United States Patent [19]

Ayres

[11] **3,864,979**

[45] **Feb. 11, 1975**

[54] **BLOOD SEDIMENTATION TUBE BARRIER**

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[22] Filed: **Mar. 30, 1973**

[21] Appl. No.: **346,423**

[52] **U.S. Cl.** ..... **73/425.4 P**, 23/259, 23/292, 55/159

[51] **Int. Cl.** **B011 3/02**

[58] **Field of Search** ..... 23/259, 292; 55/159; 73/425.4 P

[56] **References Cited**

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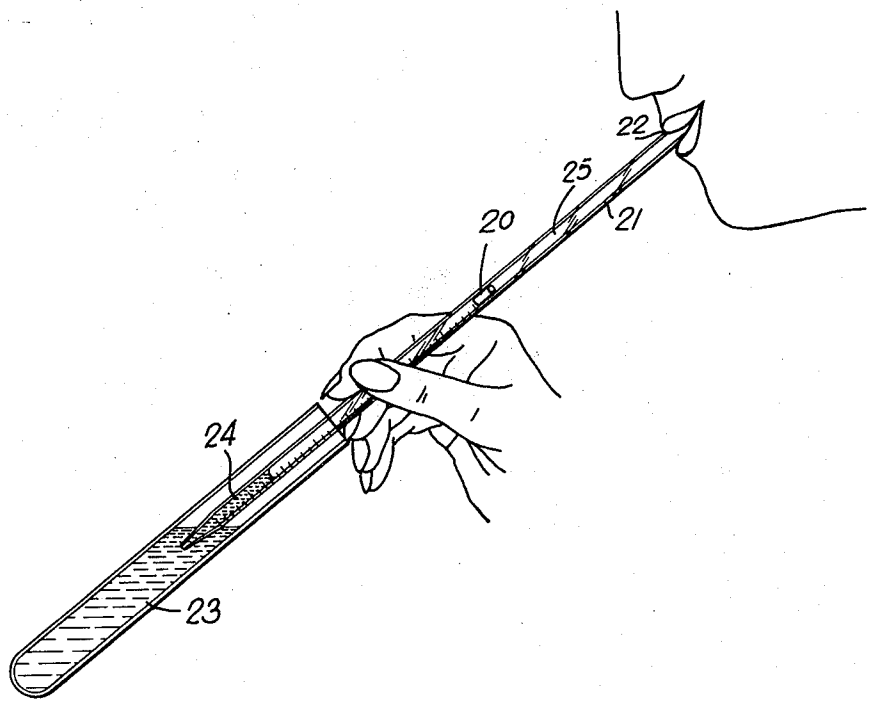
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[57] **ABSTRACT**

A liquid collection tube, such as a blood sedimentation tube, has, within, a barrier plug which permits air to pass therethrough but prevents the passage of liquid beyond the bottom of the barrier plug. The barrier plug has a resilient non-porous outer portion which engages the walls of the tube and a central porous core which is formed of a plurality of vertical adjacent filaments.

7 Claims, 3 Drawing Figures



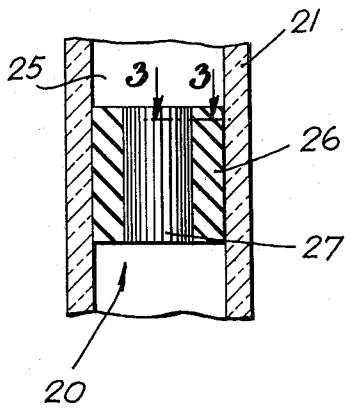


Fig. 1

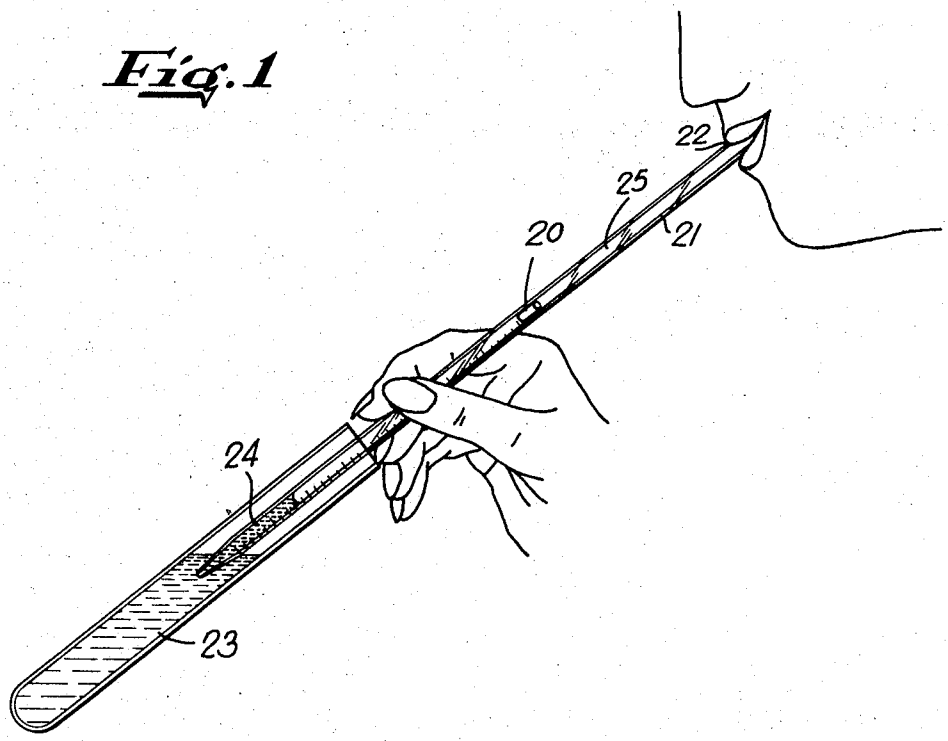


Fig. 3.

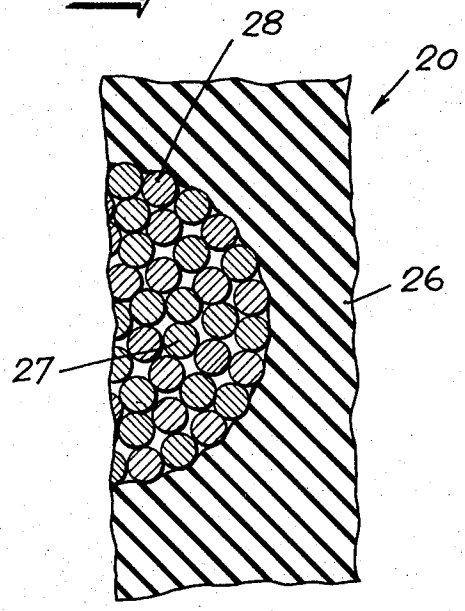
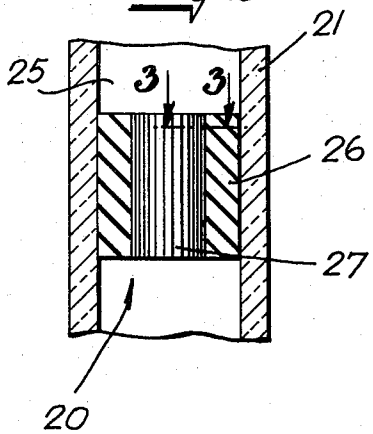


Fig. 2



BLOOD SEDIMENTATION TUBE BARRIER

BACKGROUND OF THE INVENTION

In working with blood, it is important to prevent the accidental sucking of blood up into the operator's mouth during use of the sedimentation tube. The blood may be diseased as with hepatitis, syphilis, etc., or otherwise obnoxious.

Another factor to be kept in mind in working with collection tubes is that some structure for positively providing a stop means to accurately control the height of the blood column easily and efficiently is desirable. In working with blood sedimentation tubes, the operator has to carefully control the amount of liquid being drawn into the tube. This requires periodic checking of tube levels. Automatic stop means for controlling the filling of a tube such as a blood sedimentation tube when the blood level has reached a predetermined column height would be a great improvement and a convenience over previously known procedures.

A third concern in blood sedimentation tube operations is the retention of the fluid of the proper column height in the tube during sedimentation, usually of one hour duration. Consequently, if the structure of the tube itself includes means for assisting the retention of the fluid in the tube, it would also be a great improvement and convenience over procedures presently known in the field.

SUMMARY OF THE INVENTION

With the above discussed background in mind, it is among the primary objectives of the present invention to provide a barrier means for use in a blood sedimentation tube which barrier may be positioned at a desired point along the tube length within the tube to exactly control the height of the liquid column to be drawn into the tube. The barrier also permits air to pass through so that fluid can be drawn into the tube but will not permit any of the fluid to pass through, thereby, alleviating danger of fluid flowing into the operator's mouth. Furthermore, the barrier means facilitates the retention of the fluid below it within the tube after the collection procedure has been accomplished without the necessity of additional means such as holding one finger on the top of the tube during transference of the liquid from the collection site to a test site.

In summary, a liquid collection tube barrier is provided for a hollow tube open at the top and bottom. The barrier is in the form of a plug mounted in the tube intermediate the open ends. The plug has a porous portion. When the bottom open end is placed in liquid to be collected and suction is applied to the top open end, the porous portion of the plug permits air to pass therethrough and draws liquid into the tube up to the bottom of the barrier plug and not through the porous portion. In this manner, the height of the liquid column within the tube is automatically controlled and stopped at a predetermined location to prevent liquid from progressing above the barrier plug.

With the above objectives, among other, in mind, reference is had to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a diagrammatic view of the liquid collection tube barrier of the invention mounted in a blood sedimentation tube being filled with blood;

FIG. 2 is a fragmentary sectional view of the portion of the tube containing the barrier plug of the invention; and

FIG. 3 is a fragmentary enlarged top sectional view thereof taken along the plane of line 3—3 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIGS. 1, 2 and 3 of the drawing show the barrier plug **20** mounted in the passageway of a collection tube **21.** For descriptive purposes, the type of tube in which the barrier plug is employed is a blood sedimentation tube of a conventional type. As shown in FIG. 1, the blood sedimentation tube **21** has an open top end **22** through which an operator applies suction. The opposite or bottom end **24** is also open and is applied to the source of fluid such as blood in a conventional container **23.** A continuous passageway **25** extends from tip **24** to tip **22** of the tube. Mounted in passageway **25** is the barrier plug **20** at a predetermined location. The location of plug **20** is determined by the height of the column of blood to be collected. An appropriate scale is applied to the outer face of the tube and the bottom of the plug would be positioned at, for example, the zero mark with other calibration marks below at intervals showing the amount of sedimentation in millimeters per unit time, such as in one hour.

Turning to consideration of plug **20** in detail, it is generally cylindrical in configuration having an outer portion **26** which is non-porous in nature and an inner portion or core **27** which is porous in nature. As shown in FIG. 2, portions **26** and **27** are generally concentric, with the core portion **27** being surrounded by the non-porous outer portion **26.** Portion **26** engages a sealing relationship with the inner wall of tube **21.** Portion **26** will permit the passage of neither air nor liquid while porous portion **27** will permit the passage of air but not liquid.

In regard to materials which can be utilized in the system, tube **21** can be of low cost glass or plastic and is generally transparent to permit viewing of the liquid as it is collected within the tube. A conventional column height scale can then be applied to the exterior surface of tube **21** to accurately measure how far (usually expressed in millimeters) the red cells settle during the test period (usually 1 hour).

In regard to plug **20,** the non-porous portion can be of a material such as rubber, preferably white rubber, which is of a resilient nature and which will not permit passage of air or liquid therethrough. Additionally, the material is sealable with the inner wall of the tube and will engage and hold the core portion **27** of the plug in fixed position.

The core portion is constructed of a plurality of vertical adjacent filaments **28.** The tiny filaments **28** will permit passage of air therebetween when suction is applied at the upper open end of the tube but will not pass liquid therethrough, so that when liquid reaches the bottom edge of the core group of filaments **28** it will automatically stop at that point. The resilient nature of non-porous portion **28** will maintain a tight interengagement with the filaments and retain them in closely related fixed position.

The filaments may be of a material such as wool fibers or any similar operative structure such as plastic monofilaments or nylon monofilaments.

In operation, in respect to the above discussed embodiment, tube **21** is manufactured with plug **20** at a predetermined point along its length so that only a precise column height of liquid can be collected therein. The bottom end **24** of the tube is then positioned at the source of blood and suction is applied to the open end **22** of the tube as shown in FIG. **1.** Air will then be drawn through plug **20** and through the tube into the mouth and will draw blood **24** into the tube until it reaches the bottom surface of plug **20** at which time it will automatically stop. Therefore, the operator need not be concerned with the blood column height during collection nor need he be concerned about blood passing plug **20** and entering his mouth. The next step is to transfer the tube of blood to the location where it is to be tested or handled in some other manner. Another feature of the present system assists in this transportation action. The presence of plug **20** eliminates the necessity of retaining a finger on the open end **22** of the tube during transportation in order to prevent leakage from open end **24.** This is an advantage over open systems where a finger must be retained over open end **22** to prevent blood leaking from the tube during transportation.

The action of the embodiment of plug **20** is based on much greater viscosity of blood than air. The viscosity of blood is approximately 0.010019 poise (at 20° C.). In contrast, the viscosity of air is approximately 0.000182 poise (at 18° C.). These figures show that the viscosity of blood is more than fifty times the viscosity of air. Therefore, it is much easier to suck air up through the openings between the filaments than to suck blood up between them. Furthermore, when the blood level rises to the small apertures between the filaments, it is quite easy to feel the difference in resistance to flow and to stop sucking. This is what is meant when it is stated that the air will go through the automatic stop barrier **20** but that blood will not. If forced, the greater increased resistance to flow when the blood reaches the barrier can be overridden, but with a little practice, it is very easy for the operator to suck at such a rate that the blood inflow stops automatically when the automatic stop barrier is reached. The operator can even feel the impact of the rising blood column hitting the barrier, and then stop sucking.

Tests have shown that even if some blood is sucked up into the barrier or even above it, the red cells of this blood are immobilized and will not adversely affect the sedimentation rate of the blood in the open column below the blood barrier.

By using a somewhat more porous barrier memeber, the above discussed capabilities of the present invention can be combined with the ability to dispense liquid downwardly under better than ordinary control when the index finger is lifted from the top of the tube, allowing air to enter.

Most of the previous discussion of the invention has been devoted to describing the application of the principles of the invention to blood sedimentation rate analysis. This application has been for the purposes of illustration and must not be construed as being limiting. Applications to pipetting in general are also within the scope of the invention. For example, in blood sedimentation rate testing it is stated by the medical authorities the height of the blood column is very significant but that the cross-section of the blood column can be varied within rather wide limits without adversely affecting the test results. Hence the sedimentation tubes are usually calibrated in millimeters of height and not in relation to volumetric capacity. This means that less expensive transparent tubing can be used because the cross section of the bore does not have to be closely controlled. Hence the term "column height" has been used in this patent in connection with tubes for sedimentation rate.

However, where it is desired to apply the principles of this invention to pipettes, then calibrations would be in terms of "volumetric capacity".

In addition to the handling of blood, increased safety in preventing other dangerous liquids from entering the mouth is achieved by the present invention. Also pipetting is facilitated in the provision of easy and accurate filling of the pipette relative to its scale, plus improved control in dispensing aliquots or other partial amounts, where the more porous type of barrier member is used than with blood sedimentation tests.

Thus, the above discussed objectives, among others, are effectively attained.

I claim:

1. A liquid collection tube comprising; a hollow transparent tube open at the top and bottom, a barrier plug mounted in the tube intermediate the open ends thereof, the plug having a porous portion and being mounted in the tube at a predetermined location so that when the bottom open end is placed in liquid to be collected and suction is applied to the top open end, the porous portion of the plug will permit air to pass therethrough and draw liquid into the tube up to the bottom of the barrier plug and not through the porous portion, thereby automatically stopping the height of the liquid column entering the tube and preventing liquid from progressing above the barrier plug, the barrier plug being cylindrical in configuration with a non-porous portion forming an outer part of the plug and the porous portion forming a central core concentric with the non-porous portion of the plug whereby the non-porous portion engages the side walls of the tube, and the porous portion being formed of a plurality of vertical adjacent filaments and the non-porous portion being of a resilient material.

2. The invention in accordance with claim **1** wherein the liquid containing tube is a blood sedimentation tube

3. The invention in accordance with claim **1** wherein the filament material is wool fibers and the resilient nonporous material is a white elastomer.

4. The invention in accordance with claim **1** wherein the filaments are plastic monofilaments.

5. A barrier plug adapted to be mounted in a hollow tube with open top and bottom ends comprising; a body at least partially porous and being adapted to be mounted at a predetermined location and in sealing engagement with the inner walls of the hollow tube, whereby when the bottom open end is placed in liquid to be collected and suction is applied to the top open end on the tube, the porous portion of the plug will permit air to pass therethrough and draw liquid into the tube up to the bottom of the barrier plug and not through the porous portion thereby automatically controlling the amount of liquid entering the tube and preventing liquid from progressing above the barrier plug, the plug including an outer cylindrical concentric non-porous portion and an inner porous core portion concentric with the outer portion to form a cylindrical plug, the non-porous portion being made of resilient

material and the porous portion being made of a plurality of vertical filaments adjacent to one another and positioned within the non-porous portion to form a core therein.

6. The invention in accordance with claim **1** wherein the filaments are plastic monofilaments.

7. The invention in accordance with claim **1** wherein the filaments are wool fibers and the non-porous portion is of white resilient material.

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