



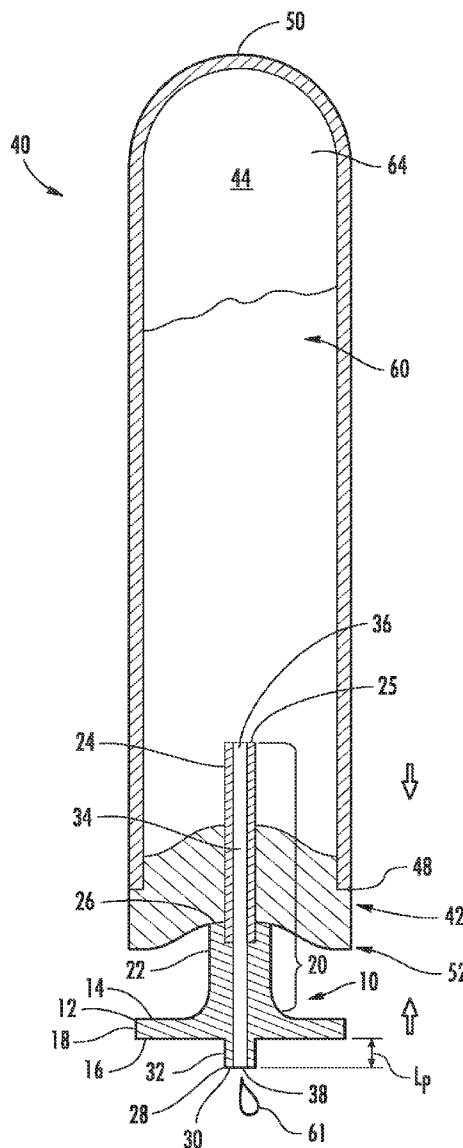
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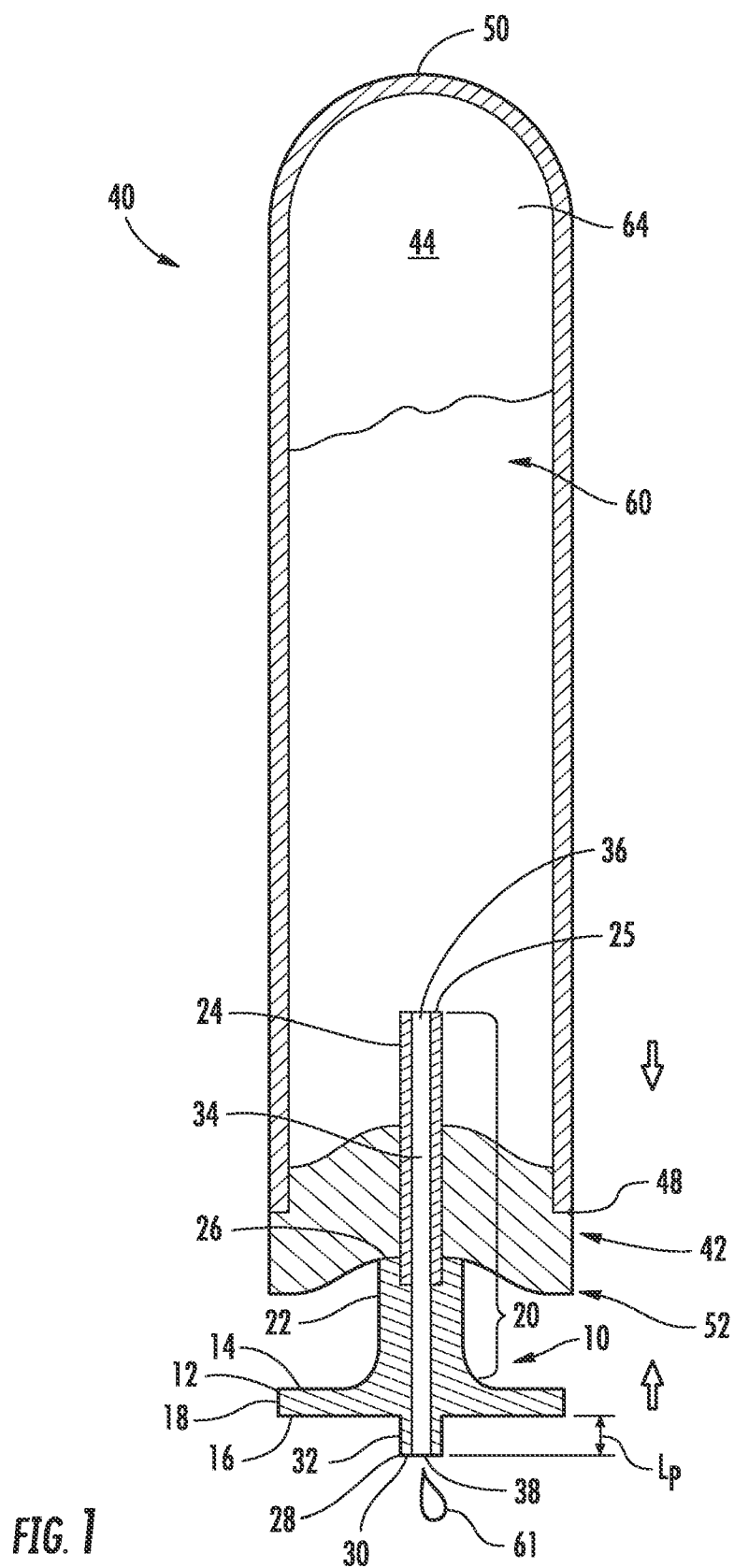
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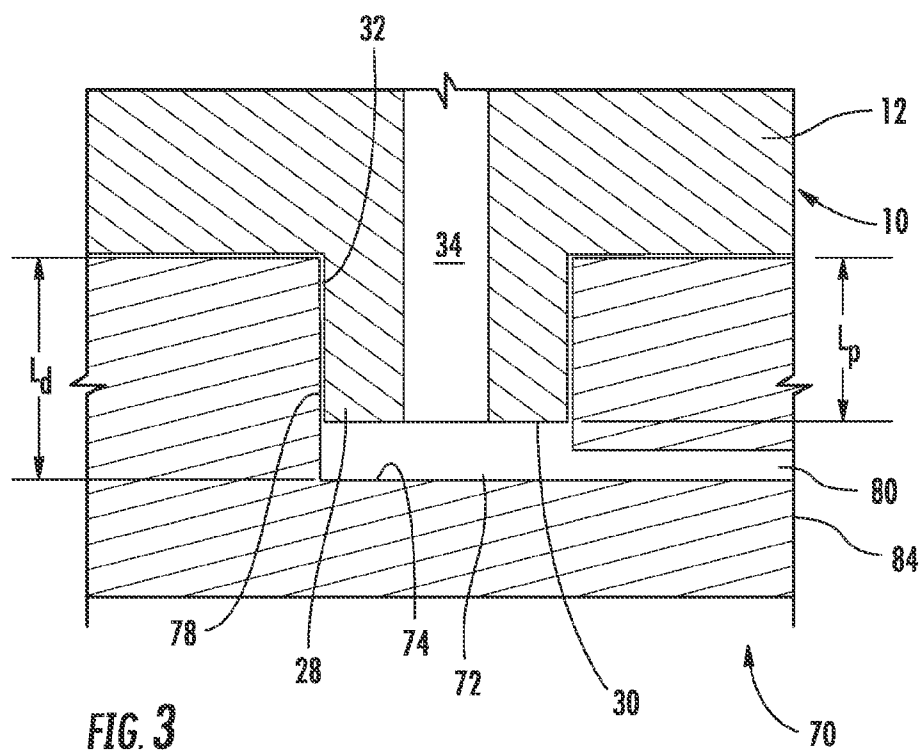
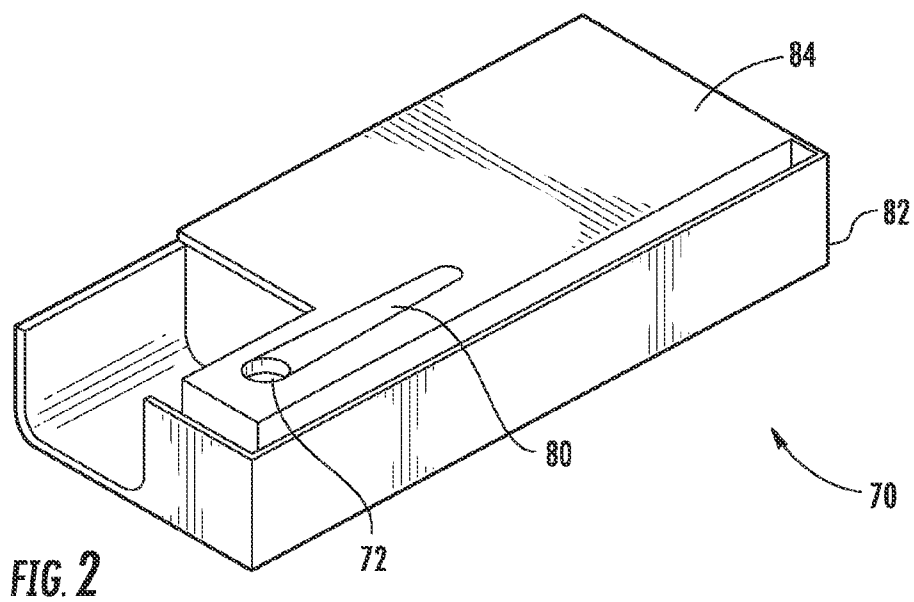
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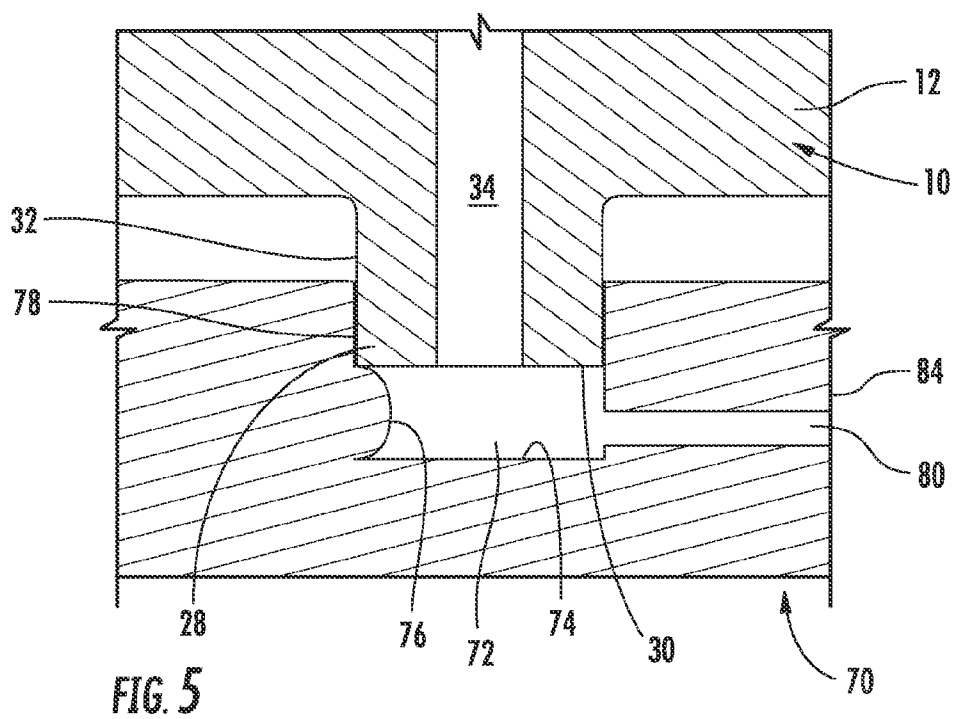
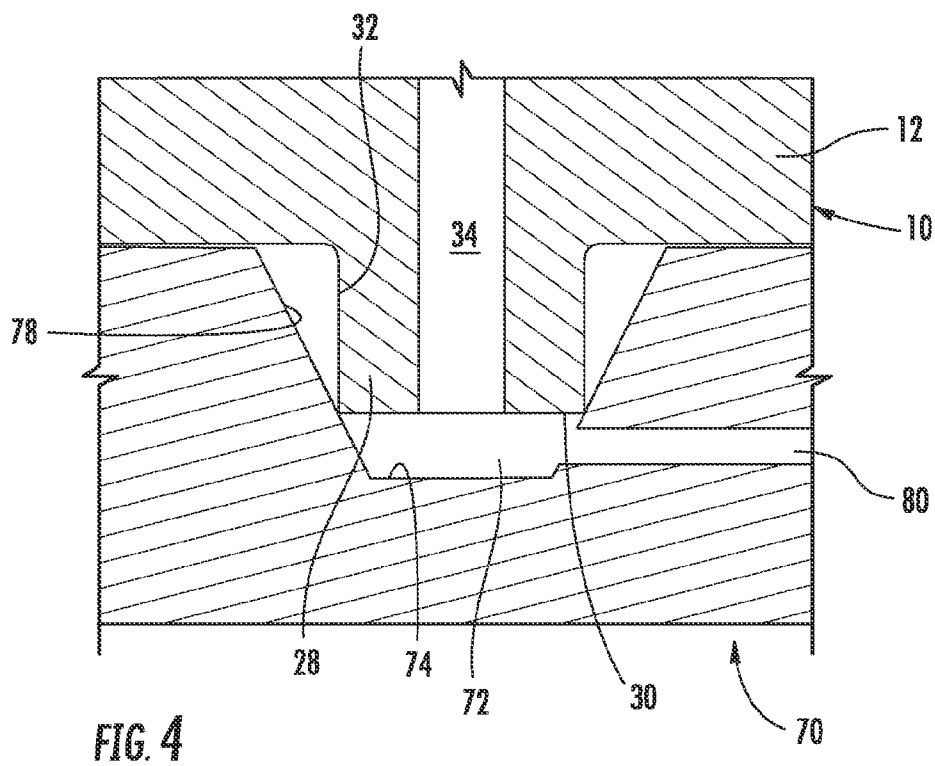
(52) **U.S. Cl.** **141/1; 141/312**(57) **ABSTRACT**

A system and method for transferring fluid directly from a container sealed with a closure, to a receptacle. The receptacle includes an aperture and an interior floor. The fluid dispenser has two ends—a first end pierces the closure to establish fluid communication between the interior and exterior of the container and the second end engages the aperture in the receptacle. Relative movement of the receptacle and container toward each other dispenses fluid from the container, through the dispenser, and directly into the receptacle. The second end of the dispenser is precluded from contacting the interior floor of the receptacle to avoid unintentional withdrawal of the fluid from the receptacle.

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SYSTEM AND METHOD FOR DISPENSING FLUID FROM A CONTAINER AND INTO A FLUID RECEPTACLE

FIELD

[0001] Embodiments relate in general to a system and method for dispensing the contents of a fluid container directly into a receptacle and, more particularly, to a system and method for dispensing the contents of a test tube directly into a cartridge-type receptacle.

BACKGROUND

[0002] Test tubes are commonly used as collection containers for blood specimens and other liquids, such as biological fluids. When blood is to be collected, an anticoagulant is placed in the test tube and a blood specimen is withdrawn from a patient directly into the test tube. The test tube is closed with a rubber stopper.

[0003] Typically, the blood or other fluid must be removed from the test tube to analyze it. Thus, the task of conveniently and efficiently dispensing fluid from a test tube onto a desired surface must be routinely performed by laboratory workers in a variety of circumstances. However, care must be taken when dispensing such fluids to avoid contamination of the fluid to be tested, such as when dispensed fluid is drawn back into the test tube. Care must also be taken to avoid spillage of the fluid and the possibility of the fluid becoming airborne, such as when the fluid is dispensed from the test tube too rapidly, which can expose the laboratory worker to the fluid as well as any diseases that may be carried by the fluid.

[0004] Prior to the present invention, devices were available to transfer fluid directly from a test tube onto a slide. This type of device eliminated the need to remove the stopper from the test tube thus avoiding the problem of creating an aerosol effect when a stopper is removed from a test tube, since laboratory workers would no longer be exposed to any contaminants or diseases in the blood.

[0005] Recently a cartridge-type receptacle has become popular for use in the analysis of the sample of biological fluid. Pipettes are typically used to transfer the fluid from the test tube into an aperture in the cartridge. But the use of the pipette required removal of the stopper from the test tube thus again creating an aerosol as the stopper is removed, thus exposing the laboratory worker to any contaminants and diseases contained in the biological fluid.

SUMMARY

[0006] Embodiments are directed to a system for dispensing fluid directly from a container into a cartridge type receptacle without the need for removing a closure or stopper from the container thus avoiding the creation of the undesirable aerosol effect.

[0007] A fluid dispenser punctures the stopper of the container and, upon creation of an increase of pressure within the container, such as by flexing the stopper inwardly, fluid exits the container through the dispenser.

[0008] A receptacle, preferably a cartridge-type receptacle, has an aperture to receive the fluid dispenser such that the fluid exiting the container through the dispenser flows directly into the receptacle.

[0009] Various embodiments of the interface between the dispenser and the receptacle are described.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] In the drawings, which are not to scale, and wherein like reference numerals identify corresponding components;

[0011] FIG. 1 is a side elevation partially cross-sectional view of a fluid dispensing system, showing a fluid dispenser inserted through a closure of a test tube such that, after relative movement between the test tube and/or the fluid dispenser, the closure flexes to pressurize the interior of the test tube resulting in a portion of a fluid in the test tube being dispensed.

[0012] FIG. 2 is a perspective illustration of a cartridge-type receptacle.

[0013] FIG. 3 is a side elevation partial cross-sectional view of a first embodiment of the interface between a fluid dispenser and a hole in a fluid receptacle.

[0014] FIG. 4 is a side elevation partial cross-sectional view of a second embodiment of the interface between a fluid dispenser and a hole in a fluid receptacle.

[0015] FIG. 5 is a side elevation partial cross-sectional view of a third embodiment of the interface between a fluid dispenser and a hole in a fluid receptacle.

DETAILED DESCRIPTION

[0016] Embodiments herein are directed to systems and methods for dispensing fluid from a container. Embodiments will be explained in connection with the dispensing blood from a test tube, but the detailed description is intended only as exemplary. Indeed, it will be appreciated that aspects can be used in connection with other containers as well as with other fluids. Embodiments are shown in FIGS. 3-5, but they are not limited to the illustrated structure or application.

[0017] Before describing systems and methods for dispensing fluid from a container, various possible components of such systems and methods will be initially described. Referring to FIG. 1, a fluid dispenser includes a base 12 having opposed first and second sides 14, 16, respectively. In one embodiment, the base 12 can be generally circular in cross-sectional shape. However, the base 12 can have any suitable conformation, such as being rectangular, triangular, oval or polygonal.

[0018] An elongated puncturing shaft 20 can extend from the first side 14 of the base 12. The puncturing shaft 20 can extend at any suitable angle relative to the first side 14 of the base 12. In one embodiment, the puncturing shaft 20 can be substantially perpendicular to the first side 14 of the base 12. The puncturing shaft 20 can be substantially centrally located on the first side 14 of the base 12.

[0019] The puncturing shaft 20 can include a stem portion 22 that can extend directly from the first side 14 of the base 12. The stem portion 22 can transition to a cannula portion 24. The cannula portion 24 can culminate in a tip 25 which may be pointed or chamfered to facilitate puncturing.

[0020] The transition between the stem portion 22 and the cannula portion 24 can have any suitable configuration. For instance, the transition between the stem portion 22 and the cannula portion 24 can include a shoulder 26, which may determine an insertion length of the puncturing shaft 20 into the container. In one embodiment, the stem portion 22 and cannula portion can each have a substantially circular cross-section with the diameter of the circular cross-section of stem

portion 22 being greater than the substantially circular cross-section diameter of the cannula portion 24, thereby forming the shoulder 26.

[0021] The cannula portion 24 can include a plurality of serrations, teeth, or barbs (not shown) for resisting any tendency of the cannula portion 24 from accidentally withdrawing from the item into which it is inserted, such as the closure of a test tube or other container. Thus, the serrations can minimize subsequent movement of the fluid dispenser 10 after it has been attached to a container.

[0022] A hollow protrusion 28 can extend from the second side 16 of the base 12. In some instances, the protrusion 28 may be the only structure that extends from the second side 16 of the base 12. The protrusion 28 can extend at any suitable angle relative to the second side 16 of the base 12. In one embodiment, the protrusion 28 can be substantially perpendicular to the second side 16 of the base 12. The protrusion 28 can be substantially centrally located on the second side 16 of the base 12. The hollow interior of the protrusion 28 can be substantially aligned with the hollow interior of the puncturing shaft 20. The protrusion 28 can terminate at a tip 30. The protrusion 28 can have an associated length L_p defined as the distance between the second side 16 of the base 12 and the tip 30.

[0023] The protrusion 28 can have any suitable conformation. In one embodiment, the protrusion 28 can be substantially circular in cross-section. In other embodiments, the protrusion 28 can be rectangular, triangular, oval or polygonal. The protrusion 28 can include one or more side walls 32, depending on the configuration of the protrusion 28. For instance, when the protrusion 28 is substantially circular, the protrusion 28 can have a single continuous side wall 28. When the protrusion 28 is polygonal, the protrusion 28 can have a plurality of side walls 32. The one or more side walls 32 can be substantially straight. Alternatively, the one or more side walls 32 can be tapered.

[0024] A flow passage 34 can extend through the fluid dispenser 10 from the protrusion 28 to the cannula portion 24. The flow passage 34 can have an inlet opening 36 in the cannula portion 24, such as at the cannula tip 25. The flow passage 34 can have an outlet opening 38 in the protrusion 28, such as at the protrusion tip 30. The flow passage 34 can extend from the inlet opening 36 to the outlet opening 38.

[0025] The flow passage 34 can have any suitable size and shape. The cross-sectional size and shape of the flow passage 34 can be substantially constant along its length or at least one of the cross-sectional size and shape of the flow passage 34 can vary along at least a portion of the flow passage 34. In one embodiment, the flow passage 34 can be substantially circular in cross-sectional shape. The flow passage 34 can be substantially straight. Alternatively, the flow passage 34 can include one or more bends, turns, curves and/or angles.

[0026] The fluid dispenser 10 can be a unitary structure. That is, all portions of the fluid dispenser 10 can be formed as a single structure, such as by plastic injection molding. Alternatively, at least a portion of the fluid dispenser 10 can be made separately and/or of a different material. For instance, the cannula portion 24 can be made of metal, and the rest of the fluid dispenser 10 can be made of plastic. In such case, stem portion 22 can be molded around the metal cannula portion 24, or the metal cannula portion 24 can be received in a passage in the stem portion 22. At least a portion of the fluid

dispenser 10 can be transparent, such as by using a transparent plastic material, thereby allowing a user a greater field of view during use.

[0027] Embodiments of systems and methods herein can include a container 40. The container 40 can have an opening 42. The container 40 can include an inner chamber 44 having an associated volume. In one embodiment, the container 40 can be a test tube in which the opening 42 is provided at a first end 48 thereof. The second end 50 of the test tube can be closed. For convenience, the following discussion will be made in connection with a test tube, but it will be understood that embodiments are not limited to test tubes, as any suitable container can be used.

[0028] The open first end 48 of the test tube can be closed by a closure 52. Any suitable structure can be used for the closure 52. The closure 52 can form a seal with the opening 42. The closure 52 can be a rubber stopper or other structure that is reusable, resealable, repuncturable, flexible and/or resilient. The closure 52 can be force fit into the opening 42 of the test tube and retained in place by at least friction.

[0029] The inner chamber 44 of the test tube can include a fluid 60. The fluid 60 can be any type of fluid. In one embodiment, the fluid 60 can be blood or another biological fluid. There may be an air space 64 between the top of the fluid 60 and the interior end of the end 50 of the test tube. In some instances, there may be little or no air space 64 between the top of the fluid 60 and the interior of the end 50 of the test tube.

[0030] FIG. 2 illustrates in general terms a cartridge-type receptacle 70 into which fluid is to be placed for subsequent evaluation. The receptacle, which will be described as a cartridge for convenience only, is a generally thin, flat, rectangular member having an aperture 72 and an interior passageway 80. The aperture or hole 70 can extend to a first depth within the receptacle such that the aperture will be in fluid communication with the interior passageway 80. The first depth may be considered to extend from the top of the receptacle to an interior floor 74 of the receptacle. The distance from the top of the receptacle 70 to the interior floor 74 of the receptacle can be considered as the depth 74 of the hole and may be designated L_d . The diameter of the hole 72 at the top surface of the cartridge is sufficient to receive at least a portion of the diameter of the protrusion 28 as will be more fully described below.

[0031] The hole 72, which is formed in the receptacle, can have any suitable cross-sectional shape which is thus defined by the size and shape of the interior wall 78 of the hole. Thus the cross-sectional diameter of the hole 72 can be substantially constant, as is shown in FIG. 3. Alternatively, the cross-sectional size of the hole 72 can vary. For instance, the cross-sectional diameter of the hole 72 can be conical or chamfered to decrease in the downward direction toward the floor 74 as is shown in FIG. 4. One or more projections 76 can extend from the wall 78, as is shown in FIG. 5. In some instances, the fluid receptacle 70 can include more than one hole 72.

[0032] The fluid receptacle 70 can include an elongated channel 80 for receiving a fluid. The channel 80 can be in direct or indirect fluid communication with the hole 72. In some instances, there can be more than one channel 80 associated with the hole 72. At least a portion of the channel 80 can extend within the interior of the fluid receptacle 70.

[0033] The channel 80 can have any suitable size or shape. In one embodiment, the cross-sectional area of the channel 80 can be substantially constant along its length. Alternatively, the cross-sectional area of the channel 80 can vary along at

least a portion of its length. The channel **80** can be substantially straight. Alternatively, the channel **80** can include one or more bends, turns, curves or angles.

[0034] The fluid receptacle **70** can be a test cartridge for use in connection with a blood/biological fluid analysis device. For instance, in one embodiment, the fluid receptacle can be a test cartridge for an i-STAT 1 handheld analysis device, which is available from Abbott Laboratories, Abbott Park, Ill. The fluid receptacle **70** can include sensors, electronic components and circuitry to conduct analysis of the fluid and/or for operative communication with a blood/biological fluid analysis device. The fluid receptacle **70** can provide an interface for operative connection and/or communication with another device, such as a blood/biological fluid analysis device. In the non-limiting illustrated embodiment, the receptacle **70** is generally rectangular shaped, including a rectangular base **82** and a generally rectangular upper member **84**. The channel **80** may extend partially in the upper member **84** and thereafter downwardly into the base **82**. Alternatively, the channel **80** may be solely in the upper member **84** or solely in the base **82**.

[0035] Now that the individual components of the systems and methods herein have been described, an example of the interaction and operation of these various components will be presented.

[0036] The fluid **60** to be dispensed can be collected within the inner chamber **44** of the container **40** by conventional techniques and sealed with a closure **52**. The fluid dispenser **10** can then be inserted through the closure **52**. Specifically, the puncturing shaft **20** can be inserted through the closure **52** until the shoulder **26** of the puncturing shaft **20** engages and abuts against the closure **52**. The base **12** may be gripped or held during insertion of puncturing shaft **20** into the closure **52**. The stem portion **22** can provide structural support for the cannula portion **24** and can help to prevent any accidental breakage of the cannula portion **24** during insertion of the puncturing shaft **20** into the closure **52**. At least a part of the cannula portion **24** can extend into the inner chamber **44**, thereby establishing fluid communication between the inner chamber **44** of the test tube and the exterior of the test tube. The test tube (with dispenser **10** attached) can be inverted into the position generally shown in FIG. 1.

[0037] When the stopper or closure **52** is flexed inwardly toward end **50** of the container **40**, fluid flows through the interior of the fluid dispenser **10** and out through the dispenser tip **30**. When the fluid dispenser **10** and the fluid receptacle **70** are brought together, fluid flows out through the dispenser tip **30** and directly into the hole **72** of the receptacle **70**. After a sufficient amount of fluid (or the desired amount of fluid) is dispensed into the receptacle, the container and receptacle can be separated such as by removing the dispenser tip **30** from the hole **72**.

[0038] However, during the time that the dispenser tip **30** is within the hole **72**, if the pressure imparted on the closure **52** is released, care must be taken to avoid a vacuum or capillary effect, either of which would cause fluid in the receptacle to be withdrawn back up through the dispenser tip **30** and thus not be available for analysis within the receptacle. Similarly, when the dispenser tip **30** is to be deliberately withdrawn from the receptacle, care must be taken to avoid a vacuum or capillary effect, either of which would cause fluid in the receptacle to be withdrawn back up through the dispenser tip **30** and thus not be available for analysis within the receptacle.

[0039] Several techniques will now be described which avoid the capillary or vacuum effect. In one such embodiment, as diagrammatically illustrated in FIG. 3, the depth L_d of the hole **72** is less than the length L_p of the protrusion. Thus as the protrusion is inserted into the hole **72**, the second side **16** of the base **12** will contact the top of the receptacle **70**. This contact prevents the dispenser protrusion from making contact with the floor **74** of the receptacle, thus reducing, if not eliminating entirely, the effect of a vacuum and/or the capillary effect.

[0040] A second embodiment is illustrated in FIG. 4, in which the side wall **78** is tapered and the diameter of the side wall **32** of the protrusion **28** may engage the side wall **78** at a point above the floor **74**, thus physically preventing the dispenser protrusion from making contact with the floor **74** of the receptacle, thus reducing, if not eliminating entirely, the effect of a vacuum and/or the capillary effect.

[0041] In FIG. 5, the interior of the hole **72** can include an interior projection **76** that limits the degree of insertion of the protrusion **28** into the hole **72**. This interior projection may be accomplished during the manufacture or molding of the receptacle.

[0042] In all three embodiments, the protrusion tip **30** is spaced from the interior floor **74** at the bottom of the hole **72**. That is, various means are provided maintain the protrusion tip **30** spaced a desired distance from the floor **74** of the receptacle.

[0043] Once the protrusion **28** is received in the hole **72**, the test tube may be moved toward the fluid dispenser **10** and/or the fluid dispenser **10** may be moved toward the test tube such that the shoulder **26** causes the inward flexing of the closure **52** relative to the test tube, as is shown in FIG. 1. As a result, the volume of the interior of the test tube is reduced thereby increasing the pressure within the interior of the test tube and the pressure increase ultimately results in a pumping or dispensing of a corresponding small volume (such as a droplet **61**) of the fluid **60** from the test tube. A droplet **61** of fluid **60** can enter the flow passage **34** through the inlet opening **36**, flow through the flow passage **34** and exit through the outlet opening **38**. The fluid can be dispensed into the hole **72**. This process can be repeated as many times as necessary to dispense the desired amount of fluid from the test tube directly into the cartridge hole **72**.

[0044] The products illustrated in FIG. 1 and FIG. 2 individually are, conceptually, part of the prior art. The term "conceptually" is used to indicate that, inter alia, (1) the relative proportion of L_p being less than L_d is not part of the prior art, (2) the use of an interior conical or chamfered side wall to limit the depth to which the tip **30** can be inserted is not part of the prior art, and (3) the use of the interior protrusion to limit the depth to which the tip **30** can be inserted is not part of the prior art. Thus, the prior art did not provide for direct transfer or direct dispensing from a container into a cartridge.

[0045] It will be appreciated that systems and methods described herein can facilitate the convenient and efficient dispensing fluid from a test tube into a fluid receptacle. Systems and methods herein can also help to avoid contamination of the fluid to be tested. By providing a spacing between the bottom **74** of the interior of the cartridge and the fluid dispenser tip **30**, the possibility that fluid dispensed into the hole **72** will be inadvertently drawn back into the test tube such as by capillary action can be minimized or eliminated.

[0046] The foregoing description is provided in the context of one possible application for systems and methods of dis-

pensing a fluid. While the above description is made in the context of a test tube, it will be understood that the systems and methods described herein be used in other contexts. Thus, it will of course be understood that embodiments are not limited to the specific details described herein, which are given by way of example only, and that various modifications and alterations are possible within the scope of the following claims.

What is claimed is:

1. A system for dispensing fluid from a container having an open end closed by a closure, the container including an inner chamber having a volume and including fluid therein, the system comprising:

a fluid dispenser; and

a receptacle having an aperture and an interior floor;

the fluid dispenser having a base with a first side and a second side, and a protrusion extending from the second side of the base and having an exterior diameter and a tip; a flow passage extending through the protrusion, and the protrusion adapted to extend into the fluid receptacle aperture with the tip remain spaced a desired distance from the interior floor of the receptacle.

2. The system of claim 1, wherein means are provided to maintain the tip of the protrusion a desired distance from the interior floor of the receptacle.

3. The system of claim 1, wherein at least one of the protrusion exterior diameter and the receptacle interior is configured to maintain the tip of the protrusion a desired distance from the interior floor of the receptacle.

4. The system of claim 1, wherein the interior wall of the receptacle is tapered to maintain the tip of the protrusion a desired distance from the interior floor of the receptacle.

5. The system of claim 1, wherein the second side of the fluid dispenser base contacts the receptacle to maintain the tip of the protrusion a desired distance from the interior floor of the receptacle.

6. The system of claim 1, wherein the protrusion has an associated length L_p and the aperture has an associated length within the receptacle L_d , wherein L_p is less than L_d to maintain the tip of the protrusion a desired distance from the interior floor of the receptacle.

7. The system of claim 1, wherein the receptacle has an interior projection to maintain the tip of the protrusion a desired distance from the interior floor of the receptacle.

8. A method of transferring fluid from a container directly into a receptacle, the container closed by a closure and having a fluid therein, the receptacle having an aperture and an interior floor, the method comprising the steps of:

providing a fluid dispenser, the fluid dispenser having a base with a first side and a second side, a protrusion extending therefrom, the protrusion having a dispenser tip;

inserting the fluid dispenser through the closure and into the interior of the container;

inserting the fluid dispenser tip into the receptacle aperture, and

moving the receptacle and container relative to each other to flex the closure to dispense fluid directly from the container into the receptacle.

9. The method of claim 8, and further including the step of maintaining the tip of the protrusion a desired distance from the interior floor of the receptacle.

10. The method of claim 9, wherein the step of maintaining the tip of the protrusion a desired distance from the interior floor of the receptacle comprises the step of abutting the second side of the fluid dispenser base with the receptacle.

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