

CONTAINER WITH IRREMOVABLE CLOSURE TO FACILITATE DISPENSATION OF  
CONTENTS

Field of Invention

- 5 The present invention relates to containers that are used to contain fluids that need to be dispensed in controlled quantities. In particular, the present invention relates to a container closure which can be readily and securely fastened to dispensing containers, bottles and the like.

10 Background to the Invention

- In many fields of endeavour, barrels, plastics containers, cans and other fluid containers are employed to enable the safe storage of a fluid. The fluids contained in the containers may be suitable for a single or several uses and can comprise fluids such as oils, fuels, chemicals, cleaning fluids. Consider a utilities manager of a manufacturing facility. The floor of the manufacturing area has to be cleaned thoroughly because of greases etc that are dropped; in order to maintain safety and productivity, the floor has to be cleaned using rotary scrubbing machines, which apply a liquid cleaner, followed by the use of liquid vacuum machines. The scrubbing machines will have a tank that is filled with, for example, water and a degreasant chemical. A particular dose of degreasant chemical is added to the water tank of the scrubber prior to use. The amount dispensed is conveniently provided by way of a hose with a dispensing function and is attached to the container. Upon filing of the cleaning tool, there is no wastage – especially if compared with the use of a cup – by an operator with a gloved hand and scooping a required amount from an open container. Not only is wastage minimised, proper cleaning is effected, using the required dosage, whereby to satisfy onerous health and safety recommendations, for example. It will be appreciated that in certain industries such as that of medical device manufacture, drug manufacturing and food production, that there will be mandated standards of cleaning mandated. By the use of prescribed amounts of chemical per unit of solvent – typically water – then national standards / site standards can be maintained.

- For example, chemicals currently used in the commercial cleaning industry or any industry are typically stored in standard blow moulded containers, for example, 5 litre (1 gallon) containers. Figure 1a shows a standard type of 5 litre container. The container is blow moulded, with an integral handle and a screw-top opening at for screw-threaded connection with a lid. The container caps use standard

screw fittings which can be fully removed for filling and dispensing from the bottle; different specific types of container open can exist for different sizes of container, such as the 20 litre and 200 litre containers shown in Figures 1b and 1c. When a chemical container is connected to a dispenser, the cap is fully removed and a flexible tube from the dispenser is inserted into the neck of the bottle. If a user wishes to dispense cleaner directly from the bottle rather than via the dispensing system there is nothing restricting this practice. It is also reported that certain households benefit from the decanting of specialised fluids into proprietary household containers. Indeed, there are many detergents that are used for several tasks, for example, and may be suitable for the general cleaning of all floors, walls and cladding, washable hard surfaces, including all paintwork and types of motor vehicles and even for garments. Such products can be decanted for unauthorised personal use.

In another field, greases and oils will need to be dispensed in a workshop; sometimes additives must be accurately dispensed; the product can be expensive. With reference to Figure 2, there is shown a proprietary system for transporting and dispensing fluid from a single drum or small container; an uppermost cap - when the barrel is standing in an upright fashion is simply enabled to be at the lowermost point when resting in a horizontal position - but not shown in the figure. Systems such as this can be adapted to catch spillage.

Bottles/containers containing automotive lubricants, household chemicals, agricultural products and the like are ill equipped to dispense without additional dispensing device. Exterior dispensing devices on the market (e.g. funnels, valves, tubes) are limited in value. They are typically rigid, i.e. not adaptable or flexible; they are typically restricted in length/range, e.g. regarding motor oil, a funnel flask can dispense into an engine's crankshaft, but cannot reach the transmission intake; they typically require cleaning and storage for reuse, i.e. the value relates to the number of possible uses and accessibility; and they are sold-separately from the bottle/container, e.g. when a consumer purchases motor oil, outside of having a funnel readily available, the consumer cannot effectively dispense the oil.

In addition to the dispensing of fluids, containers must also be housed and stacked in appropriate conditions. Businesses routinely store and move a variety of potentially polluting materials in containers ranging in capacity from a few litres up to drums of 205 litres (45 gallons) and 1000 litres (219 gallons)

industrial bulk containers (IBCs). These containers must be stored in accordance with appropriate legislation.

Containers of oil, chemicals or other potentially polluting materials can pollute surface water and groundwater. Pollution can be caused by spills from several sources, such as the incorrect storage and handling of containers; accidental leaks; vandalism and theft; overfilling or failure of storage structures; run-off from fires and contaminated firewater; incorrect or damaged drainage systems. These are all potential hazards. Additionally, there are many substances that aren't harmful to humans but that will cause pollution if they're spilt, for example liquid food and drinks, detergents and paper sludges. For example, in England and Wales, oil storage is regulated by the Control of Pollution (Oil Storage) (England) Regulations 2001, (OSR England). Oils covered by these regulations include petrol, diesel, vegetable, synthetic and mineral oils. The regulations apply to most industrial, commercial and institutional sites storing oil outside in containers over 200 litres, including drums and IBCs and to domestic premises storing more than 3500 litres.

In the field of containers for food and drink, similar issues can occur in the control of dispensing of fluids, pastes, creams, emulsions and powders. The dispensing of condiments is one issue – tomato ketchup, salad dressings, mayonnaise etc. Restaurants and the like will wish to buy in bulk and have dispensing means that allows correct dispensing to be enabled and reduce levels of pilfering. Similarly, sports drinks can be consumed with a straw – but for the container which non-sealingly allows a straw or tube to be inserted the drink cannot be consumed without spillage unless special care is taken.

Thus, known container and dispenser systems do not necessarily provide security and none are adapted to the acceptance of "universal" tube vacuum dispensing devices and/or are complex to utilise. Caps and similar closure systems for containers in production and in use to date, are designed to re-open after being attached with respect to a container. US2011303670 (Baker R.J.) relates to a security screw cap for forming the secure closure for fitting to a container to secure the container against unauthorised access and to containers having such caps.

#### Object of the Invention

The present invention seeks to provide a solution to the problems addressed above. The present invention seeks to provide a container closure that readily adapts to dispensing requirements, which can readily and easily be manufactured, at low cost.

### Statement of Invention

In accordance with a general aspect of the invention, there is provided a cap for fitment to a container, wherein the cap becomes irreversibly attached to such a container and has an aperture for the insertion of a tube whereby controlled delivery of a fluid from the container can be enabled. The apertured cap preferably comprises one of a screw-cap, a push-fit cap, having detent or glue applied thereto, for a male or female opening associated with the container. In such an arrangement, the cap can be manually attached or fitted in a no-wear or low wear mechanised process. It will be appreciated that in the attachment of some types of closure, expensive machinery is required to fasten, for example metal flanges to containers, which machines typically require re-tooling after wear, arising from the creation of welds or rolled flanges to connect the two parts together in a sealing relationship.

In accordance with a specific aspect of the invention, there is provided a container and closure combination, for the containment of fluids and extraction therefrom by way of an extraction tube, the container comprising a closed volume with an opening, the closure being configured to close the opening of the container, wherein the closure is provided with an aperture and wherein the closure, upon fitment, cannot be removed from the container opening, the aperture of the closure being defined by a unitary elastic valve member permitting unidirectional flow of fluid through the aperture; wherein the valve can operate, interchangeably, between: a first, closed condition, to prevent a free flow of fluid from the container; and, a second, operational condition, with the extraction tube sealingly engaged within the valve, to permit an extraction and dispensing of fluid from the container through the tube. By having a unitary, elastic valve member, the valve can conveniently be manufactured with the closure in a simple manufacturing process e.g. in what is known as a two – shot process, whereby the inner valve is manufactured from an elastic plastics material, with the outer surround/container engagement portion being manufactured from a more rigid plastics material.

The present invention can comprise not only the container and closure with aperture but also a tube. For example, the invention may comprise a sports drink with the apertured closure together with a tube. The tube can function as a straw, whereby a drink such as a sports drink can conveniently be consumed, the cap preventing tainting of the drink replacement thereof, which could be useful in

competition settings, for example, to ensure uniformity in provision of drinks. The tube can comprise a paste/sauce siphon/vacuum dispensing means or be associated with a paste/sauce siphon/vacuum dispensing means whereby a condiment such as a ketchup, mustard etc., can be dispensed.

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Conveniently, the apertured closure or cap is irreversibly fastened to a container by means of co-operating detent mechanism, similar to the frangible devices that indicate that an apertured closure has been removed associated with many consumer products – save that the detent item is not frangible and prevents removal of the apertured closure. Other methods of irreversible attachment could also be employed, such as one-way, push fit aperture closures using barbs from one part physically engaging a relatively softer surface of the other part of the container opening and apertured closure combinations or by having a reverse friction effect, thereby preventing removal. The respective parts of the combination could also be irreversibly or permanently attached by means of adhesive – glue or solvent or by heat welding. Simple mechanical ratchet one way locking systems can also be employed and other more sophisticated mechanical one-way systems. After the closure cap has been securely attached, it is ready for an appropriate format of dispensing tube to be inserted to extract the fluid contents. This apertured closure security feature eliminates the miss-use of fluid contents in a simple and cost effective way. The apertured closure of the present invention can simply and effectively prevent an abuse of contents, spillage, pilferage, wastage and cross-contamination.

25 The apertured closure of the present invention can conveniently be manufactured by well established techniques of injection moulding together with over moulding, whereby to maintain production costs at acceptable levels, comparable to the manufacture of known cap closures.

30 In another aspect of the invention, there is provided a container and closure with aperture combination, the container comprising a closed volume with a generally circularly shaped rim or opening, the apertured closure comprising a closure element having an inside portion for abutment with the rim, to sealingly engage therewith, a wall portion depending from the inside portion having cooperating means to securely locate with rim of the container, the outside wall of the apertured closure surrounding the outside apertured closure; wherein the apertured closure is defined with an indentation leading to a closable seal, the seal being operable to accept a tube of a dispensing apparatus.

Once securely located with the container, the apertured closure cannot be removed without damage to either the container or closure from the container, thereby preventing any unintentional or accidental dispensing of the fluid in the preparation of cleaning preparations, lubricant mixtures etcetera, where fluids need to be dispensed in measured quantities. In a simple example, a standard container for a cleaning fluid could be controlled by the use of the present invention whereby a dispenser can be used to allow metered amounts of an additive to water for a cleaning process; by having a tube associated with the dispenser then the correct metered dosage may be provided, saving waste; accidental over-pouring is prevented. Preferably, upon first mating of the apertured closure and container, they become irreversibly fastened each to the other. In the prior example, the closure can be simply fastened by hand tightening. Additionally, by having the apertured closure secured in a non-removable fashion, removal of fluid from a container with such an apertured closure by unauthorised persons is prevented, in a simple fashion. Additionally, this can provide significant advantages in the safe disposal of toxic or otherwise undesirable fluids; since any remaining fluid cannot be removed and the container and apertured closure combination cannot be re-used, the container and apertured closure combination must be disposed of, conveniently through safe/authorised channels.

The cooperating means may comprise mutually engaging screw-threads or mutually engaging bayonet fastening elements. The cooperating means may comprise detent means, whereby, for example, a clip associated with the apertured closure overlies a detent means, such as a collar about the aperture associated with the container. Such a detent system would mean that the aperture need not be limited to a circular opening, as required by a rotationally fitted connector.

The apertured closure could also be secured by an adhesive, in the event that the cap was an original fitment. Contoured apertured closures could be fitted whereby the apertured closure and container could only operate with corresponding dispensing apparatus.

Preferably, the seal can comprise a two-flap arrangement (also known as a "duck-bill seal"), or multi-flap variants thereof. The seal member can have a tube feed-in section which is of a general conic shape, having a spiral wire element

- moulded therein to provide a degree of ruggedness. A duck-bill seal can be adapted so as to seal with generally rectangular conduit tubes. The seal, when opened with a tube for dispensing can also provide space for air to pass into the container, since dispensing means typically use vacuum forces to enable passage of fluid, a partial vacuum within the container will reduce the amount of a dispensed quantity. In the alternative, a gas-tight seal may be provided as between a tube and the cap, as might be required for certain classes of fluids, when the central seal is required to be airtight. For example, the aperture may define a ring of an approximate dimension slightly less than the dimension of a tube through which aperture the tube will be connected, whereby the seal, in use is gas-tight or fluid tight. Additionally, the close fitting could remove any fluid that may be present upon the exterior wall of the tube as the tube is extracted. The rim of the aperture may be reinforced by the provision of an enhanced amount of polymeric/rubber material about the aperture, preferably further reinforced with a closed loop defined by a spiral spring, whereby a greater degree of strength is provided to the aperture. Additionally, a one way valve could be provided to enable pressure compensation to occur e.g. by the provision of air, whereby to prevent vacuum problems arising in any dispensing of the fluid.
- It will be appreciated that when a fluid tube is inserted into a container, which will generally have an aperture directed upwardly, that the weight of dispensed fluid in the tube will increase the weight of the tube and thus cause forces to act upon the seal, tending to induce the aperture to a degree of ovality (for a nominally circular tube or conduit). Accordingly, in another aspect of the invention, there is provided a centralising aperture, located at the top of the apertured closure (as seen from the user, when in normal use, with the apertured closure at the top of a fluid container). The centralising apertures may comprise a further polymeric member with an aperture or a device akin to an iris diaphragm, whereby the strain from the weight of the tube and fluid therein is borne by this first, upper aperture.

The present invention can be utilised in, for example, a stores department of a company, to ensure that fluids are utilised only with respect to their prescribed uses. In such cases, the cap is fitted after the container is initially opened, with any protective seal removed. Additionally, a container may be supplied with an apertured closure in accordance with the present invention, together with a stopper whereby to prevent loss of fluid in transit where a dispensing tube is

inserted, in use, whereby to prevent loss of fluid in transit prior and subsequent to extracting fluid from said container.

5 In accordance with another aspect of the invention, there is provided an apertured closure for use with a container. The apertured closure can be screwed-in, clipped-on or otherwise retained to ensure that the apertured closure cannot be removed whereby to enable good stock control and/or effective dispensing of liquids within a container. Upon disposal, the provision of a bung can assist in closure of the aperture for a dispensing tube, whereby the container  
10 can be appropriately disposed of through official channels. The bung can be fitted in an irremovable fashion, though a detent, a one-way screw-thread or otherwise. Whilst the invention has been described as a unitary integrally moulded closure and valve combination, it is possible that these are arranged as separate items.

15 The present invention thus provides a simple to fabricate container stopper, which can enable satisfaction of security, health and safety requirements that are imposed on all types of businesses as well as increasing compliance with rules and regulations that are seen by some as a hindrance to normal business practice. Additionally, certain industries involved with medical device  
20 manufacture, drug manufacture and food production, etc. have additional mandated standards regarding control of fluids with the use of dispensing equipment. The present invention can assist in compliance of such further standards.

25 Thus, in summary, the present invention can provide an easy to use cap that once fitted to a container cannot be removed for the placement of tubes associated with vacuum/siphons associated with dispensing means and tubes as in straws for drinking from a bottle. Fluids for all uses from any type of container or receptacle whether it is a bottle, drum, tin, can, bag or box, through a  
30 dispensing means such as a tube, syphon, straw, syringe, hose or pipe.

#### Brief Description of the Figures

For a better understanding of the present invention, reference will now be made, by way of example only, to the Figures as shown in the accompanying drawing  
35 sheets, wherein:-

Figures 1a – 1c illustrate three prior-art containers;

Figure 2 illustrates a further prior art container, upon a support;

Figure 3 shows a first embodiment of the invention placed upon a type of

container as shown in Figure 1;

Figure 4 shows an inside of the lid of Figure 3;

Figure 5 shows an inside of the lid of Figure 3, with a tube inserted therethrough;

Figures 6 and 7 show first and second views of an outside top of a first  
5 embodiment;

Figure 8 shows a side view of the first embodiment in profile;

Figure 9 shows an apertured closure in section;

Figure 10 shows an apertured closure when mated to a container top in section;

Figure 11 shows a variant apertured closure retaining system; and,

10 Figure 12 shows an additional sealant system that locates about a tube;

Figures 12a – 12j relate to a further aspect of the invention;

Figures 13a and 13b show a further variation of the invention;

Figures 14 a - 14c show a still further variation of the invention;

Figures 15a and 15b show another embodiment of the invention;

15 Figures 16a – 16b show a first strain relief assembly closure;

Figures 17a – 17c show a second strain relief assembly closure;

Figures 18 a – 18e show methods of forming a permanent connection between a  
closure device and an opening;

Figure 19 shows one form of uni-directional – screw-on-can't-screw-off apertured  
20 closure in accordance with the invention;

Figure 20 shows a bung in accordance with a further aspect of the invention;

Figures 21a & 21b show an aperture closure in accordance with another aspect of  
the invention with and without a cover;

Figure 21c shows a container and cap combination together with drinking straw  
25 inserted;

Figure 22 shows a cross-section of a tube in accordance with another aspect of  
the invention;

Figure 23 shows a perspective view of a further embodiment in accordance with  
another aspect of the invention; and,

30 Figures 24a & 24b show plan view of alternative configurations of the further  
embodiment of Figure 23.

#### Detailed description of the Preferred Embodiments

There will now be described, by way of example only, the best mode  
35 contemplated by the inventor for carrying out the present invention. In the  
following description, numerous specific details are set out in order to provide a  
complete understanding to the present invention. It will be apparent to those  
skilled in the art, that the present invention may be put into practice with

variations of the specific. For the avoidance of doubt, the term closure refers to devices used to close or seal a bottle, jug, jar, tube, can, container, barrel, keg etc. Closures can be a cap, cover, lid, plug, bung, etc..

5 Referring now to Figures 3, 4 and 5, there is shown a first embodiment of the invention. Apertured closure 30 is shown affixed to a standard five litre container 36 as referred to in Figure 1. The apertured closure has an inside seal member which abuts a rim of the opening of the container. Whilst the rim of the container is not shown, examples of such are well known, typically comprising a short  
10 length of generally circularly cylindrical wall about an aperture to the inside of the container, the outside wall having a screw-thread, which is inter-engagable with an inside wall of the apertured closure. Conveniently, the apertured closure 30 has a locking mechanism whereby once attached by way of the screw-thread fittings, removal of the apertured closure is not possible. One-way-detent  
15 systems – or barbed systems - are widely available for child-proof caps and the same detent release system can be adapted to ensure that no release is possible. A shroud may also depend from the wall of the apertured closure so that it is not possible to insert a tool to remove the cap, or at least not to enable removal and subsequent re-fitting, whereby to enable tampering to be determined. It is also  
20 possible to have the apertured closure attached by a push-on, non-releasable fashion as are also widely available. The apertured closure has a top outside face 31 with a central depression 32; along the outside wall of the apertured closure 33, there are provided knurled formations 34 which can be utilised to enable the cap to be securely fastened upon first use.

25 Figure 4 shows a view of the inside of the apertured closure 30: the inside of the central depression 32 – as seen from the outside – extends inwardly of the inside of the apertured closure and comprises an aperture with a resilient seal member 41, shown here in a self-sealed, closed position. A perimeter inside seal member  
30 42 is placed within the apertured closure whereby, in use and upon fastening of the apertured closure with respect to a container, a seal is created which prevents fluid seepage therebetween. The seal of the aperture seal member 41 and inside seal member 42 are conveniently made from the same plastics material at the same time in an injection moulding operation. The seal is  
35 conveniently manufactured from a thermoplastics rubber such as nitrile butadiene rubber, but compatibility/suitability of such a seal must be determined with reference to the fluid contained within the container. Nitrile butadiene rubber (NBR) typically comprises a family of unsaturated copolymers of 2-

propenenitrile and various butadiene monomers (1,2-butadiene and 1,3-butadiene) and the specific physical and chemical properties vary depending on the polymer's composition of nitrile, this form of synthetic rubber being generally resistant to oil, fuel, and other chemicals (the more nitrile within the polymer, the higher the resistance to oils but the lower the flexibility of the material), with a typical usable temperature ranges of -40°C to 108°C. Neoprene could also be chosen, for example; there are many other types of suitable materials. The inside wall of the apertured closure defines an internal thread 43, which corresponds with the outside thread of a container with which the container is to seal with respect to an upper sealing edge of a container opening and to which the apertured closure is associated. Reference numeral 44 indicates one-way security detent teeth, which are arranged around the inside of the apertured closure and co-operate with corresponding detent teeth associated with the container. In this case, the container is a standard 5 litre container with the detent teeth – indicted at reference 46 per Figure 4a - arranged for use with elastic "squeeze-release" child-proof caps. In contrast with such caps, the present invention provides an apertured closure or cap which does not provide any give arising from any inherent flexibility nor any frangibility – some known tamper-evident caps operate in such a fashion, whereby to ensure that once an apertured closure in accordance with the invention has been placed upon the container, it cannot be removed. Figure 5 shows the apertured closure with a plastics tube 50 inserted and retained by the seal member 41.

The present invention, in a first embodiment, therefore enables the insertion of a delivery tube into a container such as an injection moulded semi-rigid lid with a threaded outlet. In this first embodiment, when the apertured closure is fitted and a tube inserted, then the fluid can be dispensed. In a cleaning department store, for example, the container will be attached to a bench or wall, to reduce chances of a container being dropped etc. in use. The dispensing tube can be easily inserted and the use of the apertured closure will prevent the contents of the bottle leaking or spilling from the apertured closure, whilst the tube associated with a vacuum dispensing apparatus will allow control of the fluid to be dispensed, rather than the whole container being decanted by hand, with or without a measuring cup or similar. After the fluid in the container has been removed, as the tube is extracted, any remaining fluid adhering to the tube will substantially be removed by the valve of the closure wiping around the tube, assisting in keeping the area of use and the assembly itself in as clean a state as possible. The inside wall depending from the apertured closure central area

component includes an internal screw thread allowing the lid to attach to a standard blow moulded container. The semi-rigid lid includes barbed features on the inside of its internal rim. When the apertured closure is fitted to the bottle and screwed into position, the barbed features locate over existing barbed features positioned on the neck of the blow moulded bottle. Because of the orientation of the barbed features they act to lock the apertured closure in place, preventing the apertured closure from being unscrewed from the blow moulded bottle. It will be appreciated that push-on apertured closures which have a hooked flange which locate about corresponding detents associated with a neck of an outlet of the container are also possible, although by use of a pre-existing screw-threaded outlet for a container, then correct fastening can be simply ensured.

The semi-rigid lid moulding acts as a pre-form component allowing a flexible polymer to be over-moulded onto the lid. The semi-rigid lid includes a central open aperture into which a diaphragm is moulded in the flexible material. The diaphragm is of a specific shape which will allow a tube to be inserted from the outside of the lid into the bottle, but not from the other direction, since the entrance to the diaphragm seal is tapered. When the tube is removed the diaphragm closes preventing the liquid in the bottle from leaking. The shape of the diaphragm follows the form of a slit valve, such as a duckbill or cross slit valve. A cross slit valve, when viewed from the underside the diaphragm forms a cross shape. The shoulders of the cross-like membrane taper up to the diaphragm body at an angle. When liquid held inside the container applies pressure to the valve, the liquid acts on these angled faces pressing the valve closed and acting to reduce the likelihood of spillage of the contents from the container. The cross-like membrane creates four indented features in the conical shape of the diaphragm. These have a central crease line where the faces of the cross-form meet. When a tube is passed through the diaphragm from the outside, these features fold outwards allowing the diaphragm to open and grip the outside of the tube. When the tube is withdrawn from the bottle, the indented features naturally return to their original moulded shape, so that the integrity of the cross slit valve form is maintained. Tri-star slit valves also exist, as do valves with more than four slits (i.e. cross slit). Such slit valves are, in essence, check valves that can be precision-moulded, one-piece elastomeric valves that provide reliable backflow prevention at low-pressure differentials – that is to say, with reverse flow, a negative differential pressure is created whereby backflow is checked. Slit check valves can straightforwardly be designed

to start functioning at specific closing pressure ranges, dependent on specific requirements, and arising from valve size, geometry, and compound characteristics. Slit check valves can be designed to operate in pressures as low as a few millimetres of water.

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Referring now to Figures 6, 7, and 8, the container cap is shown in plan, perspective and side views, respectively. Figures 6 and 7 show the central indentation 32, which is manufactured from a resilient plastics material. It will be noted that there is a spoke-like pattern 62 radiating from the depression area, which comprise apertures defined in the semi-rigid cap member 61; not only does this provide a pattern – which can help identification of particular fluids if supplied in different colours, but also assist in a mechanical bonding of the resilient plastics material to the semi-rigid apertured closure. The outer, semi-rigid lid (i.e. less resilient than the central resilient plastics material can be manufactured from a material such as high density polyethylene (HDPE) or polypropylene, and similar plastics materials. It will be appreciated that other materials, such as brass, aluminium alloys and other metals could also be utilised to fabricate the semi-rigid cap member.

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Reference is now made to Figures 9 and 10, which show an apertured closure in cross-section, with Figure 10 also including the aperture part of the container or bottle. The valve 41 can be seen in greater detail, which loosely surrounds the tube inserted therethrough, yet only allows air to pass into the container as fluid is dispensed therefrom. Given that dispensing means typically use vacuum forces to enable passage of fluid, a partial vacuum within the container will reduce the amount of a dispensed quantity. A gas-tight seal may be provided as between a tube and the apertured closure, as might be required for certain classes of fluids, when the central seal is gastight. Accordingly, in addition to the valve as defined above for the tube, closely fitting O-rings may be secured, which O-rings create a fluid-tight seal, between aperture and tube. It will be appreciated that different seals will be required for specific tube diameters. Additionally, a one way valve will need to be provided to enable air to enter the closed volume of the container whereby to prevent vacuum problems arising in any dispensing of fluid.

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Referring now to Figure 11, there is shown a further variation. The apertured closure 30 has on interior walls a detent mechanism indicated at 1100, 1101. The valve remains the same, with seal member 41, inside rim seal 42. Instead of an exterior screw thread on the outside neck of the container, second detent

elements are shown, 1102, 1103. Figure 12 shows a still further variant, being a close-up of the indented element, but not details of the cap-to-container connection. In this case, a tube 50 is sealingly engaged with respect to the inlet by close fitting body of the apertured closure 1202, aided by a wedge-section seal element 1203. Additional non-return spikes (not shown) may be placed to prevent removal of the tube, for example if the product was particularly hazardous. Since this embodiment sealingly engages around the tube 50, a separate inlet valve must be provided within the apertured closure, or additionally with respect to the container, unless, of course the dispensing tube also carries a separate line which ensures that an appropriate degree of relative vacuum is maintained within the gaseous space of the container. Reference numeral 41 indicates the seal per Figure 4 and 5 that is displaced when the tube is inserted, which seal enables sealing of the contents of the container, once in place and prior to insertion of the tube.

A container may be supplied with an apertured closure in accordance with the present invention, in which case the apertured closure may be adhesively fastened to the container. A stopper-like element may be provided within the aperture, whereby to prevent loss of fluid in transit. By the use of a suitable adhesive tape, the apertured closure may be retained. In the alternative a twisted wire-seal fastener, in the style of a champagne cork fastener may be utilised. Other securing mechanisms could be deployed.

Referring back to Figure 4, the aperture valve conveniently comprises a cross-slit valve; Figure 12a is a plan view thereof, being an opposite face of the closure as seen in Figure 6. Figures 12b and 12c shows the aperture valve – made from an elastic plastics material, such as a thermoplastic elastomer, in perspective and plan views, respectively, separate from the outer, harder plastics moulding – conveniently made from a plastics material such as polypropylene of the closure. Other materials are known to the man skilled in the art. Figure 12d is a sectional view on line C-C of Figure 12c. Figure 12f is a sectional view on line D-D of Figure 12e. As is known, thermoplastic elastomer, bonds well to Polypropylene, the injection moulding being conveniently performed in a manual or automated twin shot injection process, as is known. Other suitable materials that may be used can be silicon rubber, natural rubber, polybutylene, ABS polymers which have suitable elasticity values and may be formed with additives such as lubricants to control the friction of the plastics material so that it is appropriate to

the liquid contained and tube employed to enable flow of liquid from the container.

It is convenient to mould the aperture valve such that the valve is sealed in a closed state upon manufacture. This provides surety against spillage when the aperture closure in accordance with the present invention is fastened to a container with a fluid therein yet has not been used. Conveniently, the valve member is sealed adjacent a peripheral edge of the cross slit 120 per Figures 4, 12a, 12c etc., the connecting member being indicated by reference numeral 121.

With reference to Figures 12g - 12h, there is a valve 124, 125 defining a slit 121; as a tube 122 having a diagonally cut end 123, is brought onto the flared upper surfaces of the valve, 124, 125, the slit is separated. With reference to Figure 12i, the tube has caused the polymeric material to separate at the thin bonded region 121 and the peripheral edges of the valve engage with the external surface of the tube. Alternatively, there may be for example, an inverted v-profile lower edge of the valve, the slit being made either as part of the moulding process or as an extra process step in manufacture. This V-notch slit aids the tearing of the membrane of the valve whilst inserting a conduit, although the presence of such a slit is dependent upon size of aperture valve and the materials employed. Upon insertion of a tube for a first time, the mould line of the valve is forced apart, without detriment to the future sealing ability of the valve. That is to say, in this further embodiment, the aperture valve of the closure can be produced to be sealed before initial insertion of a tube or conduit for the purpose of transportation and conformity. It has been found that the tube is preferably cut diagonally with respect to the axis of conduit for the tube or a tip element is fastened to the tube, whereby to facilitate insertion of the tube. With reference to Figures 12h and 12i, the tube is shown as having been cut diagonally at the insertion end. With reference to Figure 12j, the tube 122 could have an apertured end closure element 128 fitted on the end of a tube that has been cut normally with respect to the radial axis of the tube. This apertured end also benefits from having a number of openings 129 for fluid transfer into the tube. By not having a single opening, then the chances of having that single opening closed by debris or by intimate contact with a container wall are removed. Additionally a non-return valve could be optionally associated with this tube termination.

It will be appreciated that whilst the first embodiment has been shown with reference to a five litre container, the apertured closure, flexible diaphragm with

aperture can be made to in a range of sizes, to accommodate a number of standard diameter tubes and can be made with a bayonet style, clip-over style or screw-threaded whether it be left or right handed. It can be made for any size container and for any size of tube. Accordingly, for example, the container could

5 be a twenty litre container or other commonly used container from which fluids need to be dispensed, provided that an outlet has a neck, screw-threaded or otherwise which the apertured closure or cap in accordance with the invention can locate. The connection of the apertured closure with respect to the container could also comprise a push-fit design with either a male or female clip design to

10 suit a push fit design container as shown in diagram. Whilst most apertures tend to be circular in shape, by virtue of their having a circular, screw-threaded aperture, it will be appreciated that if a detent/clip system is employed, the aperture need not be circular and a square, rectangular, ot her polygonal or irregular shaped opening could be utilised. For example, the irregular shape may

15 be provided so that for particularly hazardous fluids, then appropriate shape determinant closures are to be used with such classes of fluids. In an alternative scenario, a shape could be associated with a particular manufacturer of containers and apertured closures. It is conceivable that an outline of a logo of a manufacturer could define the shape of the opening and thus the corresponding

20 apertured closure.

Referring now to Figures 13a and 13b, there is shown a variation of the valve, for use (typically, but not exclusively) with substantially rectangular tubes. Figure 13a shows one side of a flap of the valve 1301; Figure 13b shows the valve 1301

25 as would be seen from an inside of a container, prior to placement of the tube. The valve 1301 in this case is the simple single slit, two-flap duck-bill valve. The lips of the flap are tapered in the same way as the cross slit valve described above and, in operation, utilises a pressure of liquid acting upon it to cause the valve to close. Other types of uni-directional or non-return valves are known.

30 With reference to Figures 16 a - 16b, a further type of apertured closure are shown with a strain relief member that is operable to urge a tube that is introduced to enter the valve substantially centrally into the seal-aperture, whereby undue forces do not cause the tube to lie in a position other than being

35 substantially axial with respect to a central axis of the aperture. The strain relief element 1701 comprises an apertured membrane, having an aperture 1702 larger than a tube intended to pass through the seal-orifice: the strain relief element

providing a more rugged aperture against which forces arising from a tube, often several metres long and liquid filled, bearing upon the aperture seal.

Figures 17a - 17c show, respectively, a second type of strain relief member in perspective, cross-sectional and perspective - cross-sectional views of an iris-diaphragm - the iris diaphragm element 1704 comprising resiliently-biased elements 1705 which seek to reduce the aperture so-formed 1706, as is known, the element being sufficiently rugged to bear weight arising from a tube being directed through the sealed orifice of the present invention.

Figure 18a shows an opening 1802 in a container 1800 such as the one depicted in Figure 1c. The opening 1802 is shown in cross-section and is defined by a tube section 1804 depending from an outside wall 1805 of the container. The lower edge of the tube defines a rim 1806. Figure 18b shows a first style of apertured closure 1810 for such a female opening engagement in accordance with the invention; the apertured closure device comprises a plastics body that has reverse-oriented lips 1812, which depend upon the rim 1806: in the event any forces are brought axially through the opening (in a direction indicated by arrow A), then any further movement will be prevented or at least limited. For such a design, it would be appropriate to have a female opening 1802 having a length in general correspondence with the length of the insert. With regard to Figure 18c, barbs 1824 are arranged upon an external surface 1822 of the insertion part of the closure device 1820. Upon any movement to remove the closure device, the barbs will drive into the inside wall of the opening; thereby limiting any further movement of the closure device from the opening.

Figure 18d shows a third style of apertured closure 1830; barbs 1832 together with a self-tapping screw thread 1834 enable the apertured closure device to be fastened irreversibly; the barbs, parallel spaced with respect to the screw-thread prevent any undoing of the closure device. Upon any movement to remove the closure device, the barbs will drive into the inside wall of the opening; thereby limiting any further movement of the closure device from the opening. With regard to Figure 18e, the shaft of the closure device 1840 is coated with an adhesive 1842 to prevent separation once inserted into the opening 1804. Equally, a heating system could be utilised to heat weld thermo-plastics components together. It will be understood that the skilled man will be knowledgeable of similar methods of forming permanent connection between a closure device and an opening.

Figure 19 shows a more sophisticated mechanical one-way closure system without detail of the aperture 1908, wherein an apertured closure 1900 is provided with an inner cap 1902 which has a plurality of triangular saw tooth projections 1904 located on its outer surface 1905 and an outer cap 1906 which fits over and rotates relative to the inner cap 1902 and is provided with knurled features 1907 located on its inner surface. The knurled features 1907 of the outer cap are complementary to and angled the same way as the saw tooth projections 1904 of the inner cap so that when the outer cap is rotated in the opening direction, the knurled features 1907 will move freely or ratchet over the saw tooth projections 1904. In contrast, when the closure system is placed upon an opening having a complementary screw-thread, then the knurled features 1907 cam against the saw toothed projections 1904 causing the caps to rotate in unison and engage with the container.

As will be appreciated, in a still further embodiment, the apertured closure could be provided with thread cutting barbs, whereby to screw-threadedly engage with an opening, whether it be an external circumference (male) or an internal tube (female) opening.

Figure 20 shows a further alternative system, wherein a bung 2000 is inserted into an apertured closure 2002 after a container has been emptied of fluid, so that the container with remnants of fluid can be disposed of safely, without unnecessary leaks, after a dispensing conduit has been removed from the container. As will be appreciated, the bung can be secured in a number of fashions, screw-threads, extending barbs, adhesive, etc. The bung may also be placed within the aperture (but not in an irreversible fashion) prior to first use to ensure that the apertured closure is maintained as clean as possible prior to first use.

Figures 21a shows a still further embodiment of the invention, wherein the closure 210 is suitable for fitment to sports drink containers, for example. A straw can be inserted into the aperture 211 of the closure. Figure 21b shows a cover 212 overlying the aperture, prior to or after use with a straw, whereby dust, dirt or other materials cannot enter the valve assembly when the straw is absent. It will be realised that the materials used in the manufacture of the cap – and container will be food grade and that any mould release residue will be washed or otherwise removed from the aperture closure cap. It will be

appreciated that variations of this will enable food grade containers to be used for dispensing comestible sauces, creams, pastes, such as ketchups, mustard, mayonnaise etc., conveniently for use with a dispenser means having a siphon or vacuum arrangement. By the use of the present invention, sports drink manufacturers can provide drinks that cannot be tampered with, which has been of some concern with some athletes, notably with professional cyclists. Figure 21c shows a drink container 214 fitted with the aperture cap 210 together with a straw 213 in place.

- 10 In a still further aspect of the invention, a tube and valve combination may be selected to provide an improved seal in use. For example, the tube may be dimensioned to correspond with a general n-flap duckbill valve by having n-super-elliptical portions. Figure 22 shows such an embodiment 220 having two super-elliptical portions 221, 222 which are dimensioned to achieve liquid flow in the hollow centre 226 flow with a maximum degree of sealing as between the elliptical wall portions of the tube 224, 225 and corresponding inside faces of a bi-flap duckbill. It will be appreciated that this design can more effectively seal with respect to the valve or enable the use of less resilient plastics tube for a particular requirement of sealing. The design can extend a tri-, quad-, penta-, etc. stars having Lamé curve elliptical sections to correspond with trifold, quad-fold, penta-fold etc. duckbill seals. With reference to the super elliptic portion 221, this can be described as an area bounded in part by two oppositely directed Lamé curves; for an n-fold duckbill the corresponding tube can have n-elliptical portions. It would be possible to provide a keyed tube - a tube having superellipse star configuration - for specialist fluids, for example, of a length sufficient to extend to ensure that maximum use of a fluid is removed from a container. One could also have a rigid or semi-rigid tube extension which affixes to an ordinary tube, for specific specialist requirement, for example. Of course, basic polygonal shapes may also be employed. It will be appreciated that the use of the super-ellipse design together with the n-fold duckbill can be applied to the designs discussed above, in general. It will also be appreciated that the use of keyed tube-container aperture can be employed in addition to or separately from the use of colour coding of lids, tubes, dispensing valves, so that certain types of fluids are always handled through the appropriate tubing, also colour coded, if necessary.

Figure 23 shows a still further embodiment of the invention with three internally directed fingers relating to tube stress reduction finger. Figure 24a shows an

alternative embodiment with 8 stress reducing fingers. These fingers act to guide a tube such that a lack of resilience in the tube (e.g. it is stiff at ambient temperatures in the winter, then the insertion of a tube may cause the tube to go through the valve (not shown in Figures 23 – 24b) at an angle whereby full  
5 sealing of the valve about the tube could be compromised. By the provision of such stress reducing finger elements on the entry portion of the aperture, the tube is likely to be centred on entry to the valve to ensure satisfactory sealing, as is shown in figure 24B with the presence of a centrally placed tube 242.

10 In accordance with a still further aspect of the invention, the closure is provided with a dispensing device, whereby the container, once fitted with the closure and secured thereto is provided with a dispenser unit. The dispenser comprises a body which is provided with a valve, a tube, insertable through the apertured  
15 closure of the invention, the valve or other type of mechanism being operable to receive fluid from the tube and to allow a measured dose or flow therethrough, to an outlet, being a tube, spray nozzle or spout. The body of the dispenser unit conveniently being removably attached to the apertured closure and being shaped to engage with certain features of the apertured closure, perhaps by mutually arranged co-operating sets of screwthreads, whereby, for example, a  
20 container with the apertured closure may have a dispenser removably associated therewith.

The invention provides a simple to fabricate container stopper which can enable satisfaction of health and safety requirements that are imposed on all types of  
25 businesses and increases compliance. Within the EU, for example, there is an Ecolabel scheme that provides accreditation. The scheme involves certification as well as compliance checks by independent, qualified scientists, and is trusted by consumers. This, in turn, means that a business can sell its products across the European Union and in other countries where such accreditations are considered  
30 equivalent to other national standards. In so doing, a business can more easily be focussed on its primary aims, adding value to a business and its products because it increases reputation, indicates corporate social responsibility and increases sales. The present invention, by assuring economical use of liquid products can help a company achieve such accrecitation and corresponding accreditations  
35 elsewhere.

CLAIMS:

1. A container and closure combination, for the containment of fluids and extraction therefrom by way of an extraction tube, the container comprising a closed volume with an opening, the closure being configured to close the opening  
5 of the container, wherein the closure is provided with an aperture and wherein the closure, upon fitment to the container opening, cannot be removed therefrom, the aperture of the closure comprising a unitary elastic uni-directional valve member;  
wherein the valve can operate in:  
10 a first, closed condition, to prevent a flow of fluid from the container; and,  
a second, operational condition, with an extraction tube sealingly engaged with respect to the valve, to permit an extraction and dispensing of fluid from the container through the tube.
- 15 2. A container and closure combination according to claim 1, wherein the opening of the container is of circular cross-section.
3. A container and closure combination according to claim 1 or 2, wherein the opening comprises one of a simple aperture within a wall of the container; an  
20 upstanding duct from an exterior surface of the container (male opening); and a duct depending from an exterior surface of the container (female opening).
4. A container and closure combination according to any one of claims 1 - 3, wherein the container and closure are fastened, upon fitment by mutually  
25 engaging screw-threads.
5. A container and closure combination according to any one of claims 1 - 3, wherein the container and closure are fastened by means of self-tapping screw-thread fasteners.  
30
6. A container and closure combination according to claim 1 - 3, wherein the container and closure are fastened by co-operating detent means.
7. A container and closure combination according to claim 1, wherein the  
35 container and closure are fastened by mutually engaging non-return bayonet fastening elements.

8. A container and closure combination according to any one of claims 1 - 3, wherein the container and closure are mutually retained with respect to each other by mutually engaging barbs present in one of the container opening and closure, the barbs enabling entry of one element within another, but preventing  
5 removal by engagement through friction between surfaces or piercing of a second surface by barbs of a first surface.

9. A container and closure combination according to any one of claims 1 - 3, wherein the closure, upon fitment, cannot be removed from the container  
10 opening, by reason of an adhesive acting between mutually facing parts of the closure and container, wherein the mutually facing parts are adhesively connected together by one of an adhesive, solvent bonding or thermal bonding.

10. A container and closure combination according to any one of claims 1 - 9,  
15 wherein the container and closure have mating portions therebetween, which mating surfaces have mutually corresponding contours, whereby the closure and container can only operate with a corresponding dispensing apparatus.

11. A container and closure combination according to claim 10, wherein the  
20 mating portions are generally circular.

12. A container and closure combination according to claim 10, wherein the mating portions are non-circular.

25 13. A container and closure combination according to any one of claims 1 - 12, wherein the aperture when fitted with a corresponding tube enables a passage of air between the aperture and said corresponding tube, into the container whereby to provide a vacuum relief within the container, as product is removed therefrom.

30 14. A container and closure combination according to any one of claims 1 - 12, wherein the closure is fitted with a one-way valve whereby to enable a flow of air into the container, in use, under conditions of partial vacuum within the container.

35 15. A container and closure combination according to any one of claims 1 - 12, further comprising a tube, which tube in the first position of the valve is not present in the container or valve and, in the second, operational condition, is placed within the valve.

16. A container and closure combination according to any one of claims 1 - 12, further comprising a tube having two conduits, one conduit for a dispensing of fluid; the other for a flow of air into the container, whereby to prevent dispensing  
5 problems arising under conditions of partial vacuum within the container.
17. A container and closure combination according to any one of claims 1 - 12, wherein the aperture comprises a single or multi-slit valve.
- 10 18. A container and closure combination according to any one of claims 1 - 10, wherein the aperture, when fitted with a corresponding tube, is airtight as between the tube and the aperture.
- 15 19. A container and closure combination according to any one of claims 1 - 14, wherein the aperture corresponds in shape with a conduit or tube of a dispensing apparatus.
- 20 20. A container and closure combination according to claim 18, wherein the size of the aperture is less than the outside diameter of said tube, whereby the tube is sealingly engaged with the aperture.
21. A container and closure combination according to claim 20, wherein the aperture is reinforced.
- 25 22. A container and closure combination according to claim 20 or 21, wherein the aperture is supported with an elastic ring.
- 30 23. A container and closure combination according to any one of claims 1 - 22, further comprising a cover that can be clipped to, placed around or otherwise positioned about the aperture to seal the apertured closure, the cover being separate to or associated with the cap by way of a hinge element fastened to the aperture closure.
- 35 24. A container and closure combination according to any one of claims 1- 20, further comprising a plug that can be inserted into the aperture to provide a secondary seal to the apertured closure.
25. A container and closure combination according to any one of claims 1 - 20,

further comprising a plug that can be inserted into the aperture to seal the apertured closure, the plug being associated with the cap by way of a hinge element fastened to the aperture closure.

5 26. A container and closure combination according to any one of claims 1 - 25, wherein the container is operably filled with one of a fluid; a spirit; a sauce; a gel; a powder; a cream; a grease; an oil; an ointment in respect of purposes for cleaning; for manufacturing (for production processes); for horticulture and agriculture; for lubrication and/or protection; for medicine; for human and animal  
10 consumption.

27. A container and closure combination according to any one of claims 1 - 23, wherein the combination further comprises a dispensing device which enable a liquid, a spirit, a sauce, a gel, a powder, a cream, a grease, an oil, or an ointment  
15 to be dispensed by virtue of a siphoning action or a vacuum.

28. A container and closure combination according to any one of claims 1 - 24, wherein the container is operably filled with a comestible product and wherein the combination further comprises a straw to enable a fluid, a spirit, a sauce, a gel, a  
20 powder, a cream, a grease, an oil, or an ointment to be dispensed by virtue of a siphoning action or a vacuum.

29. A container and closure combination according to any one of claims 1 - 24, wherein the valve of the closure comprises an n-flap duckbill valve, wherein the  
25 tube for extraction comprises n-elements of Lamé –elliptical sections, whereby to assist in any sealing in use as between tube and valve.

30. A tube extension element having n-elements of Lamé –elliptical sections, operable in a container and closure combination of claim 29.

30 31. A closure for use in a combination according to one of claims 1 – 29.

32. A closure for use in a combination according to any one of claims 1 – 29, wherein the apertured closure is provided with a further element operable to  
35 provide strain relief for a tube, to assist in enabling a central placement of a tube upon introduction.