluid chamber when this fluid is at higher pressure than the contents of the container.

[0047] The sealing means may comprise an upper seal which seals against an upper part of the cylindrical outer surface of the first plug portion when the cap member is in the closed position and which allows the passage of fluid between the upper seal and the plug member when the cap member is in the first open position.

[0048] The sealing means may comprise a lower seal which seals against a lower part of the cylindrical outer surface of the first plug portion when the cap member is in the closed and first open positions. This ensures that in the first open position pressurised fluid can only escape into the container through the communication path and nozzle, and does not leak around the plug member. The lower part of the cylindrical outer surface may have a greater diameter than the upper part of the cylindrical outer surface.

[0049] The plug member may include an internal fluid passage which extends to the cylindrical outer surface at a position below the upper seal when the cap member is in the closed position, the internal fluid passage being in communication with the nozzle.

[0050] The closure device may include a spout connected to the spout aperture. In one embodiment the spout includes a drinking tube and a closeable cap. This allows a user to drink from the spout aperture upon removal of a spout cap or dust cap when the cap member is in the second open position.

[0051] The spout aperture may be provided in a top cap wall of the cap member and the second plug portion may include a second cylindrical outer surface which engages with a sealing means provided in the top wall. The plug member may include a reduced portion above the second plug portion having a cross-sectional area smaller than that of the second plug portion, such that in the second open position the reduced portion extends through the spout aperture to provide a communication path in use from the fluid chamber through the spout aperture.

[0052] The cap member may include an anti-tamper strip provided on the cap member to prevent rotation of the cap member relative to the housing without at least partial removal of the anti-tamper strip.

[0053] The anti-tamper strip may comprise an extension of the outer cap wall connected to the outer cap wall by a neck portion thinner than the outer cap wall, the extension being provided with a flange which engages beneath a detent means provided on the neck of the container to prevent lifting of the cap member relative to the housing. The detent means may be provided on the housing. The strip may have a tab which can be pulled to tear the strip from the outer cap wall along the neck.

[0054] The primary engagement means of the cap member and housing may include mutually engageable detent means to prevent the rotation of the cap member relative to the housing beyond a predetermined limiting angle of rotation, corresponding to the second open position.

[0055] According to a third aspect of the invention there is provided a method of introducing an additive liquid into a main liquid compartment of a container having an opening with a neck, the method comprising the steps of:

[0056] raising a cap member of a closure device and a fluid chamber defined by said cap member relative to a plug member from a closed position, in which an aperture provided in a bottom wall of said fluid chamber is closed by a first plug portion of said plug member and a spout aperture provided in said fluid chamber is closed by a second plug portion of said plug member, to a first open position, in which said first plug portion is at least partially withdrawn from said aperture to provide a communication path from said fluid chamber to said main liquid compartment and in which said spout aperture remains closed by said second plug portion,

[0057] releasing pressurised additive liquid from said fluid chamber along said communication path into said main liquid compartment, and

[0058] raising said cap member further relative to said plug member to a second open position, in which said second plug portion is at least partially withdrawn from said spout aperture to provide a communication path from said fluid chamber through said spout aperture.

[0059] Although the second plug portion may slide within the spout aperture, the spout aperture remains closed by the second plug portion when the cap member is in the first open position. This ensures that the pressurised additive liquid can only flow along the communication path into the main liquid compartment, and cannot escape to the atmosphere through the spout aperture.

[0060] The method may include the further step of causing liquid from the main liquid compartment together with the additive liquid released from the fluid chamber to pass from the main liquid compartment through the bottom wall aperture into the fluid chamber and from the fluid chamber through the spout aperture to a spout. Because the additive liquid is completely expelled from the fluid chamber under the pressure of the gas in the fluid chamber, the liquid passing to the spout through the fluid chamber is a fully mixed liquid.

[0061] The plug member may be provided on a housing, and during the raising of the fluid chamber relative to the plug member a seal may be maintained between the fluid chamber and an inner housing wall of the housing arranged in the neck of the container.

[0062] The cap member may be raised by rotating the cap member such that the fluid chamber is raised by screw thread action relative to the plug member. The action can be arranged such that a first rotation to a point of resistance is sufficient to open the cap member to the first open position, while rotation beyond the point of resistance to an end stop is sufficient to open the cap member to the second open position.

[0063] The method may include the step of at least partially removing an anti-tamper strip provided on the cap member, thereby allowing raising of the cap member relative to the plug member.

[0064] The invention will be described, by way of example only, with reference to the drawings in which:

[0065] FIG. **1** shows a cross-section through a closure device according to the invention secured to the neck of a container with the closure device in a closed position;

[0066] FIG. **2** shows a cross-section through the closure device of FIG. **1** with the closure device in a first open position in which a liquid additive is released under pressure into a main compartment of the container;

[0067] FIG. **3** shows a cross-section through the closure device of FIG. **1** with the closure device in a second open position in which liquid including he liquid additive can pass from the main compartment of the container to a spout aperture;

[0068] FIG. **4** shows a cross-section through a modified closure device according to the invention; and

[0069] FIG. **5** shows a cross-section through an alternative spout arrangement of a closure device according to the invention.

[0070] With reference to FIG. **1** there is shown a closure device **10** together with the upper part of a container **12**. The container is a standard PET bottle having a main liquid compartment **14** and a standard **30** mm neck **16** with an external thread **18**. For the purposes of this invention the thread is described as a secondary thread **18**.

[0071] The closure device **10** comprises two main parts, a cap member **20**, which defines a fluid chamber **22**, and a housing **40**. The cap member **20** includes a bottom wall **24**, which although it may be made of a different material is secured to the remainder of the cap member **20** to form a unitary member. An aperture **25** is provided in the bottom wall **24**. The cap member **20** includes a top cap wall **26**, an outer cap wall **28**, and an inner cap wall **32**, which may all be formed as a single moulding from polypropylene or any other suitable plastic. The outer cap wall includes an internal primary thread **30** adapted to engage a corresponding external primary thread on the housing **40**, as will be described below. Together the internal and external primary threads allow the cap member **20** to be lifted relative to the housing **40**.

[0072] The top cap wall **26** includes a spout aperture **34** and a spout **36**. An optional spout cap or dust cap **38** is secured to the top cap wall. Such spout caps **38** are known with beverage bottles having a drinking spout and are not further described.

[0073] The housing **40** is also preferably formed as a unitary polypropylene moulding, although it can be formed from any other suitable material. It comprises a plug member **42** arranged on the central axis of the closure member **10**, an outer housing wall **44** adapted to fit outside the neck **16**, a web **45** which sits on top of the neck **15**, an inner housing wall **46** which extends down from the web **45** inside the neck and which seals against the neck **10**, and a frame **48** which extends from the inner housing wall **46** and supports the plug member **42**.

[0074] The outer housing wall **44** has an external primary thread **50** which engages the internal primary thread **30** on the cap member. It also has an internal secondary thread **52** which engages the external secondary thread **18** on the neck **16** of the container. The secondary threads are used to fit the housing **40** to the neck **16**.

[0075] Internal sealing means **54** are provided to seal between the inner cap wall **32** and the inner housing wall **44**. In the illustrated example the internal sealing means **54** are formed as ribs on the outer surface of the inner cap wall, but they could be formed as ribs on the inner surface of the inner housing wall, or as any other suitable sealing means. The internal sealing means **54** prevents the contents of the container **12** passing between the inner cap wall **32** and the inner housing wall **44** during storage and while the cap member **20** is raised relative to the housing **40**, as later described.

[0076] External sealing means in the form of a taper **56** and rib **58** are provided to seal between the inner housing wall **44** and the neck **16** of the container **12**. Such seals are well known in the art and serve to prevent the contents of the container **12** passing between the inner housing wall **44** and the neck during storage. A taper seal may be used for the internal sealing means **54** also.

[0077] The plug member **42** has a nozzle **60** extending below it. A nozzle passage **61** is provided to convey pressurised liquid from the fluid chamber **22** when the closure device is opened. The plug member **42** has a first lower plug portion **64** which engages sealingly with the bottom wall aperture **25** and a second upper plug portion **90** which engages sealingly with the spout aperture **34**.

[0078] The lower plug portion **64** is formed with upper and lower cylindrical outer surface portions **62**, **64** which engage sealingly with sealing means **64** provided at the aperture **25** in the bottom wall **24**. In the example the sealing means comprises a smaller diameter upper seal **66** which when the plug member **42** is in the closed position of FIG. **1** engages with the upper cylindrical outer surface portion **67** above an internal fluid passage **70**, while a larger diameter lower seal **68** engages with the lower cylindrical outer surface portion **69** below the internal fluid passage **70**.

[0079] The upper surface **76** of the bottom wall **24** slopes towards the plug member **42**, so that all the liquid is drained from the fluid chamber **22** when the plug member is in the first open position. The lower seal **68** is held by a collar **72** provided on the frame **48** which urges the lower seal **68** against the lower plug portion **64**.

[0080] In the illustrated example the bottom wall **24** includes a flange **74** which locks onto a corresponding flange at the edge of the inner cap wall **32** when the cap member is assembled. However any other suitable method of vapour-tight connection may be used, such as laser welding.

[0081] At the lower edge of the outer cap wall **28** is an anti-tamper strip **80**, with a tab (not shown) which can be pulled to remove the strip. The strip is an extension of the outer cap wall **28**, connected by a neck portion **84**, and engaging the underside of the outer housing wall **44** by a detent flange **86**. Such anti-tamper strips are known in the art and are not described further. Until the anti-tamper strip **80** is at least partially removed, the cap member **20** cannot be unscrewed from the housing **40**. Once the anti-tamper strip **80** is at least partially removed the cap member **20** can be unscrewed from the housing **40** by interaction of the internal thread **30** on the cap and the external thread **50** on the housing. The threads may include mutually engaging detent means (not shown), which serve to limit the relative rotation of the cap member **20** and housing **40**. It is to be understood that any suitable mutually engaging shape or protrusion may be used to limit this movement. The anti-tamper strip may be replaced by any other suitable anti-tamper means, or may be omitted.

[0082] At the lower edge of the outer housing wall **44** is provided a detent which engages with the neck **16** of the container so that the housing **40** may not be easily removed from the neck **16** by unscrewing. Although in the example illustrated the housing **40** includes an outer wall **44** and web **45**, it is to be understood that the outer wall **44** may be omitted and the housing may be secured to the neck in any other suitable manner, for example by bonding the inner housing wall **46** to the neck **16**. In this case the primary external thread is the external thread **18** on the neck **16**, and the outer cap wall

28 and internal primary thread 30 are dimensioned accordingly to fit the thread on the neck 16.

[0083] FIGS. 1, 2 and 3 show the operation of the closure device of the invention.

[0084] In FIG. 1 the closure device 10 is secured to a container 12 containing a primary liquid (not shown), for example water in its main liquid compartment 14. The fluid chamber 22 in the cap member contains a liquid additive 120 and a head space 122 of pressurised gas. The closure device 10 is in the closed position, in which the fluid chamber 22 is sealed closed by the plug member 42. The lower plug portion 64 is engaged in the aperture 25 in the bottom wall 24, while the upper plug portion 90 is engaged in the spout aperture 34. The housing 40 is secured to the neck 16 through the secondary threads 18, 52, and the cap member 20 is screwed fully onto the outer housing wall 44 through the internal and external primary threads 30, 50. The contents of the container 12 may be at atmospheric pressure, or may be pressurised to a pressure less than that of the fluid chamber 22. There is a seal 54 provided between the fluid chamber 22 and inner housing wall 46, and further seals are provided between the inner housing wall 46 and the neck 16 so that the contents of the container are sealed from the external atmosphere.

[0085] To trigger the firing of the liquid additive 120 into the main liquid compartment 14 of the container 12, the cap member 20 must be unscrewed relative to the housing 40 to the position shown in FIG. 2, through a first angle of 45° according to the preferred embodiment. However it is to be understood that this first angle may be any desired angle by appropriate selection of the thread and pitch. First the anti-tamper strip 80 is at least partially removed so that the outer cap wall 28 is free to be raised relative to the outer housing wall 44. Then the cap member 20 is grasped and rotated. The primary threads 30, 50 have a relatively large thread angle, so that a relatively large vertical displacement is effected by a relatively small rotation. As the cap member rises, the fluid chamber 22 is lifted away from the lower plug portion 64. When the upper seal 66 of the bottom wall 24 passes above the top of the upper cylindrical outer surface portion 67, as shown in FIG. 2, the main liquid compartment 14 comes into fluid communication with the fluid chamber 22, and the pressurised additive liquid 120 is free to pass between the upper seal 66 and the outer surface portion 67 of the lower plug portion 64, into the internal fluid passage 70, along the nozzle passage 61 and out of the nozzle 60 into the main liquid compartment 14. The lower seal 68 in the bottom wall 24 continues to seal between the bottom wall 24 and the lower cylindrical outer surface portion 69 of the lower plug portion 64, so that the additive liquid 120 cannot leak into the main liquid compartment 14 along any other path. At the same time the seal 92 in the top cap wall 26 continues to seal between the top cap wall and the cylindrical outer surface 94 of the upper plug portion 90, so that the additive liquid 120 cannot leak into the spout 36.

[0086] Typically the primary thread 30, 50 is a standard 30/25 PET bottle thread with 9 mm pitch, of the type used with PET water bottles, and the closure device 10 is arranged so that the additive liquid 120 is fired into the main liquid compartment 14 when the cap member is rotated through 45° from the closed position under optimum tolerance. In practice this angle could be smaller or greater, in the range 0° to 90°.

[0087] The volume of the head space 122 is chosen to be sufficiently large so that all the additive liquid 122 is expelled into the main liquid compartment 14. The top surface 76 of the bottom wall 24 slopes down towards the aperture 25, so that under gravity all the additive liquid flows to the aperture.

[0088] Referring now to FIG. 3, following release of the additive liquid 120, the cap member 20 is rotated further through a second angle of 45° according to the preferred embodiment, until mutually engageable detent means (not shown) on the cap 20 and housing 40 engage with each other and prevent further relative rotation. Typically this happens when the cap member 20 is rotated through a total of 90° from the closed position.

[0089] As the cap member rises further, the fluid chamber 22 is lifted further away from the lower plug portion 64. When the lower seal 68 of the bottom wall 24 passes above the top of the lower cylindrical outer surface portion 69, as shown in FIG. 3, the main liquid compartment 14 comes into fluid communication with the fluid chamber 22 by means of the annular passage formed between the upper and lower seals 66, 68 and the plug member 42. At the same time the seal 92 in the top cap wall 26 passes above the top of the cylindrical outer surface 94 of the upper plug portion 90, so that the spout 36 comes into fluid communication with the fluid chamber 22 by means of the annular passage formed between the spout aperture 34 and the reduced portion 96 of the plug member 42. Typically the reduced portion 96 has a cruciform cross-section, to maximise the area of the flow path through the spout aperture 34.

[0090] If the container 12 is inverted the liquid in the main liquid compartment 14 is free to flow past the lower plug portion 64 into the fluid chamber 22 and past the upper plug portion 90 into the spout 36, enabling a user to drink from the container in a manner similar to that used with conventional sports-type spout containers.

[0091] If required, the closure device 10 can closed again by screwing the cap member 20 back down, and the container device will be sealed closed when it reverts to the position shown in FIG. 2, although it can then be further rotated to the position shown in FIG. 1.

[0092] A method of assembling a closure device 10 according to the invention will now be described. The cap member 20, without the bottom wall 24, is formed by moulding from polypropylene for example. The housing 40 is also formed separately by moulding from polypropylene for example. The bottom wall 24 can be formed of any suitable material or combination of materials and is formed so that it can be readily secured to the inner cap wall 32 of the cap member 20 to form the fluid chamber 22. The seals 66 68 may be formed of softer sealing material on a frame of more rigid material. Suitable materials for the sealing portion are natural or synthetic rubber or thermoplastic elastomers. Suitable materials for the frame are metal or rigid plastics.

[0093] The bottom wall 24 is secured to the inner cap wall 32 by any appropriate technique, for example by engagement of a detent flange 74 on a corresponding groove in the external face of the inner cap wall 32, or by laser, sonic or spin welding. The fluid chamber 22 is then defined by the bottom wall 24, the top cap wall 26 and the inner cap wall 32.

[0094] The cap member 20 is placed in an inverted position. After purging with nitrogen or other suitable purging means to remove contaminants, the additive liquid 120 is then introduced into the fluid chamber 22 through the aperture 25 in the bottom wall 24, while closing the spout aperture 34 by any suitable means.

[0095] The housing 40 is then placed on the cap member 20 by engagement of the external primary thread 50 on the

housing **40** with the internal primary thread **30** on the cap member **20** so that the plug member **42** enters and closes both the aperture **25** in the bottom wall **24** and the spout aperture **34** in the top cap wall **26**, thereby sealing the additive liquid **120** in the fluid chamber **22**.

[0096] The fluid chamber **22** may be pressurised either at the time of filling or at any other time before using the closure device **10** to close a container **12**. The pressurising step may be accomplished by providing pressurised gas to the nozzle passage **61**. The nozzle passage **61** is in communication with an internal fluid passage **70** which exits on the cylindrical outer surface **62** of the of the plug member **42**, and so is in communication with the volume **63** between the upper **66** and lower seals **68**. The lower seal **68** is held against the lower plug portion **64** by a collar **72** on the housing **40**, and continues to seal against the lower plug portion **64** even when the volume **63** is pressurised. The upper seal **66** provides a one-way valve means to enable the fluid chamber **22** to be pressurised. The upper seal **66** functions as a flap valve. When the pressure in the volume **63** is greater than the pressure in the fluid chamber **22** the upper seal **66** is urged away from upper cylindrical outer surface portion **67** of the plug member **42** so that pressurised gas can flow from the volume **63** past the upper seal **66** to the fluid chamber **22**. When the source of pressurised gas is removed, and the pressure in the volume **63** and the nozzle passage **61** reverts to atmospheric pressure, the upper seal **66** is urged against the upper cylindrical outer surface portion **67** of the plug member **42** to seal the fluid chamber **22** closed.

[0097] Typically the gas forms a head space **122** in the fluid chamber **22** of between 0% and 60% of the volume of the fluid chamber **22**.

[0098] Alternatively the additive liquid **120** can be introduced after the housing **40** has been fitted to the cap member **20**, by introducing the liquid under pressure through the nozzle passage **61** in the same way as described above for the introduction of the pressurised gas.

[0099] After the fluid chamber **22** has been pressurised, the closure device **10** is secured to the neck **16** of a container **12** by engagement of the internal secondary thread **52** on the housing **40** with the external secondary thread **18** on the neck **16** of the container, to seal the contents of the container.

[0100] FIG. **4** shows an alternative top cap wall **26**A, which is formed separately from the remainder of the cap member **20**. In this embodiment the bottom wall **24** may be formed as an integral moulding with the inner and outer cap walls, although it is illustrated as a separate part. Because the top cap wall **26**A is separate, the fluid chamber **22** can be readily filled with the liquid additive **120** after engagement of the cap member **20** and housing **40**, since the fluid chamber remains open until the top cap wall **26**A is secured to the cap member **20** by engagement of a rib **27**B on the perimeter of the top cap wall **26**A in a groove **27**A provided on the inner surface of the inner cap wall **32**. A seal **27**C ensures that the fluid chamber **22** remains vapour tight. Pressurised gas can then be introduced to the fluid chamber **22** through the nozzle passage **61** as described above.

[0101] An alternative spout arrangement is shown in FIG. **5**. The spout **36** has a slideable spout closure **100** arranged to slide within the spout **36**. The upward travel of the spout closure is limited by detents **102**. The user opens the spout closure by pulling a spout closure cap **104** upwards. This causes the spout closure apertures **106** to slide above a seal **108**, so that the interior of the spout **36** is in fluid communication with the atmosphere. Similar sports type spout closures are known in the art, and the invention may be used with any known spout or spout closure arrangement.

[0102] The present invention provides a closure device which requires fewer components than prior art devices. The closure device is simple to manufacture, as in one embodiment it requires only three moulded components, the cap member body **20**, the cap member bottom wall **24** and the housing **40**. The closure device can be assembled and filled with the liquid additive **120** and then stored or transported before use on a standard container **12**. It does not require separate filling at the bottling location.

[0103] The closure device allows introduction and mixing of the liquid additive **120** into the contents of the main liquid compartment **14** of a container **12** without removal of the closure device **10** from the container **12**.

[0104] The closure device allows a user to access the mixed liquid through a spout without removal of the closure device **10** from the container **12**.

[0105] The closure device can be used with any standard container **12**, of any shape or volume, of any material, for example PET, glass, metal or any suitable plastic. The external secondary thread **18** on the neck **16** of the container **12** can be any standard thread.

[0106] The closure device optimises use of the volume within the neck **16** of the container **12**, since the fluid chamber extends across the whole available area of the neck **16**. The internal diameter of the fluid chamber **22** is limited only by the thickness of the inner housing wall **46** and the inner cap wall **32**. The volume of the fluid chamber **22** may be varied by varying the length of the fluid chamber.

[0107] The closure device cannot be operated to introduce the liquid additive **120** into the main liquid compartment **14** unless the anti-tamper strip **80** is at least partially removed, thereby providing security to the consumer that the additive has not been mixed with the contents of the container prematurely, for example while sitting on a shelf in a shop.

[0108] The internal shape of the fluid chamber **22**, which has a top surface **76** of the bottom wall **24** which slopes down towards the aperture **25** and lower plug portion **64**, ensures that only a minimum amount of residual liquid additive remains in the fluid chamber after release of the additive. The sloping shape allows the full amount of liquid additive **120** to be delivered even if the container is tilted from the vertical during operation of the closure device to fire the additive.

[0109] The materials of the closure device can be selected to avoid any compatibility problems with the liquid additive **120**. During storage the liquid additive is only in contact with the cap member **20** and the plug member **42**. The plug member can be made separately from a different material to the remainder of the housing, if required. A liner, for example of stainless steel, can be used inside the fluid chamber to avoid contact with the moulded cap member **20**, if required. Certain flavouring or colouring additives are not compatible with sealant materials. The bottom wall **24** can thus be manufactured, for example by inset moulding, so that the upper surface **76** of the bottom wall **24** is polypropylene or other suitable inert material, while the seals **66**, **68** are protected below the material of the upper surface.

[0110] In the illustrated embodiments the plug member **42** is shown as a unitary element on which are arranged both the lower plug portion **64** and the upper plug portion **90**. However the plug member **42** may be formed as two or more separate elements with the lower plug portion **64** and the upper plug

portion **90** arranged on different elements, and with connecting means such that both the lower plug portion **64** and the upper plug portion **90** remain connected to the housing **40** as the cap member **20** is raised.

[0111] The closure device of the invention offers a simplified process for filling and assembling the closure device, and can be assembled and fitted to a container without the need for adhesive. The fluid chamber **22** can be easily pressurised, using any appropriate source of pressurised gas, which can simply fit to the nozzle **60** on the housing **40** once the closure device has been assembled. No specialised aerosol technology is necessary. The liquid additive **120** can be denser or more viscous, and the area of the nozzle passage **61** and internal fluid passage **70** can be increased if required, to improve the flow of a more viscous additive. Additives which require shaking to dissolve them can be used with the closure device of the invention, since it permits shaking of the container after firing with no risk of spillage through between the closure device and container, because the closure device remains sealed to the neck.

[0112] Modifications and variations are possible without departing from the scope of the invention. In addition to the modifications and variations described above, the liquid additive may be replaced by a gel or a free flowing powder or the like. The bottom wall **24** may be formed integrally with the remainder of the cap member **20**. The closure member may be used with a container holding a carbonated beverage, providing the pressure of the main liquid compartment **14** is less than the pressure of the fluid chamber **22**. The primary threads **30**, **50** may be of any suitable thread design, and arranged so that the closure device fires, that is ejects the liquid additive **120** into the main liquid compartment **14**, after any suitable angle of rotation, for example 45°, and allows access to the main liquid compartment **14** through the spout **36** and fluid chamber **22** after any suitable further angle of rotation, for example 45° to 450°.

1. A closure device for use with a container having a main liquid compartment and an opening with a neck,

the closure device comprising a cap member defining a fluid chamber and a plug member having a first plug portion sealingly engageable in an aperture in a bottom wall of the fluid chamber and a second plug portion sealingly engageable in a spout aperture,

wherein the cap member is movable relative to the plug member to raise the cap member

from a closed position in which the first plug portion closes the bottom wall aperture and the second plug portion closes the spout aperture,

through a first open position in which the first plug portion is at least partially withdrawn from the bottom wall aperture to provide a communication path in use from the fluid chamber to the main liquid compartment and in which the second plug portion closes the spout aperture,

to a second open position in which the second plug portion is at least partially withdrawn from the spout aperture.

2. A closure device according to claim **1**, wherein the plug member is provided on a housing having an inner housing wall adapted to fit inside the neck of the opening and wherein the closure device includes sealing means which seals between the fluid chamber and the inner housing wall.

3. A closure device according to claim **2**, wherein the cap member includes an internal thread which engages with an external thread on the housing.

4. A closure device according to claim **3**, wherein the cap member includes a top cap wall, an outer cap wall on which is provided the internal thread and an inner cap wall extending from the top cap wall to the bottom wall and arranged inside the outer cap wall, the fluid chamber being defined by the top cap wall, the inner cap wall and the bottom wall.

5. A closure device according to any of claims **4**, wherein the housing comprises an outer housing wall on which is provided the external thread.

6. A closure device according to claim **5**, wherein the outer housing wall is provided with an internal secondary thread adapted in use to engage with an external secondary thread provided on the neck of the opening of the container.

7. A closure device according to claim **5**, wherein the housing comprises an inner housing wall arranged inside the outer housing wall and provided with internal sealing means to seal against an outer surface of the inner cap wall and external sealing means to seal against an internal surface of the neck of the opening.

8. A closure device according to claim **5**, wherein the housing further comprises a frame which supports the plug member so that the plug member is arranged inside the inner housing wall and extends upwardly into the fluid chamber in use.

9. A closure device according to claim **1**, wherein the first plug portion includes a cylindrical outer surface which engages with a sealing means provided in the bottom wall.

10. A closure device according to claim **1**, further including a spout connected to the spout aperture, wherein the spout includes a drinking tube and a closeable cap.

11. (canceled)

12. A closure device according to claim **1**, wherein the spout aperture is provided in a top cap wall of the cap member and the second plug portion includes a cylindrical outer surface which engages with a sealing means provided in the top wall.

13. A closure device according to claim **12**, wherein the plug member includes a reduced portion above the second plug portion having a cross-sectional area smaller than that of the second plug portion, such that in the second open position the reduced portion extends through the spout aperture to provide a communication path in use from the fluid chamber through the spout aperture.

14. (canceled)

15. (canceled)

16. A closure device according to claim **1**, wherein the fluid chamber contains an additive liquid and a head space of pressurised gas.

17. (canceled)

18. (canceled)

19. A container having a main liquid compartment, an opening having a neck, and a closure device closing said opening,

wherein the closure device comprises a cap member defining a fluid chamber and plug member provided in the neck of the container, the plug member having a first plug portion sealingly engageable in an aperture in a bottom wall of the fluid chamber and a second plug portion sealingly engageable in a spout aperture,

wherein the cap member is moveable relative to the plug member to raise the cap member

from a closed position in which the first plug portion closes the bottom wall aperture and the second plug portion closes the spout aperture,

through a first open position in which the first plug portion is at least partially withdrawn from the bottom wall aperture to provide a communication path from the fluid chamber to the main liquid compartment and in which the second plug portion closes the spout aperture,

to a second open position in which the second plug portion is at least partially withdrawn from the spout aperture.

20. A container according to claim **19**, wherein the plug member is provided on a housing having an inner housing wall arranged inside the neck of the opening and wherein the closure device includes sealing means which seals between the fluid chamber and the inner housing wall.

21. A container according to claim **20**, wherein the cap member includes an internal thread which engages with an external thread on the housing.

22. A container according to claim **19**, wherein the main liquid compartment contains a beverage.

23. (canceled)

24. A container according to claim **19**, wherein the fluid chamber contains an additive liquid and a head space of pressurised gas.

25. (canceled)

26. (canceled)

27. (canceled)

28. (canceled)

29. (canceled)

30. (canceled)

31. (canceled)

32. (canceled)

33. A container according to claim **19**, further including a spout connected to the spout aperture, wherein the spout includes a drinking tube and a closeable cap.

34. (canceled)

35. (canceled)

36. (canceled)

37. (canceled)

38. (canceled)

39. A method of introducing an additive liquid into a main liquid compartment of a container having an opening with a neck, the method comprising the steps of

raising a cap member of a closure device and a fluid chamber defined by said cap member relative to a plug member from a closed position, in which an aperture provided in a bottom wall of said fluid chamber is closed by a first plug portion of said plug member and a spout aperture provided in said fluid chamber is closed by a second plug portion of said plug member, to a first open position, in which said first plug portion is at least partially withdrawn from said bottom wall aperture to provide a communication path from said fluid chamber to said main liquid compartment and in which said spout aperture remains closed by said second plug portion,

releasing pressurised additive liquid from said fluid chamber along said communication path into said main liquid compartment, and

raising said cap member further relative to said plug member to a second open position, in which said second plug portion is at least partially withdrawn from said spout aperture to provide a communication path from said fluid chamber through said spout aperture.

40. A method according to claim **39**, including the further step of causing liquid from the main liquid compartment together with the additive liquid released from the fluid chamber to pass from the main liquid compartment through the bottom wall aperture into the fluid chamber and from the fluid chamber through the spout aperture to a spout.

41. A method according to claim **39**, wherein the plug member is provided on a housing, and wherein during the raising of the fluid chamber relative to the plug member a seal is maintained between the fluid chamber and an inner housing wall of the housing arranged in the neck of the container.

42. A method according to claim **39**, wherein the cap member is raised by rotating the cap member such that the fluid chamber is raised by screw thread action relative to the plug member.

43. A method according to claim **39**, further including the step of at least partially removing an anti-tamper strip provided on the cap member, thereby allowing raising of the cap member relative to the plug member.

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