

[54] METHOD OF AND APPARATUS FOR COLLECTING CULTURES

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[51] Int. Cl..... A61b 10/00

[58] **Field of Search** 128/2 W, 2 F, 269;
195/103.5 R, 139

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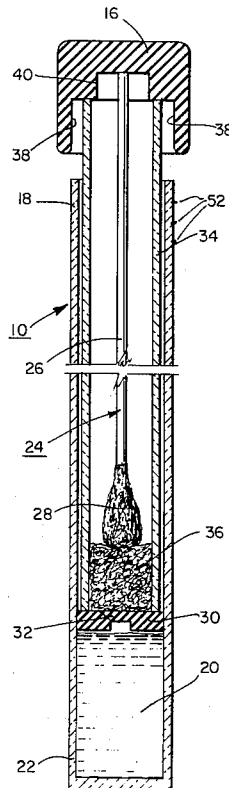
Primary Examiner—Kyle L. Howell

Attorney, Agent, or Firm—Woodcock, Washburn, Kurtz & Mackiewicz

[57] **ABSTRACT**

A swab is packaged in a tube having an open end and containing a culture-sustaining liquid at the bottom of the tube and a plug including a one-way isolating valve located above the liquid. After removal of the swab from the tube and swabbing of a body canal or the like with the absorbent tip of the swab, the swab may be placed back in the tube with the absorbent tip adjacent the plug. The plug may then be forced downwardly through the liquid by pressing on the end of the swab or another liquid member telescoped within the tube so as to force the liquid up through the valve into contact with the absorbent tip. A closure or cap which may be used to press on the end of the stick or the rigid member then forms a seal at the open end of the tube.

11 Claims, 14 Drawing Figures



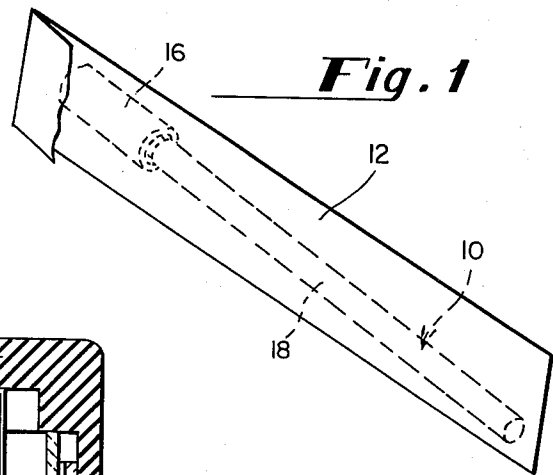


Fig. 1

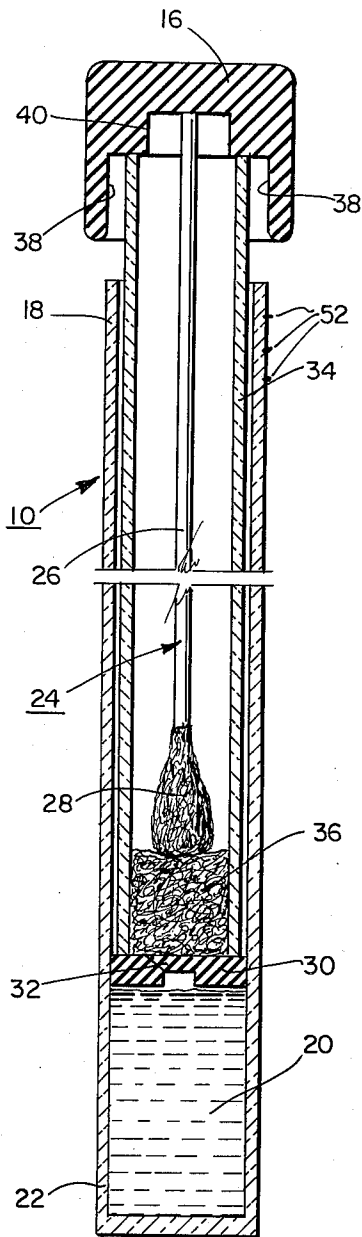


Fig. 2

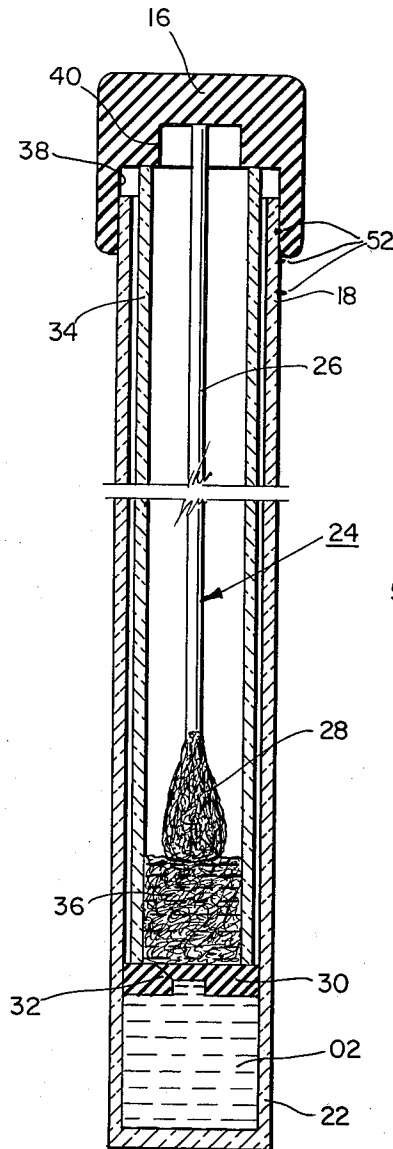


Fig. 3

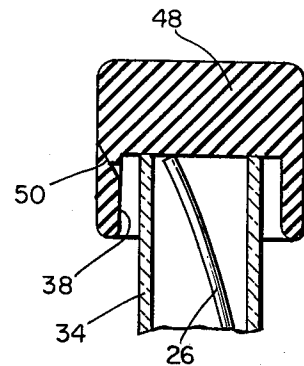


Fig. 4

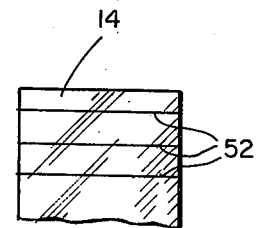


Fig. 5

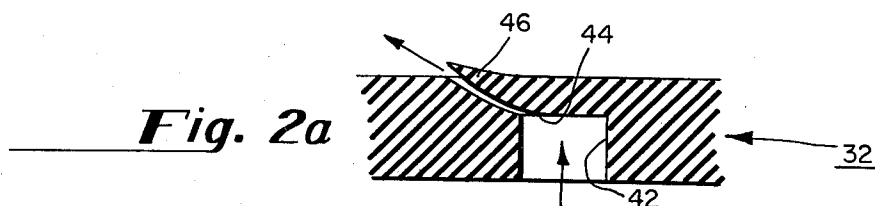


Fig. 2a

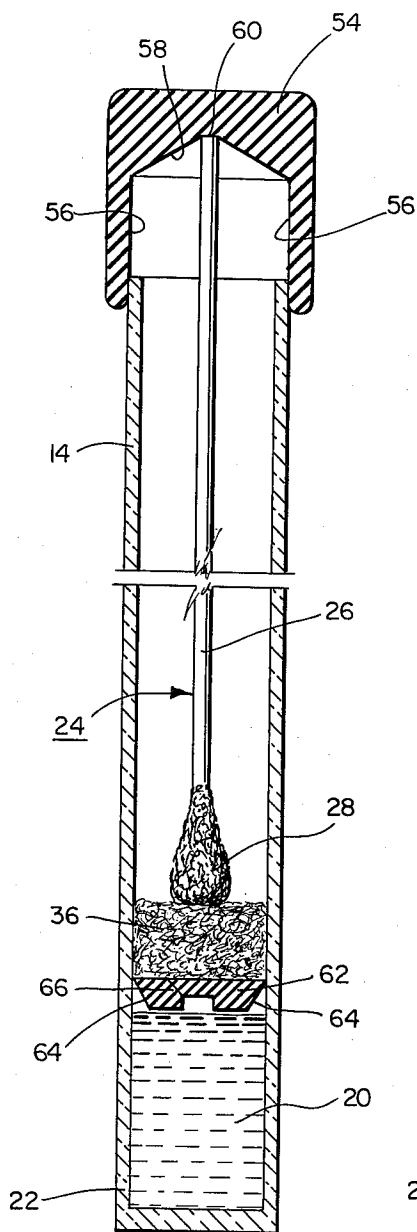


Fig. 6

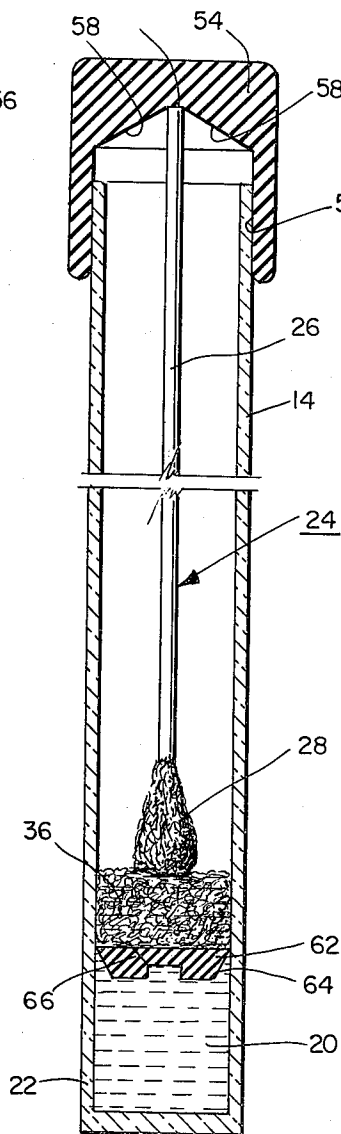


Fig. 7

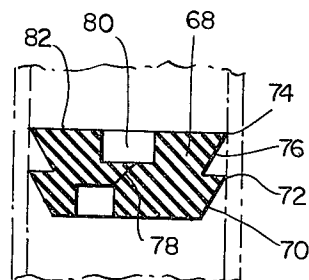


Fig. 8

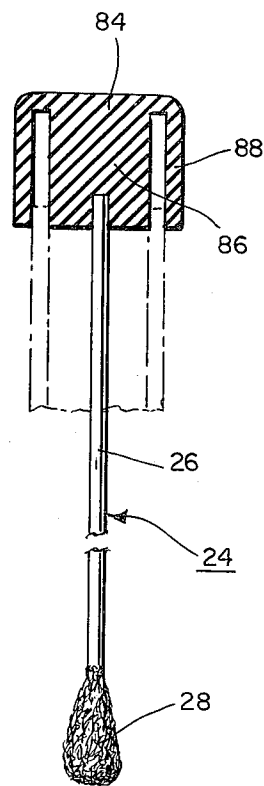


Fig. 9

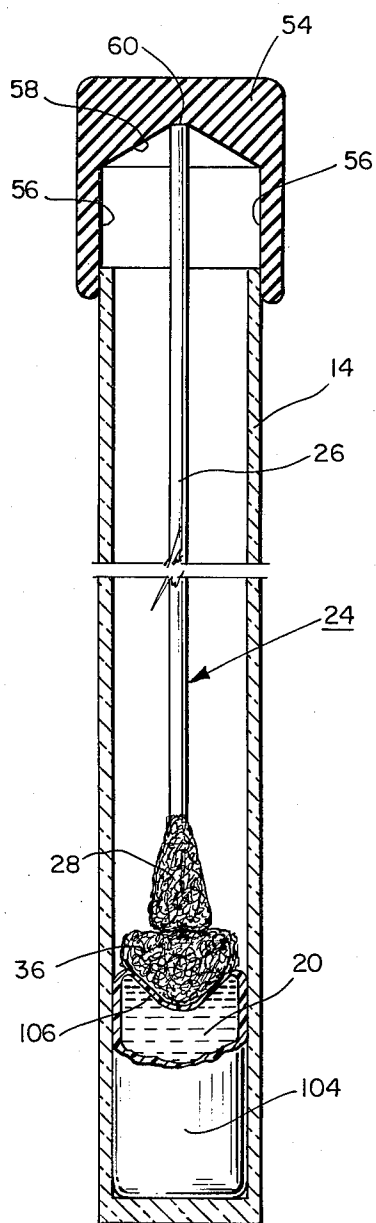


Fig. 12

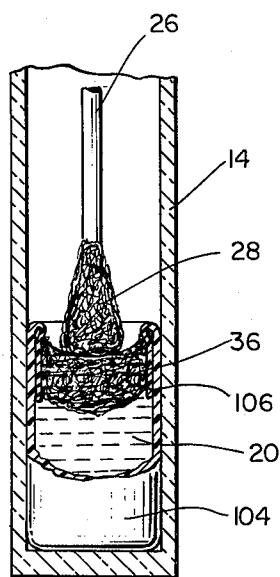


Fig. 13

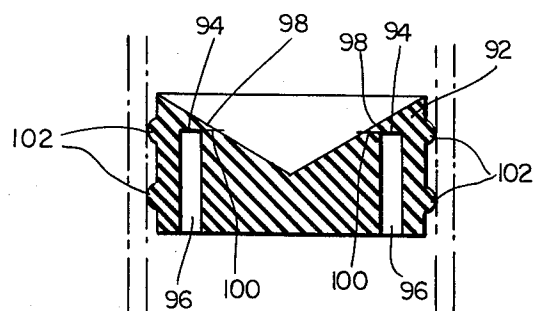


Fig. 10

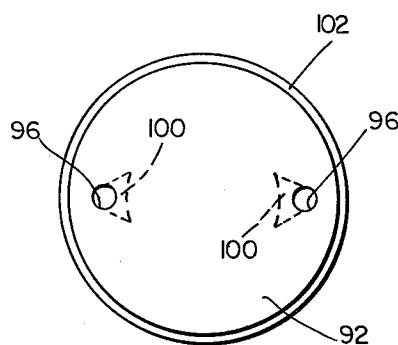


Fig. 11

METHOD OF AND APPARATUS FOR COLLECTING CULTURES

BACKGROUND OF THE INVENTION

This invention relates to a swabbing method and apparatus for use by physicians and technicians for collecting a culture from various areas of a patient's body, such as the ears, the nose and throat, and for keeping the culture moist and alive for a period of time after it is collected.

In general, this is accomplished through the use of a container which receives the culture-carrying swab and bathes the swab in a culture-sustaining liquid. U.S. Pat. No. 3,450,129 — Avery et al. discloses a particular swabbing unit for this purpose. The unit includes a container which carries its own sealed supply of liquid in a frangible ampoule along with a swab, all of which is packaged in a sanitary wrapper. After the swab has been removed from the wrapper and container and the culture has been taken, the swab is inserted back into the container, a cap is applied to the end of the container and the frangible ampoule is broken so as to bathe the absorbent tip of the swab in the culture-sustaining liquid which was incapsulated in the ampoule.

SUMMARY OF THE INVENTION

It is therefore one object of this invention to provide a swabbing method and apparatus for taking cultures which is economical.

It is another object of this invention to provide such a method and apparatus which may sustain the life of a culture for an extended period of time.

In accordance with one important aspect of the invention, a container tube is provided for receiving a culture-carrying swab comprising a tube having an open end and closed bottom, a culture-sustaining liquid at the bottom and a plug in sealing engagement with the walls of the tube above the upper level of the liquid. The plug includes a one-way isolating valve closing an opening through the plug so as to permit the flow of the liquid through the plug into contact with the absorbent tip of the swab as the plug is forced downwardly toward the bottom of the tube.

In one embodiment of the invention, an inner tube is telescoped within the container tube with the swab located centrally in the inner tube. The inner tube may then be used to push the plug through the liquid by pushing on the upper end with the closure member.

In another embodiment of the invention, the swab itself is utilized to push the plug down through the liquid. Once again the closure member may be utilized to push on the upper end of the swab. In order to assure that the force on the plug is substantially axially directed at the center of the plug to avoid skewing of the plug within the container tube, the interior of the cap is tapered upwardly to a centrally located surface. Similarly, the upper surface of the plug may be tapered downwardly toward a centrally located surface.

In accordance with another important aspect of this invention, the closure member and the container tube are provided with elongated sealing surfaces so as to allow the closure member to be moved downwardly toward the bottom while maintaining a seal. The closure in turn forces the inner tube or the swab downwardly so as to move the plug closer to the bottom. In this manner, fresh culture-sustaining liquid may be periodically

introduced into contact with the absorbent tip of the swab so as to assure that the tip is maintained in a moist condition. For this purpose, marks may be applied to the upper end of the container tube to indicate the various positions to which the closure member may be periodically moved.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a swabbing apparatus embodying the invention in its wrapper;

FIG. 2 is a sectional view of the swabbing apparatus embodying the invention;

FIG. 2a is an enlarged view of a valve in the plug of the swabbing apparatus shown in FIG. 2;

FIG. 3 is a sectional view of the swabbing apparatus of FIG. 2 after the culture-carrying swab has been sealed into its container tube;

FIG. 4 is a sectional view of another closure member for the container tube of FIGS. 2 and 3;

FIG. 5 is a partial elevational view of the markings on the container tube of FIGS. 2 and 3;

FIG. 6 is a sectional view of another swabbing apparatus embodying the invention before the swab has been bathed in a culture-sustaining liquid;

FIG. 7 is a sectional view of the swabbing apparatus of FIG. 6 after the swab has been bathed in a culture-sustaining liquid;

FIG. 8 is a sectional view of a modified plug which may be utilized with the swabbing apparatus shown in FIGS. 6 and 7;

FIG. 9 is a sectional view of a swab which is permanently affixed to a closure member which may be utilized with the container tube of FIGS. 6 and 7;

FIG. 10 is a sectional view of another modified plug which may be utilized with the swabbing apparatus shown in FIG. 9;

FIG. 11 is a bottom view of the plug of FIG. 10;

FIG. 12 is a sectional view of another swabbing apparatus embodying the invention before the swab has been bathed in a culture-sustaining liquid; and

FIG. 13 is a fragmentary cross-section of a lower portion of the apparatus shown in FIG. 12 after the swab has been bathed in a culture-sustaining liquid.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A swabbing apparatus 10 constructed in accordance with this invention for use in obtaining cultures is enclosed within a wrapper 12 comprising paper or the like as shown in FIG. 1. As shown in FIG. 2, the apparatus 10, which has been removed from the wrapper 12 of FIG. 1, comprises a container tube 14 and a closure member or cap 16 which is not sealed to the upper and open end 18 of the tube 14. The tube 14 contains a culture-sustaining liquid 20 at the closed end or bottom 22 of the tube 14 and remains isolated from a swab 24 comprising an elongated member or stick 26 and an absorbent tip 28. This isolation is achieved by a piston-like plug 30 comprising a substantially resilient material such as rubber or a plastic so as to resiliently and sealingly engage the walls of the tube 14. The plug 30 includes a one-way valve 32 which allows the liquid 20 to flow through an opening in the plug 30 when the plug is forced downwardly into the liquid 20 but maintains substantial physical isolation between the absorbent tip 28 of the swab 24 and a culture-sustaining liquid.

uid when the plug 30 is in the position shown in FIG. 2.

The tube 14 also contains an inner tube 34 on which the cap 16 (the cap is shown as shortened in length because of space limitations of the drawings) is resting which forms a chamber spaced and isolated from the sides of the tube 14 and within which the swab 24 is located. An absorbent material 36 such as cotton, rayon or a foam is located within the chamber formed by the tube 34 supporting the tip 28 above the plug 30.

Once the apparatus 10 has been removed from the wrapper 12 as shown in FIG. 2, the cap 16 may be removed from the upper end of the inner tube 34. A swab 24 may then be grasped between the finger tips at the upper end protruding from the inner tube 34 and removed from the tube 14. At that time, the absorbent tip 28 may be brought into contact with that portion of the body from which a culture is to be taken and re-inserted back into the inner tube 34.

At this time, the plug 30 is pushed downwards through the liquid 20 by pressing on the cap 16 which in turn presses on the upper end of the inner tube 34 so as to transmit the downward force therethrough to the plug 30 moving it to the position shown in FIG. 3. Note that the level of the liquid 20 now extends above the bottom of the inner tube 34 so as to saturate the absorbent material 36 and thereby assure that the tip 28 remains moist to keep the culture alive.

In order for the cap 16 to perform this pushing function with respect to the plug 30, the inside of the cap has a particular configuration. An elongated sealing surface 38 is provided which is adapted to engage the outside of the container tube 14 so as to isolate, at least to some degree, the contents of the tube once the surface 38 has been brought into contact with the outside of the tube 14. In addition, the cap 16 includes a shoulder which extends substantially perpendicular to the axis of the cap 16 so as to provide a surface which pushes against the upper end of the tube 34. Finally, the cap 16 includes a recess 40 which receives the upper end of the swab stick 26. The recess 40 has slightly less depth than the protrusion of the swab stick 26 beyond the end of the tube 34 to assure the swab 24 is, to some degree, formed into the cotton 36.

The nature of the one-way isolating valve in the plug 30 is shown in some detail in the enlarged view of FIG. 2a. The valve 32 includes a hole 42 which extends upwardly from the underside of the plug 30. An inclined slit is provided which extends from the upper surface of the plug 30 at one side of the hole 42 down to the upper end of the hole 42 so as to form a flap 46 which is biased to the closed position when the plug 30 is stationary within the liquid 20 and pressure on opposite side of the plug 30 are substantially equal. It will be understood that the bias provided by the resilient material of the plug is sufficient to maintain the resilient flap 46 closed even when there is some pressure differential between opposite sides of the plug to be sure that the valve remains closed even when the tube 14 is inverted. For other details relating to the nature of this valve, reference is made to the inventor's own U.S. Pat. No. 3,661,265.

Referring now to FIG. 4, a somewhat modified cap 48 is shown where there is no recess to receive the upper end of the stick 26 which protrudes beyond the upper end of the tube 34. In this embodiment, the cap 48 forces the stick 26 down into the absorbent material

36 and also bends the stick 26. In this embodiment, it is generally desirable to have the stick protrude somewhat less beyond the upper end of the inner tube 34 so that the bending of the stick 26 and the burying in the absorbent material 36 may accommodate the extra length of the stick without undue pressure on the plug 30 which might force the valve 32 to remain closed. However, because there is some pressure on the cap 48, a rather tight seal must be achieved between the sealing surface 38 and the outside walls of the tube 14 in order to hold the cap 48 on the upper end of the tube 14. Since such a tight fit will not permit the escape of the air as the cap 48 is applied to the tube 14, a one-way air vent 50 is provided at the upper end of the sealing surface 38. The air vent 50 is similar in design to the one-way isolating valve shown in detail in FIG. 2a. In other words, it is designed to maintain substantial isolation of the contents within the tube 14 while opening under the influence of compressed air within the tube as the cap 48 forms a seal therewith.

In the embodiment of FIGS. 2 and 3, an air valve similar to that shown in FIG. 4 has not been provided. It is not of course necessary as long as the skirt of the cap 16 having a sealing surface 38 is sufficiently flexible to spread and thereby release the air within the tube 14 when the cap 16 is applied to the tube 14. Of course, a one-way air valve could be provided in the cap 16 if the cap 16 was too rigid to permit the escape of air along the sealing surface 38.

In accordance with another important aspect of the invention, the culture-sustaining liquid 20 may be periodically introduced into the area above the plug 30 so as to extend the period in which the culture may be kept alive. For this purpose marks 52 shown in FIGS. 3 and 5 are provided on the exterior and upper end of the tube 14. When the cap 16 is first placed on the tube 14 after the culture has been taken, it is pushed down to the first of the marks 52. It may then be sequentially advanced to the other marks at desirable intervals, e.g., every 24 hours, to keep re-introducing the liquid into contact with the absorbent material 36 and absorbent tip 28 of the swab 24.

In the embodiment of FIG. 6, the inner tube for pushing the plug downwardly through the liquid 20 is eliminated and the pushing is performed by the swab 24 itself. For this purpose, a cap 54 is provided with a skirt including an internal sealing surface 56 for engaging the outside walls of the tube 14 and a recess comprising upwardly and inwardly tapered walls 58 leading to a flat surface 60 near the top of the cap 54. The purpose of the taper 58 is to provide a surface which will center the upper end of the stick 26 with respect to the cap 54 and thereby direct the forces applied to the cap substantially axially downwardly through the tube 14 to move a plug 62 through the liquid 20 as shown in FIG. 7. Without the taper 58, the stick 26 may be off-center with respect to the cap 54 and this would apply a non-axial force to the plug 62 with the possibility of skewing it within the tube 14. Although this skewing would still permit the liquid to saturate the absorbent material 36 and the tip 28, it would not permit the controlled periodic introduction of the liquid into contact with the tip 28 as is considered highly desirable.

Note that plug 62 has a rather limited contact with the walls of the tube 14 as achieved by the tapered surface 64 at the periphery thereof. This reduces the amount of friction between the plug 62 and the walls

of the tube 14 to permit the swab 24 to push the plug downwardly through the liquid 20. It will of course be appreciated that the strength of the stick 24 is substantially less than the tube 34 shown in FIGS. 2 and 3. A valve 66 in the plug 62 is substantially identical to that shown in FIG. 2a.

Note that the sealing surface 56 of the cap 54 does engage the top of the tube 14 even without submerging the plug 62 in the liquid 20. This is desirable in that it does permit the wrapper 12 as shown in FIG. 1 to be eliminated without contaminating the swab 24 or the interior of the tube 14 prior to use of the swab 24 to take a culture.

In order to assure that the plug containing the one-way valve does not become skewed within the tube 14 when the swab 24 depresses it through the liquid 20, it is possible to provide an additional area of contact between the tube 14 and the plug as shown in FIG. 8. Plug 68 of FIG. 8 includes a tapered surface 70 with an area 72 adapted to resiliently and sealingly engage the walls of the tube 14. In addition, an upper sealing area 74 is provided along an upper tapered surface 76 which also engages the sides of the tube 14 and serves to stabilize the plug 68 within the tube 14 without substantially increasing the friction encountered when attempting to submerge the plug 68 in the liquid 20.

In order to prevent the tip of the swab from closing a one-way isolating valve 78, the valve 78 is recessed at the bottom of a hole 80 extending downwardly from an upper surface 82. The hole 80 is sufficiently small to prevent the tip of the swab from forcing the absorbent material down into the hole but sufficiently large to allow the flap of the valve 78 which is similar to that shown in FIG. 2a to open when the plug 68 is being submerged in the culture-sustaining liquid.

In the embodiment of FIG. 9, the stick 26 of the swab 24 is embedded or otherwise attached to a cap 84 having a centrally located pedestal 86 and a skirt 88 providing a sealing surface for engaging the tube 14 shown in phantom. The pedestal 86 is provided so as to permit substantially the entire length of the swab stick 26 to be inserted into a particular body canal without contacting the body canal with the skirt 88 of the cap 84. With this arrangement, the problem of skewing the plug within the tube is substantially eliminated since mounting of the swab 24 on the cap 84 at the central portion thereof substantially assures axially directed forces on the center of the plug.

In the embodiment of FIGS. 10 and 11, the problem of axially directing a force on the center of a plug has been solved by providing a downwardly and inwardly tapering surface 90 in a plug 92 which, when utilized in conjunction with a cap 60 having an upwardly and inwardly tapered surface 58 as shown in FIGS. 6 and 7, will serve to center a freely movable swab 24 along the axis of the tube thereby assuring the central, axially directed force on the plug 92. In addition to centering the tip 28 of the swab 24 on the plug 92, the tapered surface 90 also allows the swab 24 to assist in opening spaced one-way valves 94 which are located near the periphery of the plug 92. The valves 94 include elongated holes 96 extending substantially parallel with the axis of the plug and terminated by flaps 98 which are formed in part by the tapered surface 90. By observation it will be seen that any pressure located in the central area of the surface 90 will tend to collapse areas 100 of the plug beneath the flaps 98 so as to assist in

opening the valves 94. It will also be seen that at least one valve 94 will be clear of the tip 28 to permit it to open.

It is also possible to slightly modify the valves 94 which are similar to that shown in FIG. 2a by providing an essentially vertical slit at the top of the holes 96 extending upwardly from a central position of the holes 96 rather than extending horizontally from the side of the hole as shown in FIGS. 10 and 11. As a result, there are two flaps formed instead of one. Such a valve may be placed at the bottom of the tapered surface 90 with the result that the swab pushes on the tapered surface above the valve so as to assist in opening the valve as the plug is pushed toward the bottom of the tube.

In order to reduce the amount of friction along the side of the tube, sealing engagement is provided by annular ridges 102. The use of a plurality of such ridges again serves to stabilize the plug without substantially increasing the friction.

In the embodiment of FIGS. 12 and 13, the movable plug has been eliminated and the culture-sustaining liquid 20 has been encapsulated within an ampoule 104 having a downwardly and inwardly tapered or concave surface 106 at the upper end thereof. The surface when used in combination with an upwardly tapered surface 58 of the cap 54 serves to center and axially direct the force applied to the flap 54 thereby permitting the use of the swab 24 to transmit a force sufficient to break as shown in FIG. 13, the surface 106 which may comprise, for example, a plastic such as polyethylene. The remainder of the ampoule 104 may comprise any suitable material such as a plastic which may be fused or otherwise sealingly affixed to the material forming the surface 106. It is important in the embodiment of FIGS. 12 and 13 as well as FIGS. 10 and 11, not to use excessive amounts of absorbent material 36 since large amounts of such material might impede the centering of the swab 24 and the centering of the axially directed force applied by the cap 54.

The culture-sustaining liquid 20 may comprise any liquid which is capable of providing the culture with an environment in which it can live. For this purpose, the liquid might comprise distilled water, a saline solution or another non-reactive liquid capable of sustaining such life.

Although specific embodiments of the invention and modifications thereof have been described and suggested, it will be understood that the appended claims are intended to cover other embodiments and modifications which fall within the true spirit and scope of the invention.

What is claimed is:

1. An apparatus for collecting cultures including an elongated member having an absorbent swabbing tip received within a container tube having an open end, a closed end and sides therebetween, a culture-sustaining liquid at the closed end of the tube, the improvement comprising plug means within said tube adjacent said culture-sustaining liquid, a portion of said plug means extending outwardly toward the sides of said tube in resilient contact therewith so as to form a sliding, substantially liquid-tight junction with the sides of said tube, said plug means including a resilient isolating valve member closing an opening in said plug means, said resilient isolating valve member being closed when said plug means is stationary within said tube so as to create substantial physical isolation of the

swab within the tube from the culture-sustaining liquid when the plug means is located above the culture-sustaining liquid, said resilient isolating valve member opening in response to movement of said plug means toward the bottom of said tube through said culture-sustaining liquid so as to moisten said absorbent swabbing tip of said swab with said culture-sustaining liquid, said plug means having a surface adjacent said tip tapering radially inwardly toward said closed end for guiding the absorbent tip toward the center of said plug means to enable said elongated member to transmit a substantially axial force for moving said plug means through the culture-sustaining liquid.

2. The apparatus of claim 1 further comprising a closure member having a surface tapering radially inwardly away from the end of said elongated member opposite said absorbent swabbing tip for guiding said end of said elongated member toward the center of said closure member thereby enabling the elongated member to transmit a substantially axial force from said closure member to said plug means when said closure means is pushed on said tube.

3. The apparatus of claim 1 wherein said isolating valve member is spaced from the center of said plug means such that pressure applied at the center of said plug means by said swab tends to open said valve member.

4. The apparatus of claim 1 including more than one said valve member closing more than one said opening in said plug means, each valve member being spaced from another and the center of said plug means to assure that at least one valve member will open.

5. The apparatus of claim 4 wherein said plug means includes holes extending upwardly from the bottom of the plug means and terminating in each said valve member, each said valve member comprising a flap extending across one of said holes to said tapered surface of said plug means and formed in part therefrom.

6. The apparatus of claim 1 wherein said plug means includes at least one hole extending upwardly from the bottom of the plug means and terminating in at least one said valve member, said valve member comprising a flap extending across said hole and formed in part from the upper surface of said plug means.

7. An improved method of collecting cultures in a live condition utilizing an apparatus comprising a collection tube having sides and a bottom containing a culture-sustaining liquid adjacent the bottom of the tube, a plug located within the tube above the liquid and in resilient contact with the sides of the tube, the plug including an isolating valve remaining closed when the plug is stationary above the liquid and opening as the plug is moved downwardly through the liquid, and a swab including an elongated member having an absorbent tip at one end thereof and adapted to be disposed within the tube above the plug, and closure means for sealingly engaging the open end of the tube, the im-

proved method comprising the steps of:

swabbing an area of culturable material with the absorbent swabbing tip of the swab;

inserting the swab into the tube;

transmitting a downward force to the plug through the swab so as to open the isolating valve and permit the liquid to saturate the absorbent tip of the swab;

metering a selected amount of culture-sustaining liquid into saturating contact with the absorbent tip as a function of the swab position, and

closing said valve when said swab comes to rest in said tube so as to substantially isolate any culture-sustaining liquid remaining adjacent the bottom of the tube from said swab.

8. The method of claim 7 including the step of applying said closure means and transmitting said downward force through said closure means to said swab.

9. Apparatus for collecting cultures and the like comprising:

a hollow tubular container having a closed end, an open end and sides extending therebetween;

a culture-sustaining liquid positioned within said tubular container adjacent said closed end;

piston means forming a swab-receiving chamber within said hollow tubular container, said chamber being substantially isolated from the sides of said tubular container, said piston means including a plug portion adjacent said culture-sustaining liquid and in resilient contact with the sides of said tube so as to form a sliding, substantially liquid-tight junction with the sides of said tube, said plug portion having an opening therethrough for communication between said swab-receiving chamber and said culture-sustaining medium, said plug portion including a resilient isolating valve member in said opening, said valve member remaining closed when said piston means is stationary within said tubular container; and

a swab having an absorbent swabbing tip with at least said tip being enclosed within said chamber, said resilient isolating valve member adapted to open as said piston means is advanced through said culture-sustaining medium toward said closed end so as to allow said culture-sustaining medium to flow through said opening to moisten said absorbent tip of said swab enclosed within said chamber.

10. The apparatus of claim 9 wherein said piston means comprises a tubular portion contacting said plug portion and extending along a substantial length of said swab.

11. The apparatus of claim 10 wherein said piston means further comprises a cap closing said tubular portion and said tubular container at said open end thereof.

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