

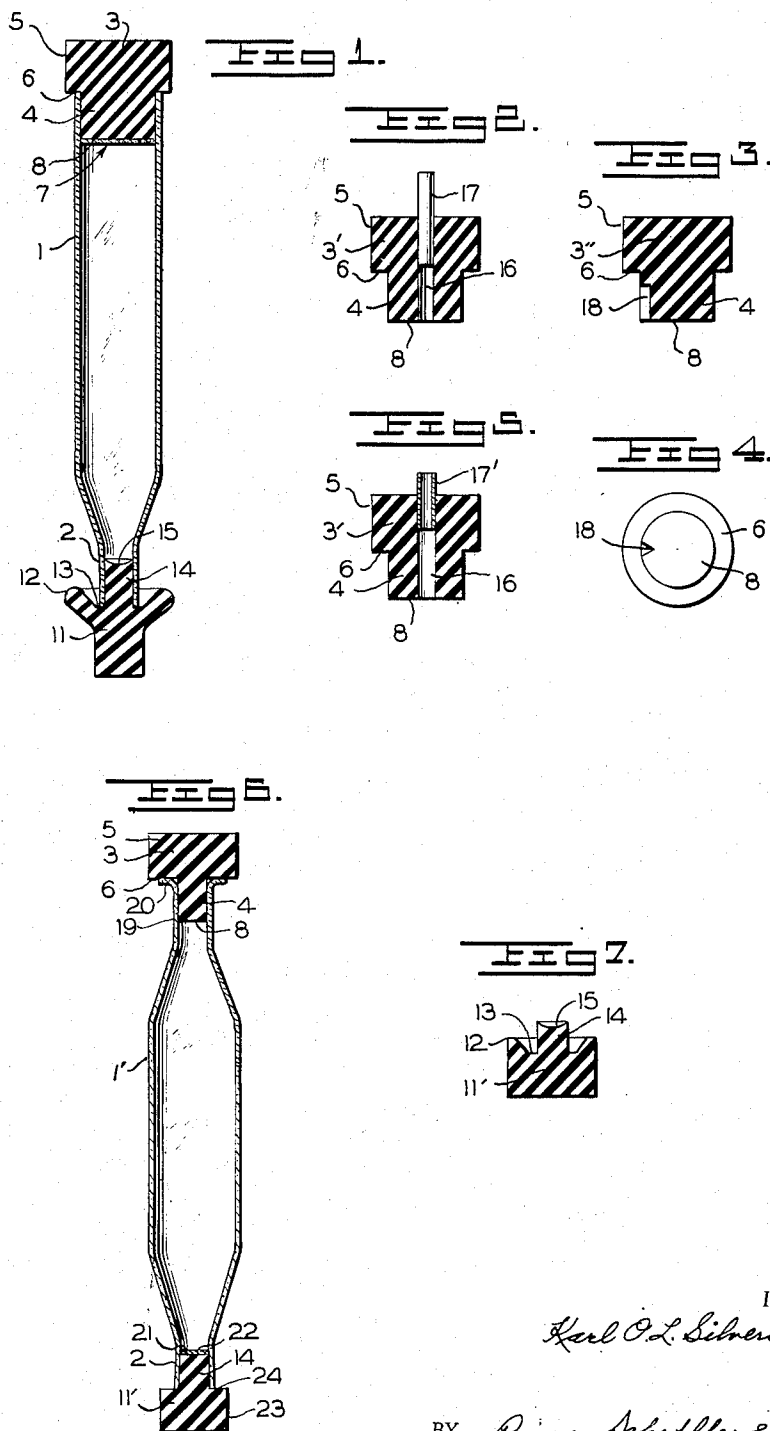
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CONCENTRATING VESSEL AND STOPPER THEREFOR

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CONCENTRATING VESSEL AND STOPPER
THEREFOR

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1 Claim. (Cl. 233—26)

This invention relates to improvements in stoppers as closing means for the end openings in vessels for the concentration of materials suspended or dispersed or otherwise contained in liquids, especially for testing purposes, and more particularly in a centrifuge tube assembly including such stoppers.

In co-pending U. S. patent application Serial No. 716,614 of December 16, 1946, now abandoned, there are described a method for concentrating materials suspended or otherwise contained in liquids, for instance salts, cells, bacteria or the like in medical tests, and a longitudinal vessel open at both ends suitable for carrying out this method with appertaining closing means, for instance stoppers, for its end openings.

The vessel according to the above-mentioned application is characterized by one or both of the end openings being adapted, for instance by the vessel tapering towards this end or these ends, respectively, so that at the removal of the closing means of the respective end opening used as the lower opening of the vessel and at closed vessel for the rest only a certain small volume of the content of the vessel, e. g. a drop or a little coherent lump of concentrated material, follows the closing means out of the vessel, while the rest of the content remains in the vessel. This construction also provides for an easy and perfect cleaning and disinfection of the vessel.

The method according to the above-mentioned application consists mainly in that the liquid is subjected to a concentrating treatment, for example by centrifuging, sedimentation, shaking, electrophoresis or the like, if desired in combination, in such a vessel, so that material heavier than the liquid is collected on the inner terminal surface of the lower closing means, and any lighter material that may be in the test at the upper surface of the liquid in the vessel, whereupon the portion of the content of the vessel nearest the lower stopper, e. g. a drop, is taken out by means of the lower closing means, for the examination of the material gathered in said portion, and if required subsequent removals of drops may be made in the same way for further examination. Any test of lighter material that may be required can be taken out in known manner on the surface of the liquid and especially round the edge of same in an upper narrower part of the vessel.

In the patent application above cited there are also described and shown closing means in

the form of stoppers of elastic material, for instance rubber or plastics, for closing the end openings of the vessel used for carrying out the method. The conical stoppers shown are to a certain degree satisfactory for their purpose, but they have certain drawbacks, which are not inherent in the new constructions of the stoppers being the objects of the present invention.

The closing stopper according to the invention is in the first place characterized by having a cylindrical or slightly conical inner part for introduction into the opening of the test vessel and an outer part having a greater diameter or cross-section and intended to rest on the outer edge of the opening of the vessel, for the purpose of preventing the stopper either during its introduction from being put in more than a certain distance or, when used in an upper opening, from being pressed into the vessel during the treatment, for instance by the centrifugal force, when an undesirable pressure may arise in the vessel.

In the accompanying drawing some different constructions of a closing stopper according to the invention are illustrated, in the first place intended and carried out for a test tube of the kind described and shown in the U. S. patent application Serial No. 716,614.

Fig. 1 illustrates in cross-section one embodiment of the assembly according to the present invention, showing a simple stopper for the upper end opening of the centrifuge tube, and a collared stopper for the lower end opening of the tube;

Fig. 2 illustrates in cross-section an upper-end stopper provided with an axial bore between the inner and outer end surfaces of the stopper;

Fig. 3 illustrates in cross-section an upper-end stopper provided with a notch on the outer surface of the inner cylindrical or slightly conical inserted part thereof;

Fig. 4 is a bottom plan of the stopper shown in Fig. 3;

Fig. 5 illustrates in cross-section an upper-end stopper provided with a bore therethrough and a small glass pipe placed in the bore, a so-called pipette stopper;

Fig. 6 illustrates in cross-section another embodiment of the assembly according to the present invention showing a centrifuge tube whose open end portions are necked down and whose upper necked-down end portion terminates in a collar or flange; and

Fig. 7 illustrates another lower-end stopper in accordance with the present invention.

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In Fig. 1 the assembly consists of a centrifuge tube 1 having upper and lower end openings and having a lower substantially cylindrical neck portion 2 of reduced diameter, of the order of that of a drop of liquid, terminating in said lower end opening.

The upper end opening of tube 1 is shown as closed by an upper end opening stopper 3 comprising a substantially cylindrical or slightly conical elongated resilient inner (inserted) portion 4 adapted to project through the upper end opening of tube 1 and an outer portion 5 of larger diameter than 4 and forming an annular faying or ledge surface 6 substantially at right angles to the length axis of stopper 3 for tightening against the edge of the upper end opening of tube 1 and for preventing the stopper 3 both from being inserted into tube 1 more than a certain limit during the introduction and from being pressed farther into tube 1 during a centrifuging operation. A cylindrical configuration on part 4 is advantageously used in a relatively narrow opening, while a slightly conical configuration is used in the case of a relatively wide opening. At 7 is represented a layer of a suitable coating material adhering to the inner end surface 8 of part 4 of stopper 3. Such coating layer may be omitted where there is no advantage in preventing contact between the liquid contents of tube 1 and the stopper 3.

As shown in Fig. 1, the neck portion 2 of centrifuge tube 1 is closed by a lower end opening stopper 11. The form here shown is particularly adapted for use when conducting tests of fluids containing infectious material, e. g., bacteria or virus. In this form, stopper 11 is provided with an outstanding and upstanding collar-like extension 12 providing a basin 13 in which can be caught liquid which may run along the surface of the inserted part 14 of the stopper because of incaution in taking out the stopper, so that such liquid does not come in contact with the examiner's hand when grasping stopper 11 for removal of the same from the lower end opening of the tube. The upper (inner) end surface of the inserted part 14 of the lower stopper may be provided, as shown in Fig. 1, with a cavity 15 having a depth appropriate for the desired size of the test drop to be taken out of the lower end of the tube with the stopper.

Figs. 2 and 3 illustrate alternative forms of upper end opening stoppers either of which can be substituted for the upper stopper shown in Fig. 1. In Fig. 2, the stopper 3' is provided with an axial bore 16, which bore—as shown—may be closed by a generally cylindrical plug member 17. Or, bore 16 can be closed simply by obstruction of its outer end with a finger. In lieu of bore 16, there may be provided—as shown in Fig. 3—on the generally cylindrical surface of inserted part 4 of stopper 3' a notch 18 extending upwardly from the surface 8 toward the outer part 5 and terminating somewhat short of the latter.

Or, referring to the embodiment illustrated in Fig. 2, there may be fitted into bore 16—in lieu of plug 17—a short glass tube 17', as illustrated in Fig. 5.

According to the embodiment illustrated in Fig. 6, the upper end of centrifuge tube 1' may be necked in somewhat and may terminate, as at part 19, in an outstanding flange 20. Inserted portion 4 of stopper 3 has a diameter appropriate for making a tight fit with the

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necked part 19. The inner end surface 8 of the stopper may be unprotected, as shown, or it may be protected by a layer of suitable coating material as shown in Fig. 1. The lower stopper, 11', may have, as shown, its inner end surface 21 protected by an adhering layer 22 of a suitable coating material, or surface 21 may be left bare. The cylindrical inserted part 14 of stopper 11' has a diameter substantially less than that of the outer part 23, merging with the latter in an annular faying or ledge surface 24 for engagement with the end surface of the necked-down lower end portion 2 of centrifuge tube 1'.

Fig. 7 illustrates a slight modification of the lower stopper shown in Fig. 1, according to which an annular rim 12' is substituted for extension 12.

When a stopper according to Figure 1 is being introduced into a filled vessel, the air in same above the surface of the liquid will be compressed by the stopper and the more the further in the stopper is put. Thus pressure rises in the vessel. This is often very inconvenient, but it can be prevented by providing the stopper with an axial bore 16 therethrough according to Figure 2 or with a notch 18 or the like on the generally cylindrical surface of the inner portion 4 of the upper stopper according to Figure 3, which notch, however, should end at a small distance, for instance 2 to 3 mm., below the surface 6 to secure the tightening between the stopper and the vessel. In the former case the bore may be closed with a small plug 17 or the like or when necessary be obstructed with a finger. Naturally the plug 17 may be replaced by a valve (not shown), preferably adjustable, which blows off air until a certain pressure remains in the vessel. By adapting the length of the part 4 of the stopper causing an increase of the pressure in the vessel during the insertion of the stopper, until the part 5 comes into contact with the edge of the vessel, it is possible to secure a controllable pressure in the vessel. As the volume of the test attending the lower stopper at its removal is dependent upon, besides the viscosity and the surface tension of the liquid, the inner pressure in the opening, which is influenced by the pressure in the vessel, one is thus able by such an adaption of said part 4 to adjust the volume of the liquid pressed out at the removal of the stopper. With the same vessel large or small drops can thus be obtained by different length of the stopper. In the same way the pressure at the top of the vessel and the volume of the liquid pressed out, besides with a valve as mentioned above, can be adjusted, though not within such wide limits, by inserting a plug 17 to a greater or lesser distance into the bore 16 of the stopper. When using a stopper according to Figure 3 the air in the vessel will escape through the notch 18 during the introduction of the stopper until tightening begins to take place, and during the end of the introduction then a small pressure rise takes place in the air remaining in the vessel, which in some cases is suitable. The stopper according to Figure 6 has also proved to give a very good tightening when the upper edge of the opening of the vessel is bent outwards, since the stopper will rather adhere to the opening. Figure 5 shows a stopper with a small glass pipe 17' placed in an axial bore 16. Its employment is clear from the name pipette-stopper. By the aid of a finger against the outer opening of the glass pipe 17' the examiner can adapt the quantity of concentrate and/or liquid taken out in

each special case or remove it in several portions as required.

Figure 6 shows the simplest construction of a stopper for a lower opening, consisting of an inner conical part 14 and a cylindrical outer larger part 23. In this case the stopper is provided with a protective coating 22 in order that its interior might not be infected by the content of the vessel, or else its inner end surface 21 is treated so as to become smooth and non-porous and thereby easy to clean and disinfect completely and effectively. The lower end opening stoppers illustrated in Figs. 1 and 7, also are suitable when treating tests containing infectious material, for instance bacteria or virus. Here the outer part 11 or 11' of the stopper is made with a collar 12 or 12' or the like forming a basin 13, in which liquid that may run along the outer surface of the inserted part 14 of the lower stopper by incaution in taking out the stopper can be caught, so that it does not come in contact with the examiner's hand when it is grasping the part 11 or 11' for the removal of the stopper. 15 indicates a cavity in the inner end of the stopper, where the surface may be concave or in another way inclined towards its centre with different depth for different test liquids, depending, for example, upon how large a test-volume or -drop one desires to take out from the vessel with the stopper.

At the same time as better tightening is obtained with the stopper according to the invention than with the solely conical or solely cylindrical straight stoppers else generally used, it is attained with the stopper according to the invention that the pressure arising in the vessel is minimized or limited at wish during and before the treatment in same, and further that the examiner will not be subjected to infection when treating tests containing infectious matter.

Figure 1 shows stoppers used in a test tube, for instance a centrifuge tube, of a type suitable, for example, for cell tests, urine tests and the like, and Figure 6 shows stoppers used in a test tube of a type suitable, for instance, for tests containing heavy as well as light tubercle bacilli.

The invention is not bound to the constructions of the stoppers and the vessels, in which the stoppers are used, mentioned above or shown in the drawing by way of example only. Naturally the stoppers according to the invention can also to advantage be employed in vessels of other kinds and for other purposes than those above mentioned, for instance for test tubes of the ordinary type of pointed glass tubes and the like.

Having described my invention, what I claim as new and desire to secure by Letters Patent of the United States of America is:

A centrifuge tube or the like assembly comprising an elongated vessel having aligned upper and lower end openings and having a lower substantially cylindrical neck portion of reduced diameter, of the order of that of a drop of fluid, terminating in said lower end opening, an upper end opening stopper comprising a substantially cylindrical elongated resilient inner portion pro-

jecting through the upper end opening of said vessel and an outer portion of larger diameter than said inner portion, said outer portion forming a ledge surface for tightening against the edge of said vessel which forms the upper end opening thereof and preventing the stopper from being both inserted to more than a certain limit during the introduction and pressed further into the vessel during a centrifuging process, and a lower end opening stopper having a substantially cylindrical elongated resilient rubber-like inner portion projecting through the lower end opening into the lower necked portion of the vessel for a distance at least as great as is the diameter of said neck portion and in sliding engagement with a substantially peripheral inner surface of said neck portion, said cylindrical neck portion of reduced diameter having a substantially greater length than the length of the inner portion of said lower end opening stopper, and an outer portion of larger diameter than said inner portion, said outer portion forming a ledge surface for tightening against the edge of said vessel which forms said lower end opening thereof and having above its outer terminus an upwardly directed collar forming a catch basin around said inner portion, and said inner portion having an inner terminal face surface providing a concave recess within said portion, said concave recess forming in association with said neck portion a sample collecting, shaping and protecting pocket adapted to facilitate at occasional underpressure in the vessel air intake action while preventing dislodgement and dilution of a mass of sample disposed therein when said lower end opening stopper is withdrawn from said lower neck of the vessel.

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