

[54] LIQUID COLLECTING AND FILTERING
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[22] Filed: Apr. 28, 1972

[21] Appl. No.: 248,621

[52] U.S. Cl. 128/2 F, 23/259, 128/DIG. 5,
210/359

[51] Int. Cl. A61b 5/14

[58] Field of Search 23/253 R, 259, 230 B;
210/359; 128/2 F, DIG. 5

[56]

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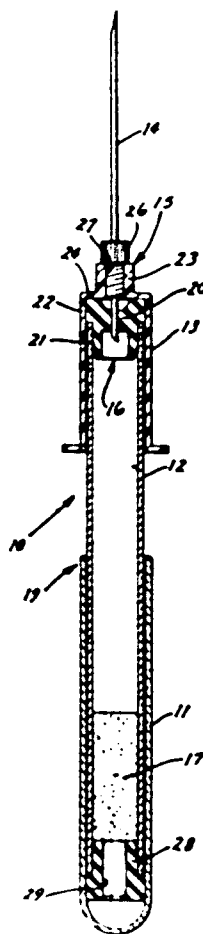
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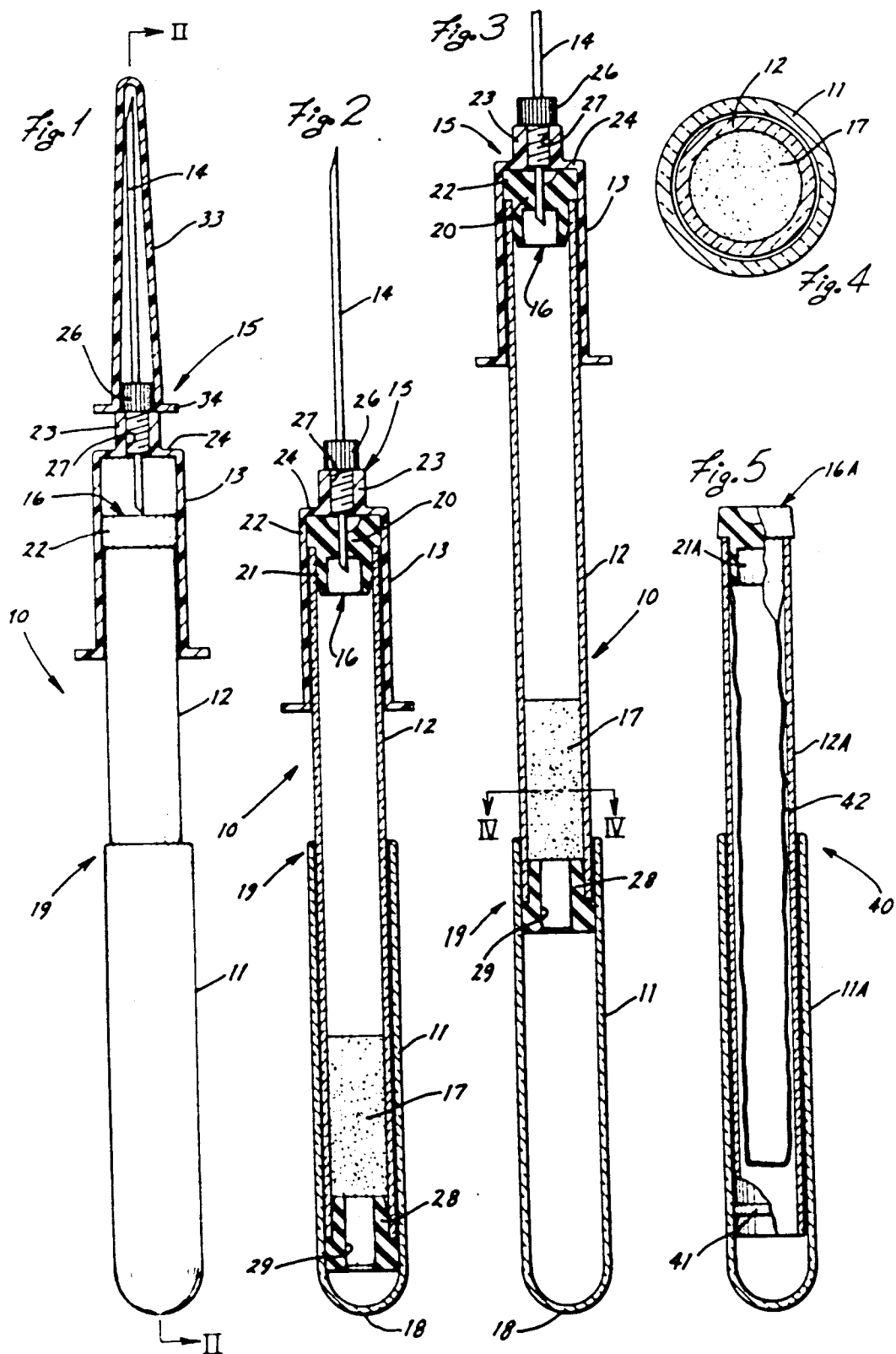
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ABSTRACT

A pair of telescopically arranged tubes defining an expandable, closed chamber in which the pressure is initially and substantially below ambient pressure. The inner tube has an inlet end with a perforable closure member thereon and an outlet end which communicates with the outer tube. A cannula is supported upon said inlet end for movement between a position spaced from said closure member and a position penetrating through said closure member to communicate with said chamber. Filter means is disposed in said inner tube so that liquid moving from the inlet end through the outlet end of said inner tube must pass through the filter.

8 Claims, 5 Drawing Figures





LIQUID COLLECTING AND FILTERING DEVICE

BACKGROUND OF THE INVENTION

This invention relates in general to a device for collecting a liquid, such as blood, from a patient and thereafter separating a part of said liquid from the remainder.

Persons familiar with the collection and assaying of liquids, such as blood, are aware of the effects upon the collection and handling of the specimen resulting from the elapse of time, the need for temperature control and chemical changes which can occur in a sample.

In the case of blood samples, it is important that the blood should be permitted to clot at a temperature of approximately 20°C. during a period of approximately 20 minutes. The serum should be promptly separated from the clot after the syneresis has occurred. In many situations, it is difficult and/or inconvenient to control the time and temperature factors as accurately as desired. For example, it may be necessary to transport the samples to a laboratory where they are centrifuged to produce the separation. In such case, several minutes may be necessarily sacrificed on one side or the other of the twenty minute optimum because of the batch operations which are frequently involved. On the other hand, the individual doctor may have insufficient need for blood tests to warrant his own centrifuge equipment so that he must rely upon techniques which produce less than completely satisfactory separations.

Accordingly, a primary object of this invention has been the provision of a device whereby samples of liquid, such as blood from a patient, can be collected and thereafter subjected to an operation whereby part of the liquid phase of the sample is separated from the remainder.

A further object of this invention is the provision of a device, as aforesaid, whereby the sample can be sanitarily collected, permitted to set for the prescribed amount of time and then subjected accurately to a filtering process whereby the serum is separated from the cells in the clot at precisely the proper time.

A further object of this invention is the provision of a device, as aforesaid, wherein a part of such device is used as a container for transporting the serum to a testing laboratory or station, wherein some of the parts of the device can be recovered and sterilized, and wherein the portion of the filter for the clotted cells can be easily and sanitarily disposed of with a minimum of effort.

Other objects and purposes of this invention will become apparent to persons familiar with this type of subject matter upon reading the following descriptive material and examining the attached drawings, in which:

FIG. 1 is a partially central cross-sectioned and partially side elevational view of a device embodying the invention.

FIG. 2 is a sectional view substantially as taken along the line II—II in FIG. 1, with the needle sheath removed.

FIG. 3 is a fragment of FIG. 2 with parts thereof in different operational positions.

FIG. 4 is a cross-sectional view taken along the line IV—IV of FIG. 3.

FIG. 5 is a fragment of FIG. 2 showing a modified construction.

For convenience in description, the terms "upper," "lower," and words of similar import will have reference to the collecting and filtering device, and parts thereof, as appearing in FIGS. 2 and 5. The terms "inner," "outer," and derivatives thereof will have reference to the geometrical center of said filtering device and parts thereof.

SUMMARY OF THE INVENTION

The objects and purposes of the invention, including those set forth above, have been achieved by providing inner and outer tubes telescopically arranged with respect to each other to define a closed, expandible chamber. The inner tube is closed at its exposed end by a perforable closure member, the other end thereof being open. The outer tube is closed at the unsleeved end thereof. Annular sealing means is disposed between the inner and outer tubes near the other end of the inner tube. A cannula sharpened at both ends is coaxially mounted upon one end of sleeve means, the other end of which is sleeved in sealed relationship upon the exposed end of the inner tube. The chamber, which is under a substantially reduced pressure, can be reached by one end of the cannula when the sleeve means is moved toward the outer tube. Filter means is disposed within the inner tube. After the cannula is inserted into a patient and then connected to the chamber, liquid is drawn therethrough into the inner tube, by the reduced pressure therein. The cannula is separated from the inner tube and the tubes are inverted. After the tubes have set as required, the tubes are righted again, the outer tube is moved downwardly along the inner tube away from the closure member whereby the liquid in the inner tube is drawn through the filter into the outer tube.

DETAILED DESCRIPTION

FIG. 1 illustrates one preferred embodiment of the collecting and filtering device 10 which is comprised of a cylindrical outer tube 11, a cylindrical inner tube 12, a cylindrical needle holder 13, a cannula or needle 14, a closure member 16 on the upper exposed end of the inner tube 12 and a filter 17. The needle 14 and holder 13 combine to form a needle assembly 15. The inner and outer tubes combine to form a tube assembly 19.

The outer tube 11 is preferably fabricated from glass, but may be fabricated from some other rigid durable material, such as plastic, and it has a closed end 18. The inner tube 12 is also preferably fabricated from glass, but may be fabricated from some other durable rigid material, such as plastic, and it is open at both ends. The closure member 16 at the upper end of the inner tube 12 may be substantially conventional, elastomeric stopper having a hollow shank 21 and an integral end wall 20 including an annular flange 22 which extends radially beyond the shank 21. The flange 22 abuts the upper axial end of the inner tube 12 and preferably extends radially beyond the outer circumferential surface of the inner tube 12.

The needle holder 13 may be fabricated from any reasonably rigid and durable material, such as plastic, and has an internal diameter such that it is snugly and sealingly engaged by the peripheral edge of the flange 22 when said needle holder is telescoped upon the upper end of the tube 12. The needle holder 13 has an

upper and annular end projection 23 of reduced diameter with a radial wall 24 therebetween.

A needle hub 26 snugly embraces the needle 14 near to, but spaced from, the lower end thereof. In this embodiment, the needle hub 26 is threadedly received into the threaded opening 27 in the projection 23. However, alternatively, the hub 26 can be firmly gripped within the projection at the time that the needle holder 13 is formed.

The lower end of the needle 14 extends downwardly from the wall 24 a sufficient distance that it completely penetrates the upper wall 27 of the closure member 16 to communicate with the interior of the inner tube 12 when the end wall 24 is against the flange 22. However, as shown in FIG. 1, the needle holder 13 can be securely held upon the upper end of the tube 12 by engagement with the flange 22, prior to penetration of the needle 14 through the upper wall 27. The lower end of the inner tube 12 is provided with a cylindrical plug 28 having a central, axial opening 29. This plug 28 may be an elastomeric, flanged stopper similar to the closure member 16, but having an opening extending completely axially therethrough. The plug 28 serves to hold a cylindrical filter 17 within the inner tube 12. The filter 17 (FIG. 4) may be fabricated from any type of suitable filtering material such as a foamed plastic, the porosity of which is such that, for example, it will permit the liquid phase of whole blood to pass therethrough while preventing the cellular material of the blood clot from passing therethrough.

An elongated tubular cannula sheath 33, which is open at its inner end and closed at its outer end, may be sleeved upon the hub 26 to protect the outer end of the needle 14 from contamination and/or from inadvertently causing an injury. The sheath 33 may have a flange 34 at its inner end to facilitate its mounting and removal relative to the hub 26.

OPERATION

The collecting and filtering device 10, including the needle assembly 15, may be furnished as an assembled device evacuated and ready for application to a patient. Alternatively, the inner tube 12 and outer tube 11 may be furnished with the closure member 16 and filter 17 as one independent assembly. Thus, the needle assembly 15 would be furnished separately with the sheath 33. In either event, the chamber defined by the inner tube 12 and the outer tube 11 telescoped thereon, is evacuated before the closure member 16 is applied to the inner tube. Normally, the needle assembly 15 is removed from the upper end of the inner tube 12 and the sheath 33 is removed before a sample, such as of blood, is taken from a patient.

After insertion of the needle into the patient, the inner tube 12 is inserted into the needle holder 13 and moved relatively toward it so that the inner end of the needle 14 passes completely through the upper wall 27 of the closure member 16, as shown in FIG. 2, and thereby communicates with the interior of the inner tube 12. Due to the reduced pressure within the inner tube 12, the blood is immediately drawn through the needle 14 and into the inner tube 12 above the filter 17. When a proper amount of blood is collected, the needle 14 is withdrawn from the patient and the filtering device is placed in an inverted position where it remains for approximately 20 minutes, during which a clot forms in the blood. The needle assembly 15 can be re-

moved from the inner tube 12, before the inversion of the device, whereby the needle is withdrawn from the closure member 16, which is self-sealing.

After the clot has formed in the inner tube 12, the tube assembly 19 is returned to its FIG. 2 position and the inner tube is moved upwardly relative to the outer tube 11 (FIG. 3) and this creates a reduced pressure in the outer tube below the filter 17. Accordingly, by this procedure, the liquid phase of the blood is drawn downwardly through the filter 17 and into the outer tube 11. The inner end of the closure member 16 can be mechanically formed (as with small projections) or chemically treated to enhance clotting.

The outer tube 11 can be completely removed from the inner tube 12 with the liquid phase in the outer tube. The cellular material in the clot will remain in the inner tube above the filter 17. A stopper, not shown, can now be placed in the upper end of the outer tube 11 for ease of handling, and the outer tube with its liquid phase can thereafter be taken to the laboratory for appropriate tests.

It will be seen that, after the filtering device 10 has been used to collect the filter the blood sample, the closure member 16, the filter 17, the needle 14 and the plug 28 can be disposed of. The inner and outer tubes and the needle holder can be sterilized for reuse.

MODIFIED CONSTRUCTION

The modified filtering device 40 (FIG. 5) has an outer tube 11A and inner tube 12A which are preferably identical with the outer and inner tubes 11 and 12, respectively. Also, a closure member 16A is mounted in and on the upper end of the inner tube 12A for engagement by a needle holder substantially identical to the needle holder 13 shown in FIG. 2.

The opening at the lower end of the inner tube 12A is unobstructed and the seal between it and the outer tube 11A is provided by an elastomeric sealing ring 41 which encircles and snugly embraces the inner tube 12A near the lower end thereof for snug but slidable engagement with the inner wall of the outer tube 11A. A filter bag 42, which is open at its upper end and closed at its lower end, is disposed within and extends lengthwise substantially the full length of the inner tube 12A. The upper end of the filter bag 42 is snugly gripped between the shank 21A of the closure member 16A and the inner surface of the inner tube 12A at the upper end thereof.

The filter bag 42 can be made from material such as Milipore plastic having a pore size of less than 5 microns so that it will contain the cellular elements in the blood sample. The bag material is preferably non-wettable and inert. The bag could also be made from fabric which is silicone-coated to avoid wetting.

The operation of the modified filter device 41 is substantially the same as that set forth above with respect to the filtering device 10. That is, the chamber within the inner tube 12A, containing the filter bag 42, is evacuated before the operation is commenced. After the blood is received into the bag 42, it is permitted to clot while the device 41 is inverted. Thereafter the outer tube 11A and inner tube 12A are righted again and then moved relatively away from each other. During this action, a reduced pressure condition is created in the outer tube 11A which thereby draws the liquid phase of the blood through the pores of the filter bag 42 and thence down into the lower end of the outer

tube 11A. The outer tube 11A is then removed from the inner tube 12A and either tested at once or stoppered for subsequent testing.

Although a particular preferred embodiment of the invention has been disclosed in detail for illustrative purposes, it will be recognized that variations or modifications of the disclosed apparatus, including the rearrangement of parts, lie within the scope of the present invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a device for collecting a sample of blood removed from a patient by cannula means and thereafter separating the serum from the clot of cellular material, the combination comprising:

an elongated and rigid cylindrical inner tube having openings at both ends thereof and defining an elongated passageway therethrough;

resiliently flexible closure means supported upon one end of said inner tube for sealingly closing said one end of said inner tube, said closure means having a perforable axial end wall;

ringlike annular seal means on said inner tube near the other end thereof;

an elongated and rigid cylindrical outer tube having a closed end and an open end, said inner tube having a length substantially greater than the length of said outer tube;

an elongated part of said outer tube near said open end being freely slidably telescoped on a portion of said inner tube, the annular seal means on said inner tube being slidably and sealingly engaged with the interior wall of said outer tube for permitting free slidable telescopic movement of said inner and outer tubes relative to one another, said inner tube, said outer tube, said closure means and said annular seal means defining an air-tight chamber, the pressure within said chamber being materially below ambient pressure prior to collection of said sample; and

filter means positioned within said inner tube and extending across said passageway and through which said serum can pass, but which blocks said blood clot.

2. A device according to claim 1, wherein the perforable end wall of said closure means is constructed from an elastomeric self-sealing material so as to permit same to be penetrated by a cannula, said material being self-sealing for closing the opening created by said cannula after withdrawal of said cannula from said closure means.

3. A device according to claim 1, further including elongated sleeve means snugly and slidably mounted upon said inner tube adjacent said one end thereof, said sleeve means projecting outwardly beyond said one end of said inner tube and having a reduced diameter hub portion, double-pointed cannula means fixedly mounted on the hub portion of said sleeve means, one end of said cannula means being positioned to penetrate axially and completely through the perforable end wall of said closure means upon slidable movement of said sleeve means relative to said inner tube in a direction toward said outer tube, and the axial end wall of said closure means being constructed of a self-sealing elastomeric material.

4. A device according to claim 1, wherein said filter means comprises an elongated flexible bag closed at one end and open at the other end thereof and having a plurality of small perforations therethrough, said bag extending over a major portion of the length of said passageway, the open end of said bag being sealingly engaged with said closure means.

5. A device according to claim 1, wherein said annular seal means comprises an annular plug of elastomeric material fixedly secured to said inner tube adjacent said other end thereof, said plug having an axial passage extending completely therethrough and including an annular shank portion projecting into and fixedly and sealingly connected to said inner tube, said plug also having an annular flange portion disposed exteriorly of said other end of said inner tube and positioned in sealing and sliding engagement with the interior wall of said outer tube, and said filter means comprising an axially elongated substantially cylindrical filter member constructed from a porous material, said filter member being disposed within the passageway formed by said inner tube and positioned in abutting engagement with the shank portion of said plug.

6. A device for collecting a sample containing a liquid and thereafter filtering said liquid from said sample, comprising:

first elongated tubular means having open ends and defining a passageway therethrough;

perforable closure means tightly closing and sealing one end of said first tubular means;

second elongated tubular means having a closed end and an open end, said second tubular means being sealingly and slidably telescoped upon said first tubular means so as to cover the other end thereof.

elongated sleeve means snugly and slidably mounted upon said one end of said first tubular means for movement lengthwise thereof;

cannula means pointed at both ends and coaxially supported by said sleeve means exteriorly of and adjacent said one end of said first tubular means, one end of said cannula means being positioned to penetrate axially and completely through said closure means for communication with said passageway as said sleeve means is moved lengthwise along said first tubular means toward said second tubular means;

filter means in said first tubular means extending completely across said passageway.

7. A device according to claim 6, wherein said first tubular means has a length substantially greater than the length of said second tubular means, said first tubular means being normally substantially fully telescoped within said second tubular means so that said other end of said first tubular means is disposed closely adjacent the closed end of said second tubular means, the one end of said first tubular means being spaced outwardly a substantial distance from the open end of said second tubular means when in said fully telescoped position, whereby said sleeve means can be slidably moved relative to said first tubular means in a direction toward the open end of said second tubular means for causing said cannula means to penetrate said closure means.

8. A device according to claim 6, wherein said filter means is an elongated flexible bag closed at one end and open at the other end thereof and having a plurality of small perforations therethrough, the open end of said bag being sealingly engaged with said closure means near said first tubular means so that the adjacent end of said cannula means can communicate with the interior of said bag.