Jan. 27, 1948. J. W. CAMPBELL 2,435,033

DEVICE FOR TRANSFERRING FLUIDS

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Fig. 1.

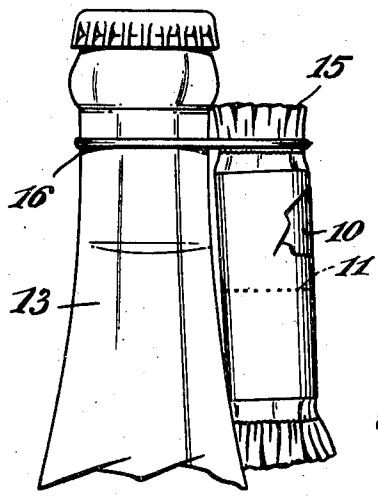


Fig. 3.

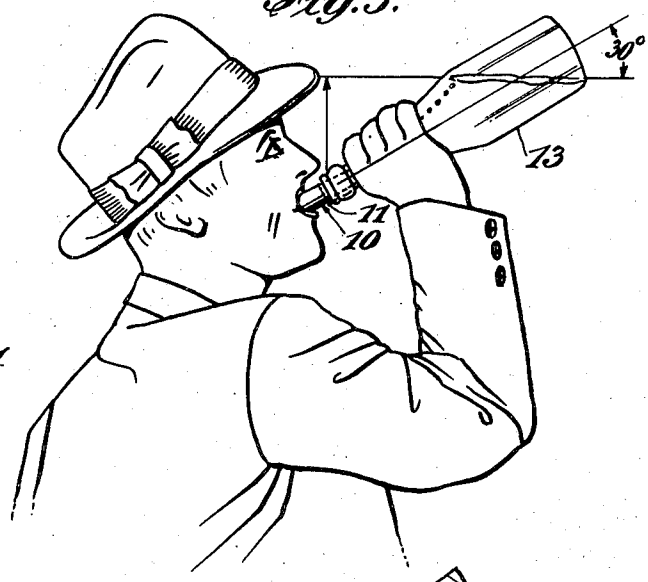


Fig. 2.

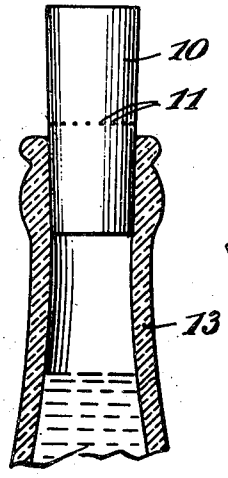


Fig. 4.

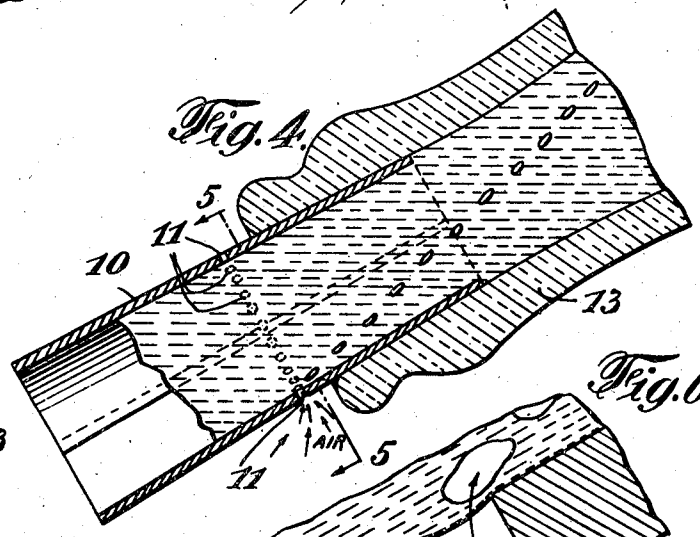


Fig. 6.

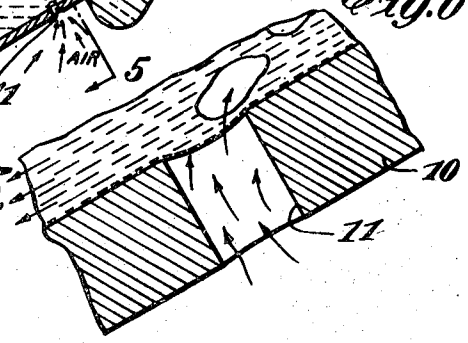


Fig. 5.



Fig. 7.

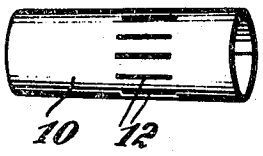


Fig. 5a



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Fig. 8.

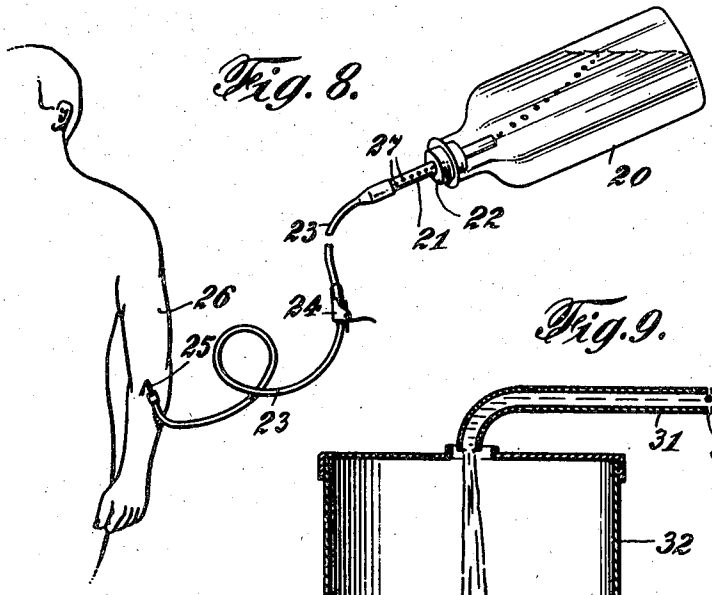


Fig. 9.

Fig. 10.

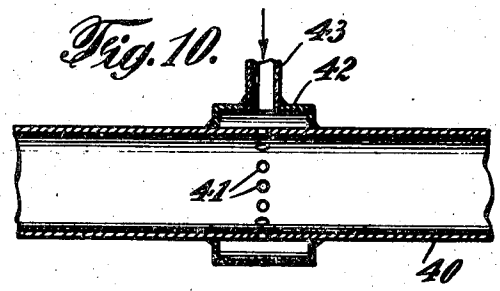
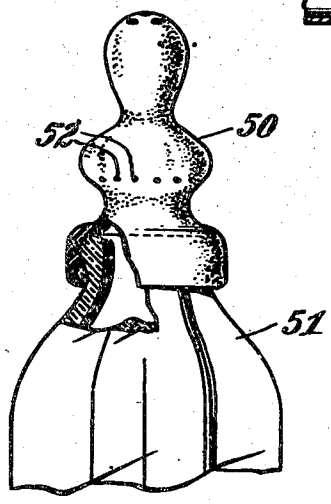


Fig. 11.



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UNITED STATES PATENT OFFICE

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DEVICE FOR TRANSFERRING FLUIDS

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Application July 14, 1944, Serial No. 545,018

3 Claims. (Cl. 215—79)

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This invention relates to an accessory which facilitates the transference of liquids from containers by gravity by employing the force of surface tension of the liquids to prevent leakage. This is accomplished by neutralizing the vacuum in the container created by the transference of the liquid in that the use of properly determined orifice or orifices—located in the accessory—permit the ingress of air, while at the same time the predetermined limitation of the diameter of size of these openings allows surface tension to prevent the leakage of fluid.

This invention further relates to the providing of a sanitary and convenient means for the drinking from a container all types of liquids (beer, milk and milk products, water, soda, cola and other soft, alcoholic and non-alcoholic drinks) and dispenses with the use of glasses, cups, straws, etc., and by its conical shape permits easy insertion into the container and effectively seals the space between the accessory and the neck of the container. Moreover, the conical shape permits nesting in packaging. Various attempts have been made to provide devices for this purpose but objections inherent in the principle employed, the construction, function and operation have prevented a general use of the same. Embodiments of the invention may be applied to other uses.

This invention consists generally of an accessory adapted to act as a valve in a low pressure system made of non-wettable material, consisting of a partition to separate two fluids, said partition, having means for communicating one fluid with the other, said means to utilize the variances of surface tensions of said fluids, to allow for the ingress of one without permitting the egress of the other, the surface tension forces of the one fluid being at all times greater than forces capable of moving the fluid through said means, said surface tension forces causing the fluid to bridge the surface areas of the means.

The invention will be more fully described hereinafter and various embodiments thereof will be shown in the drawings, and the invention will be finally pointed out in the claims.

In the accompanying drawings,

Fig. 1 is a front view of the improved accessory held in a position of non-use and applied to a bottle;

Fig. 2 is a side view of the accessory attached to a bottle;

Fig. 3 is a perspective view showing the manner of use of the improved accessory;

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Fig. 4 is an enlarged central section of the bottle tip and the accessory applied thereto;

Fig. 5 is a transverse section taken on line 5—5 of Fig. 4;

Fig. 5a is an end view of the accessory such as shown in Fig. 5, in which the circumferential openings are omitted and the orifice formed at the bottle end of the accessory embodies the invention;

Fig. 6 is a diagrammatic view of the mode of operation of the accessory in the form, for example, as that shown in Fig. 4;

Fig. 7 is a side view of an accessory having slits circumferentially placed;

Fig. 8 is a perspective view of a bottle for injection contents, to which an embodiment of my invention is applied;

Fig. 9 is a section of two communicating vessels, having my invention applied thereto;

Fig. 10 is a section of a pipe surrounded by a hollow collar to mix one fluid with another; and

Fig. 11 is a perspective view of a nipple for bottles, having this invention embodied therein.

Similar characters of reference indicate corresponding parts throughout the various views.

To further described the accessory as related to the drinking from containers, it consists of an accessory made of paper, plastic, metal, Celluloid, natural or synthetic rubber, or other materials of a non-wettable character, fashioned into a cylindrical or conical shape open at both ends and tapered for insertion into containers used for beverages, with the one bore end of convenient size for insertion into the mouth of the user. The accessory shall taper to an angle of ½° to 8° which is to provide:

1. Nesting for saving of space and for easy packaging.

2. Adaptability to various diameter container openings.

3. Self-wedging and firm attachment to container openings.

Any variation of this taper from within this angular range will not provide all three features.

The accessory relies on the surface tension of the liquid to prevent leakage, yet permits the passage of air to neutralize the vacuum created above the liquid in the container so that the liquid readily flows. The improved accessory has very small openings, so small as to insure a sealing by the surface tension of the liquid of said openings, which thereby prevent the liquid from passing through these openings. Air, however, under atmospheric pressure can find its way through the liquid to provide neutralization of

said vacuum above the level of the liquid which has been created by the transference of some of the liquid, thereby permitting the orderly flow of the liquid through the accessory. The fluid seal will again quickly close without permitting leakage through the opening or openings; this action repeating itself. Over and over again while passing through the accessory the liquid will through surface tension close the openings against itself but not against the air which under atmospheric pressure will continuously enter the container. The applicable rule is: When the circumference of the hole or opening, or conduit, is multiplied by the surface tension of the fluid, it should equal or slightly exceed the weight of a column of the fluid having the same circumference and a height which height will equal its operational head. It is from this relationship, with the knowledge of the surface tension of the liquid, that the area of the hole can be determined. My invention includes applications of this concept to include the use of the force of surface tension to allow for the neutralization of a vacuum to prevent leakage. Such instance as this, for example, is when the hole is extended to a canal or conduit as by an overlap in the accessory as shown in Fig. 5*a* and in which the circumferential openings are omitted, and the orifice **14***a* has such a predetermined size that the surface tension of the liquid in the container prevents the passage of the liquid through the orifice, and the force of surface tension is coupled with a time factor in the prevention of leakage. This embodiment would omit the circularly disposed holes **11** of Fig. 4.

The accessory has one or more holes or openings exterior to the container of the liquid, such holes having an area over which the liquid will pass without entering the hole, save only such convexity as results from the weight of the liquid restrained by its surface tension forces. A plurality of such holes can be circumferentially or longitudinally, or otherwise arranged. Slits or slots may be substituted for the holes and the disposition of the holes, slits or slots need not be necessarily uniformly arranged, provided such holes, slits or slots are free from the container and from the mouth, when accessory such as is applied to a bottle, is being used.

Referring to the drawings, the improved accessory is made from a rectangular sheet of material of sufficient stiffness and of a non-wettable surface to maintain its shape and of sufficient inherent resiliency to return to its initial position. This sheet is molded, or rolled to shape by mechanical means such as by overlapping its longitudinal ends into a lap joint as shown in Fig. 5, glue or other holding means being supplied. When so fashioned it is generally cylindrical with, however, one end of slightly less diameter than the other end, whereby the cylinder becomes slightly tapered. One example of one end adapted to be inserted into the container is shown in Figs. 2, 3 and 4. The slightly tapering shape brings about a tight hold when inserted in the container.

In Fig. 4, the accessory **10** has about at is median position a circumferentially disposed series of openings **11**, spaced from each other. One of these openings is sufficient to carry out the invention. The exterior air enters the opening but the surface tension of the fluid will prevent the fluid from passing out of the opening yet enables the proper neutralization of the vacuum above the fluid. A plurality of such openings increases the air inflow into the container thereby accelerating the neutralization of vacuum above the fluid. By arranging the openings circumferentially or otherwise any position of the accessory in the container will make it operative, and no particular attention need be given to the positioning of the openings. It is essential that the openings be in communication with the atmosphere or comparable fluid as generally shown in Fig. 4. Should a canal or conduit be used as in Fig. 5*a* as an alternate to the openings **11** for example its external hole that is in the plane passing through the tip of the bottle must still occupy a position external to the container and the lips of the user, if the embodiment be used. Slits or slots **12** as shown in Fig. 7 or other configurations may be used, and the material may be specially prepared to provide interstices in a circumferential or other zone, where the openings are now shown, the remaining parts of the material being more compressed or compacted, provided always that the foregoing relationships between external pressure of the air or atmosphere, surface tension, forces of the fluid, height or column above the opening, etc. be followed.

The invention described may be applied to other uses; for instance, difficulty has been encountered in transferring a fluid suitable for injections due to the desire to keep such fluid free from contamination of the atmosphere or oxidation of the atmosphere. In Figure 8 the sealed bottle **20** has a tube **21** inserted through its cork **22**, to which tube **21**, a flexible tube **23**, with a control device **24** is attached to the free end of which tube **23**, an injection needle **25** is applied to the arm of the patient. In the tube **21**, there are arranged either circulary, or in alignment, or otherwise, small surface tension openings **27** as described permitting entrance of air, but preventing exit of any of the fluid.

In Figure 9, the filled closed vessel **30** has a conduit **31**, communicating with another vessel **32** to be filled. The conduit **31** has the surface tension holes **33** as described.

In Figure 10, when it is desired to mix two fluids, one fluid passes through the pipe **40** which is provided with the surface tension holes **41**. Surrounding this portion of the pipe **40** is a hollow ring **42**, the interior of which is supplied by a pipe **43** with a fluid which will enter the surface tension openings **41**. These openings, however, prevent the fluid in the pipe **40** to pass outwardly through such openings.

Much difficulty has been encountered with baby feeding by bottles with nipples. Bleed channels have been provided. In Figure 11 a nipple **50** is applied to a bottle **51**. The nipple **50** is provided with surface tension openings **52**, preventing egress of the fluid, but permitting inlet of the air.

The accessory may be enveloped in a Cellophane like wrapper **15** as shown in Fig. 1, with its one or both ends held by detachable strings **16**, to the bottle **13**. Such accessory with suitable advertising matter printed thereon may be then supplied during the sale of the bottle **13**.

The material used for the accessory has preferably a certain inherent stiffness, but is sufficiently flexible so that it may or may not form in the mouth portion a somewhat collapsed portion without tearing or breaking the material.

There has been provided a sanitary and convenient means for drinking directly from the container by neutralizing the vacuum, which would ordinarily hinder this manner of drinking; adequate amounts of liquid can be secured

directly from the container. The anti-vacuum feature utilizes the balancing of the fluid weight against its surface tension to provide a leakless means of neutralizing the vacuum created when drinking.

The sizes of the holes, slits or slots are of the greatest importance; their size is determined by mathematically balancing the physical property of surface tension of the liquid used against the weight of a column of the liquid which is determined by the height of the fluid above the vent or its operational head and the diameter is equivalent to the size of the hole. The surface tension about the hole is obtained by multiplying the circumference of the hole by the known surface tension of the fluid (in the case of water 75 dynes per centimeter multiplied by the circumference of the hole in centimeters) which gives the total force of the surface tension which must act against the weight of the column of fluid. The weight of the column is determined by multiplying the total volume by the specific gravity of the fluid. The surface tension force must equal or exceed the weight of the column of fluid. If the drinker uses about a 30° angle of the container to the horizontal a pin hole size of hole will result from calculations, and this can be more accurately determined for various liquid as well as any angle of tilt employed in drinking from the container.

I have described several forms of my invention, but obviously various changes may be made in the details disclosed without departing from the spirit of the invention as set out in the following claims.

What I claim is:

1. In an accessory adapted to act as a valve in a low pressure system, the combination of means for enclosing and conducting a fluid including a wall of a material to separate the enclosed fluid from a fluid exterior to said wall, said wall having a cavity having an axis substantially at right angles to said wall, and the orifice formed by the opening of said cavity having a non-wettable edge at the enclosed fluid side of said wall, said non-wettable edge of said orifice of said wall having a predetermined circumferential size, being determined by the force of the column of fluid above the orifice, of a height equal to the operational head and of cross-sectional area equal to that of the orifice, being equal to or less than the force developed by the surface tension acting on the non-wettable perimeter of the orifice, for bridging said orifice, for withholding said fluid through said cavity preventing egress of the same, but permitting intermittent ingress from the opposite end of said cavity of the other fluid at the other side of the wall to the non-wettable edge when the pressure of the ingress fluid becomes intermittently greater than the resisting forces of the withheld fluid at the orifice.

2. In an accessory adapted to act as a valve in a low pressure system, the combination of means for enclosing and conducting a fluid including a wall of a material to separate the enclosed fluid from a fluid exterior to said wall, said wall having a cavity having an axis substantially at right angles to said wall, and the orifice formed by the opening of said cavity having a non-wettable edge at the enclosed fluid side of said wall, said non-wettable edge of said orifice of said wall having a predetermined circumferential size being determined by the force of the column of fluid above the orifice, of a height equal to the operational head and of cross-sectional area equal to that of the orifice, being equal to or less than the force developed by the surface tension acting on the non-wettable perimeter of the orifice, for bridging said orifice, for withholding said fluid through said cavity preventing egress of the same, but permitting intermittent ingress from the opposite end of said cavity of the other fluid at the other side of the wall to the non-wettable edge when the pressure of the ingress fluid becomes intermittently greater than the resisting forces of the withheld fluid at the orifice, said wall being a sheet of material fashioned into a tube shape with end bores, one bore end shaped into the neck of a standard bottle and having its other bore end adapted to be inserted into the mouth of a drinker, the fluid in the bottle adapted to pass through the interior of the tube shaped material, the exterior surface being exposed to the atmosphere between the bottle and said mouth, and having said orifice along said exposed surface.

3. In an accessory adapted to act as a valve in a low pressure system, the combination of means for enclosing and conducting a fluid including a wall of a material to separate the enclosed fluid from a fluid exterior to said wall, said wall having a cavity having an axis substantially at right angles to said wall, and the orifice formed by the opening of said cavity having a non-wettable edge at the enclosed fluid side of said wall, said non-wettable edge of said orifice of said wall having a predetermined circumferential size being determined by the force of the column of fluid above the orifice, of a height equal to the operational head and of cross-sectional area equal to that of the orifice, being equal to or less than the force developed by the surface tension acting on the non-wettable perimeter of the orifice, for bridging said orifice, for withholding said fluid through said cavity preventing egress of the same, but permitting intermittent ingress from the opposite end of said cavity of the other fluid at the other side of the wall to the non-wettable edge when the pressure of the ingress fluid becomes intermittently greater than the resisting forces of the withheld fluid at the orifice, said wall being a sheet of material fashioned into a tube shape with end bores, one smaller than the other, the smaller bore end shaped into the neck of a standard bottle and having its larger bore end adapted to be inserted into the mouth of a drinker, the fluid in the bottle passing through the interior of the tube shaped material, the exterior surface being exposed to the atmosphere between the bottle and the mouth, and having a plurality of said orifices circumferentially spaced around the tube shaped material along said exposed surface.

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