

[54] **MEANS FOR APPLYING SUCTION
HAVING AUTOMATIC CUTOFF OF
DISPLACEMENT VOLUME**

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[51] Int. Cl. **G01f 23/04**

[58] Field of Search **222/326; 73/425.4,
73/425.4 P; 128/233**

[56] **References Cited**

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[57] **ABSTRACT**

A device is described herein for successively applying pressure and suction to a volume in flow communication therewith. The device is preferably applied to introducing liquid into and permitting the drainage of liquid from, the internal volume of a hollow longitudinally-extending member; (e.g. a disposable sterile pipette).

3 Claims, 2 Drawing Figures

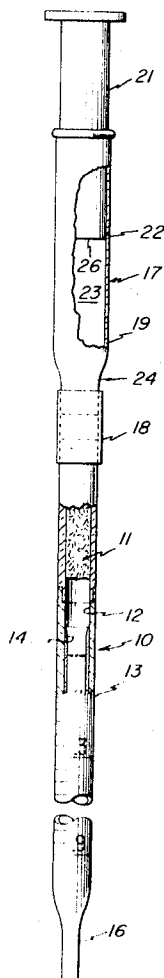


FIG. 2

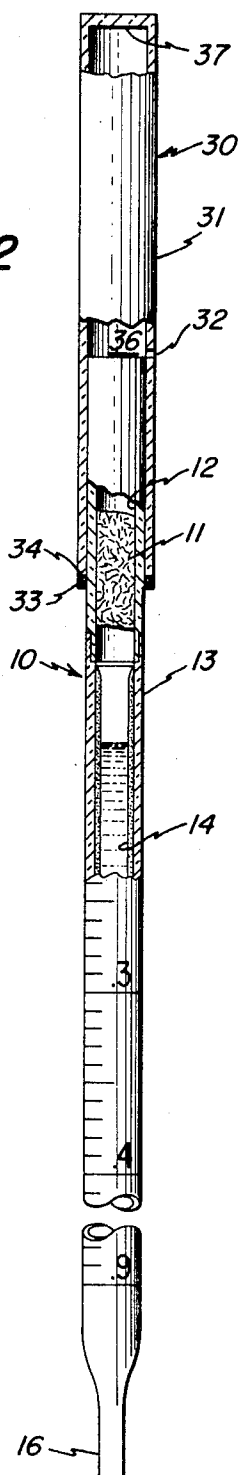
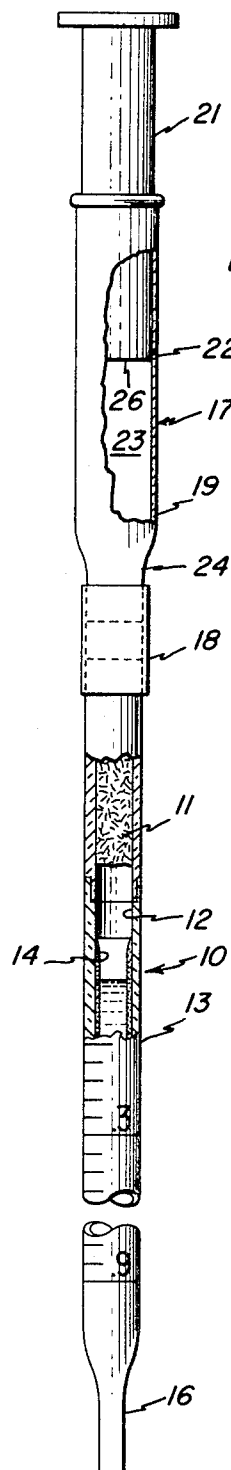


FIG. 1



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MEANS FOR APPLYING SUCTION HAVING AUTOMATIC CUTOFF OF DISPLACEMENT VOLUME

BACKGROUND OF THE INVENTION

Improved devices are described in U. S. Pat. application Ser. No. 130,254 — Bergeron for combined sampling and culturing to enable a measure of the microorganism content of a liquid sample. The aforementioned patent application is assigned to the assignee of the instant invention and was filed Apr. 1, 1971. The preferred structure is a long, thin tube (e.g. a disposable sterile, transparent, pre-plugged serological pipette) having internal area thereof coated with a culture medium.

When such internally coated devices are used to determine the content of colony-producing microorganisms (i.e. bacteria, yeasts or molds) therein, it is desirable both to be able to control the distance traversed by the liquid into the device and to be assured that the drainage characteristics of the tube itself will determine the period of time during which the liquid will be in contact with the culture medium.

SUMMARY OF THE INVENTION

Both of these objectives are satisfied by employing the suction devices described herein. Each such suction device is capable of successively applying pressure and suction to the internal volume of the sampling/culturing tube and is provided with means to automatically limit the total volume of liquid (and thereby the extent of tube length of culture medium exposed to the liquid sample) brought into the sampling/culturing device. In the preferred construction, the pressure and suction are each generated in a cylindrical element by volume change, the cylindrical element having a breach through the wall thereof disposed in a particular location. During the application of pressure this breach is covered. When the breach is exposed during the application of suction, the interior of the cylinder is placed into flow communication with the atmosphere thereby destroying the suction and permitting the established drainage characteristics of the sampling/culturing tube to determine the period and nature of contact between the liquid and the culture medium.

BRIEF DESCRIPTION OF THE DRAWING

The exact nature of this invention as well consideration objects and advantages thereof will be readily apparent from consideration of the following specification relating to the annexed drawing in which:

FIG. 1 is an elevational view partly in section showing the suction device of the instant invention attached to and in communication with the upper end of a pipette lined with a thin layer of culture medium and

FIG. 2 shows a similar view of a second embodiment of the suction device of this invention similarly disposed.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 pipette 10 is shown made of a transparent material, preferably a plastic. Pipette 10 has plug 11 of cotton or similar fibrous material disposed in passage 12 at the mouthpiece end of barrel 13. The inner surface of passage 12 is covered at least in part by a layer 14 of a suitable solid (a stiff gel) culture medium. This

same material forms a tip plug (not shown) at the lower end thereof. After removal of this plug (as will be described hereinbelow), the liquid to be assayed is drawn up into the bore by applying suction to the mouthpiece end thereof.

The presence of the sterile barrier (plug 11) insures protection against the passage of microorganisms therethrough in either direction. At the same time, if a suitable ambient is provided for culturing (i.e. an oxygen-containing ambient for anaerobic bacteria; a non-or low-oxygen content ambient for anaerobic bacterial), plug 11 removes the need for hermetically closing off the mouthpiece end of pipette 10.

Layer 14 and the nutrient tip plug are introduced by drawing the nutrient into the sterile pipette in the warm, free-flowing state to some desired height and then permitting the nutrient to drain. A thin coating of nutrient remains on and uniformly coats the interior surface of the barrel 13. The nutrient material gels and the last portion of the draining nutrient, being more viscous as it begins to gel, accumulates in dropper tip 16 forming the tip plug referred to hereinabove. The presence of such a plug is a positive indication that the pipette has been coated and has not been used. Immediately before use, it is merely necessary to apply pressure within the bore sufficient to dislodge the plug. Removal of this plug serves to clear the tip 16 for the sampling/culturing step and, as well, to leave plastic surface exposed in passage 12 at tip 16 for bonding thereto of the later applied clay plug (not shown) that is forced into the tip to seal the tip end. In addition, removal of this plug returns the tip to the original dimensions and surface conditions, which then determine flow and drainage characteristics therethrough.

In use the inoculating liquid is drawn into the pipette to a height below the upper limit of the layer 14 and is then permitted to drain therefrom.

After the tip 16 has been plugged, the unit is ready for incubation in the vertical position at room temperature or in a thermostatically controlled oven (not shown). Incubation is usually carried out at a temperature of about 37°C for a period of about 18-24 hours.

After incubation (or standing at room temperature), the pipette may be readily examined for microorganism growth (e.g. colonies of bacteria) by disposing the pipette with the longitudinal axis thereof at a small angle with the rays emanating from some light source. Visual readouts for bacteria concentrations ranging from 10^3 - 10^9 bacteria/milliliter may be readily obtained.

In the steps of inoculating the nutrient layer 14 of pipette 10 it is particularly desirable both to control the distance traversed by the inoculating fluid up the nutrient-lined bore and to be certain that the ordinary drainage characteristics of the pipette will be the prime determinant of the period of time during which the inoculating fluid will be in contact with the nutrient layer 14. Device 17 shown attached to the upper end of barrel 13 of pipette 10 by means of flexible tubing 18 consists of a modified disposable syringe (barrel 19 and piston 21). The modification consists of introducing an orifice, e.g. a hole or slit 22, through wall 19, which when uncovered by piston 21 places the bore of the barrel 19 into communication with the atmosphere.

Coupling 18 (e.g. rubber or plastic tubing) provides an air-tight junction between tip 24 or barrel 19 and the top of pipette 10. The location for hole 22 is determined by making the volume of bore 23 defined by the

lowest point of travel of end 26 of piston 21 and the point in the upward travel of piston 21 at which hole 22 is being uncovered equal to the volume of liquid (thereby setting the extent of vertical travel of the liquid) to be brought into the nutrient-lined bore of barrel 13.

With hole 22 properly located, device 17 is connected to pipette 10 using flexible member 18 providing junctions sealed against the entrance of air, the connection being made with the piston 21 drawn back to uncover hole 22. When the connection has been made, the operator need only advance plunger 21 to seal off orifice 22 and continue moving plunger 21 forward building up the pressure until the tip plug is expelled from pipette 10. After plunger 21 has reached the limit of forward travel, the tip 16 of the pipette 10 is placed in the liquid sample and the plunger motion is reversed and quickly withdrawn for the inoculation step. The liquid sample will continue to rise in the nutrient-lined bore of pipette 10 until the plunger 21 exposes orifice 22 releasing the vacuum and permitting gravity (and the shape of tip 16) to control the drainage time and the character of the drainage of the inoculating liquid from pipette 10.

A second embodiment 30 of this invention is shown in FIG. 2 in air-tight sealing engagement with the outer surface of the upper end of barrel 13 of pipette 10. The elements of pipette 10 are the same as those described in connection with FIG. 1. Device 30 consists of barrel 31 closed at the upper end thereof, hole 32 (similar in location and function to hole 22) and O-ring 33 located in recess 34.

Device 30 is employed by urging the open end thereof over the upper end of pipette 10. An air-tight seal is formed by O-ring 33 against the outer surface of barrel 13 and as device 30 is pushed down to force more and more of the barrel 13 into bore 36, the displaced air exits via hole 32 until this hole becomes covered by barrel 13. From this point on continued forcing of barrel 31 down over barrel 13 causes a buildup of pressure in bore 36 until the tip plug is expelled from pipette 10 as described in connection with the embodiment shown in FIG. 1. This forward travel of barrel 30 is continued until the upper end of barrel 13 is in contact with end 37. At this point, tip 16 of pipette 10 is

placed in the liquid sample and the travel of device 30 is reversed. As has been described in connection with FIG. 1, the liquid sample will rise in the nutrient-covered bore of the pipette until hole 32 is exposed permitting drainage of the liquid sample by gravity.

Thus, it may be seen that by the use of the devices shown in FIGS. 1 and 2 any number of identical pipettes may be individually filled to a fixed distance from the open end of the pipette by the use of the device of this invention.

If desired, as for example, in making multiple cultures from the same sample, the devices of FIGS. 1 and 2 may be modified by interposing a manifold in the system. The manifold would receive the upper ends of a plurality of pipettes at once in sealing engagement and would have a necked-down tubular portion either to connect to flexible number 18 or to be engaged by O-ring 31.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A device for successively applying pressure and suction to a volume in flow communication therewith comprising in combination:

- a. a hollow longitudinally-extending walled member defining a straight bore, said member being open at only one end and
- b. sealing means disposed adjacent said one end, said sealing means being adapted to receive the outer wall of a hollow cylinder in sealing engagement to place the interior thereof in flow communication with said bore through said one end,
- c. said member having a small orifice extending through the longitudinal wall thereof from said bore to the ambient thereby limiting the length of said bore effective for the application of pressure and suction.

2. The device of claim 1 wherein the sealing means is located within the bore of the member along the inner surface thereof.

3. The device of claim 1 wherein the walled member has a cylindrical barrel and a piston in the bore of said barrel provides closure of said bore at the opposite end thereof from the one end, said piston being selectively movable to cover and uncover the orifice.

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