United States Patent [19]

Maiocco

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[54] **TWO-PIECE CONCENTRIC CENTRIFUGE SAMPLE CONTAINER**

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[52] **U.S. Cl.** **233/26;** 210/DIG. 23; 220/17; 134/135

[51] **Int. Cl.²** **B04B 9/12**

[58] **Field of Search** ..... 233/26, 27, 1 R; 210/DIG. 23, DIG. 24; 220/17; 134/135, 201

[56] **References Cited**

UNITED STATES PATENTS

3,066,671	12/1962	Cohen	128/220 X
3,249,295	5/1966	Childs	233/26 X
3,355,098	11/1967	Farr	233/26
3,468,474	9/1969	Shoblom et al.	233/27
3,586,064	6/1971	Brown et al.	210/DIG. 23

FOREIGN PATENTS OR APPLICATIONS

1,014,348	8/1957	Germany	233/26

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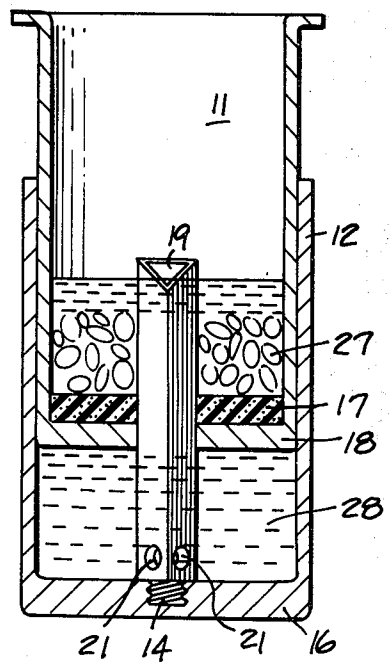
[57] **ABSTRACT**

The invention provides a container assembly for use in conjunction with centrifuges of the normal or axial type. The assembly includes a pair of telescopically engageable containers in fluid communication via a conduit extending coaxially from the base of the outer container through the base of the inner container. Component phases of a fluid mixture within the inner container may be separated by withdrawing the inner container from the outer container until the conduit opening communicates with the appropriate component phase, and fluid is permitted to flow through the conduit into the outer container.

7 Claims, 6 Drawing Figures



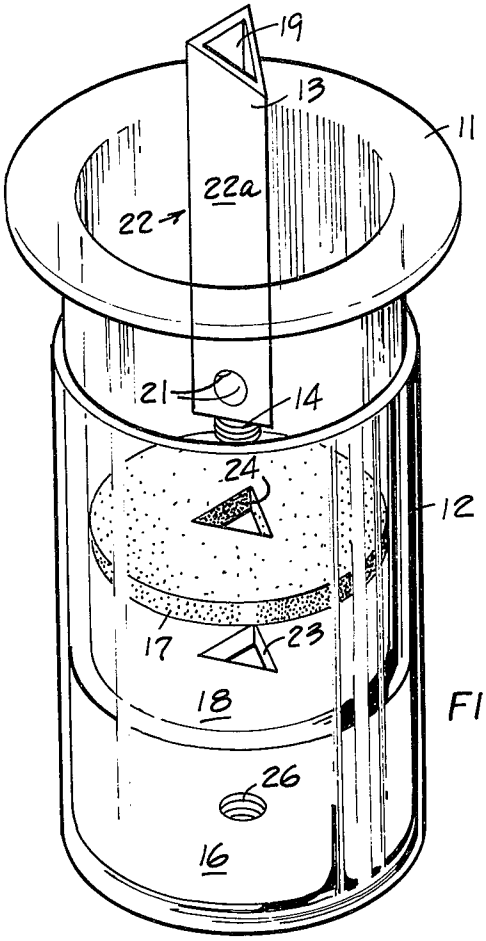


FIG. 1.

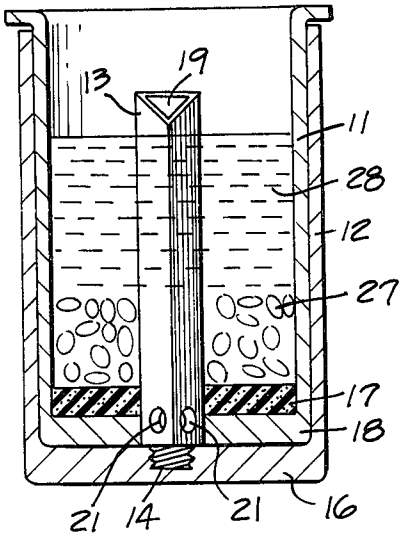


FIG. 2.

FIG. 3.

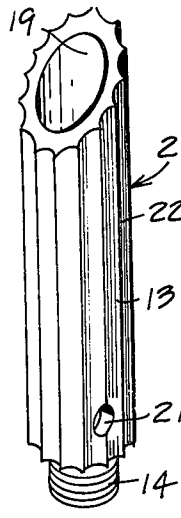


FIG. 4.

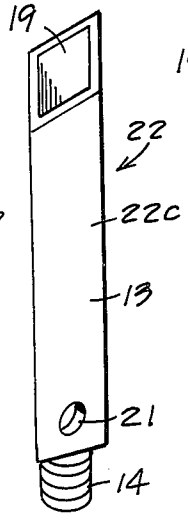


FIG. 5.

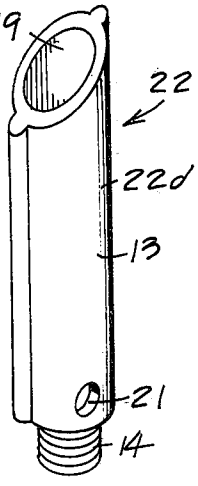
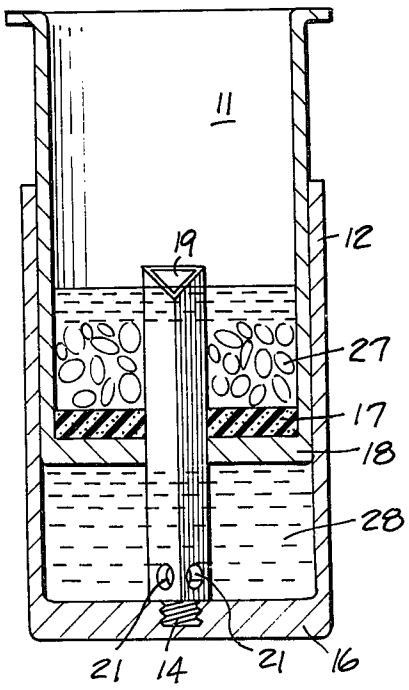


FIG. 6.



TWO-PIECE CONCENTRIC CENTRIFUGE SAMPLE CONTAINER

BACKGROUND OF THE INVENTION

This invention relates to centrifuges. In particular, this invention relates to centrifuges and container assemblies therefor which include means for separating resultant phases of a centrifuged fluid mixture.

Conventionally, centrifuges of both the normal and axial type are equipped with apparatus for containing fluid mixtures during the centrifuging process. Since it is frequently desired to separate the phases of the fluid mixture resulting from centrifugation, such apparatus is frequently equipped with means for effecting the separation of these phases. Exemplary of such prior art apparatus are those described in U.S. Pat. Nos. **3,355,098** issued Nov. **28, 1967** to Farr; **3,779,383** issued Dec. **18, 1973** to Ayres; and **3,586,064** issued June **22, 1971** to Brown et al.; which broadly provide apparatus including valve and piston means for facilitating the separation of component phases of a fluid mixture.

Other prior art apparatus for containing and facilitating separation of the component phases of a fluid mixture include those described in U.S. Pat. Nos. **1,394,743** issued Oct. **25, 1921** to La Duke; **700,056** issued May **13, 1902** to Kremer; **1,776,498** issued Sept. **23, 1930** to Freeland; and **3,146,163** issued Aug. **25, 1964** to Brewer.

Many of the prior art devices tend to be relatively complex, and tend therefore to be difficult to operate efficiently and to be uneconomical to use, particularly in view of the disposable character of many such devices. Others of the prior art devices which are simpler to use and manufacture frequently do not permit efficient separation of phases of fluid mixtures.

It is therefore desirable to provide efficient means for containing a fluid mixture during separation of the components thereof into phases, particularly by centrifuging, and for implementing separation of these component phases.

SUMMARY AND OBJECTS OF THE INVENTION

The invention comprises a container assembly for containing a fluid mixture during separation of the components thereof into phases, and for implementing separation of these phases of the fluid mixture. The system includes a pair of telescopically engageable containers, which, when so engaged, are in communication via a conduit extending coaxially upwards from the base of the outer container through the base of the inner container; sealing means are provided to obtain a substantially fluid-tight seal between the conduit and the inner container. The conduit is threadably secured to the base of the outer container, and is of an irregular circumference to prevent rotation of the conduit with respect to the inner container, so that the conduit may be secured to or unsecured from the base of the outer container by rotation of the inner container. The conduit is provided with apertures at the proximal and distal portions thereof for communicating fluid from the inner container to the outer container via the conduit.

The component phases of a fluid mixture contained within the inner container of the assembly may be separated by withdrawing the inner container from the outer container until the distal aperture of the conduit is at the interface of the phases to be separated. The fluid above the conduit will then flow by gravity into the outer container via the apertured conduit. After the desired volume of fluid has been transferred to the outer container, the inner container is rotated to disengage the conduit from the base of the outer container, and the inner container and conduit are removed as a unit. The outer container may then be capped for storage or transport of the fluid contained therein.

It is therefore an object of the invention to provide a container assembly for fluid mixtures wherein such mixtures may be separated into component phases by centrifuging, and these resultant phases efficiently separated.

It is another object of this invention to provide a container assembly for implementing the separation of component phases of a fluid mixture contained therein.

It is a further object of this invention to provide a reusable container assembly for fluid mixtures wherein such mixtures may be separated into their component phases, and the less dense phase thereof may be directly separated from the centrifugate into a convenient storage or transport container.

Other objects and advantages of the invention will be apparent from the following description and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded view of the container assembly, illustrating the inner and outer containers partially engaged, and one embodiment of the conduit and sealing means therefor;

FIG. **2** is a sectional side view of the container assembly illustrating the inner and outer containers fully engaged with the inner container containing a fluid mixture which has been separated into component phases;

FIG. **3** is a view similar to FIG. **2**, but illustrating the inner container partially withdrawn from the outer container so that fluid in the less dense phase has been conducted into the outer container via the conduit; and

FIGS. **4, 5** and **6** are views of alternate embodiments of the conduit.

DETAILED DESCRIPTION

With reference to the drawings, the container assembly of the invention is generally indicated at **10**, and includes an inner container **11** telescopically engageable with an outer container **12**, a conduit **13** having a threaded base **14** threadably engageable with the base **16** of the outer container **12**, and sealing means **17** for providing a substantially fluid-tight seal between the conduit **13** and the base **18** of the inner container **11**. The conduit **13** includes a distal aperture **19** at the distal portion thereof, and proximal apertures **21** adjacent the threaded base **14** thereof. The conduit **13** has an irregular circumference **22** such as the pyramidal form **22***a* illustrated in FIG. **1**, or the fluted, diamond or elliptical forms **22***b*, **22***c* and **22***d*, respectively, illustrated in FIGS. **4, 5** and **6**, respectively. The base **18** of the inner container **11** and the sealing means **17** are provided with aligned openings **23** and **24**, respectively, corresponding to the circumference **22** of the conduit **13** to permit the conduit to be inserted through the sealing means and base of the inner container for engagement of the threaded base **14** of the conduit with a threaded recess **26** of the base **16** of the outer container **12**. Preferably, the aligned openings **23** and **24** of the inner container **11** and the sealing means **17** and

the recess 26 of the base 16 are all positioned so that the conduit 13 is disposed coaxially with the inner and outer containers 11 and 12.

To employ the assembly 10, the inner and outer containers 11 and 12, the sealing means 17, and the conduit 13 are assembled, preferably by positioning the sealing means 17 in the bottom of the inner container 11, inserting the conduit 13 through the openings 23 and 24 of the sealing means and base 18 of the inner container, and threading the threaded base 14 of the conduit 13 into the threaded recess 26 of the base 16 by rotating the inner container 11 until the conduit is secured; owing to the irregular configuration of the circumference 22 of the conduit 13, rotation of the conduit with respect to the inner container 11 is prevented while the conduit 13 is being secured in this manner. The inner container 11 is then fully engaged with the outer container 12 by telescoping the inner container into the outer container until the proximal apertures 21 of the conduit 13 are immediately subjacent the base 18 of the inner container 11, as shown in FIG. 2. The fluid mixture, such as whole blood, to be separated into component phases, is then placed in the inner container 11 so that the fluid level in this container is below the distal aperture 19 of the conduit 13, and the fluid subjected to centrifugation or gravitational settling. The resultant phases, such as the cellular phase 27 and serum phase 28 of whole blood illustrated in FIG. 2 may then be separated in the following manner:

The inner container 11 is withdrawn until the distal aperture 19 of the conduit 13 is in the vicinity of the interface of the phases 27 and 28 as shown in FIG. 3, so that contamination of the less dense phase does not occur. The less dense or upper, phase then flows through the distal aperture 19, the conduit 13, and the proximal apertures 21 into the outer container 12. When the desired volume of fluid has flowed into the outer container 12, the inner container 11 and the conduit 13 are removed as a unit by reversing the above-described assembly process. The conduit 13 is disengaged from the base 16 of the outer container 12 by rotating the inner container 11, and the inner container and conduit are then withdrawn from the outer container.

The outer container may then be capped for storage or transport of the fluid contained therein, or alternatively, this fluid may be decanted to another container.

It is desirable that the container 11 fit snugly into the outer container 12, so that subsequent withdrawal of the inner container to separate the component phases creates a slight vacuum in the outer container; this will hasten the flow of fluid through the conduit 13. Additionally, it may be advantageous in some instances to provide a plug (not shown) or similar device for the distal aperture 19 during centrifugation to prevent contamination of the outer container with material from the centrifugate which might otherwise occur.

It is apparent that the above-described container assembly of this invention provides simple, efficient, economical means for containing a fluid mixture during centrifugation and for implementing separation of the resultant component phases of such a mixture. Although the invention has been described with respect to a specific embodiment, numerous equivalent embodiments within the spirit and scope of this invention are contemplated, and it is not intended to limit this invention except as defined by the appended claims.

What is claimed is:

1. In a centrifuge, a container assembly for containing a fluid mixture during centrifugation and for separating phases of said fluid mixture resulting from centrifugation, said container assembly comprising
   a. an outer container;
   b. an inner container, telescopically engageable with said outer container, and having an opening in the base thereof;
   c. a conduit threadably secured to the base of said outer container and communicating said outer container with said inner container through said opening in the base of said inner container; and
   d. sealing means for preventing fluid leakage into said outer container from said inner container through said opening in the base thereof.

2. The invention of claim 1, wherein said conduit has an irregular circumference and said opening conforms thereto.

3. A container assembly including separating means for separating phases of a fluid mixture contained therein, said container assembly comprising
   a. an outer container;
   b. an inner container, telescopically engageable with said outer container, and having an opening in the base thereof;
   c. a conduit threadably secured to the base of said outer container and communicating said outer container with said inner container through said opening in the base of said inner container; and sealing means for preventing fluid leakage into said outer container from said inner container through said opening in the base thereof.

4. The invention of claim 3, wherein said conduit has an irregular circumference and said opening conforms thereto so that substantial relative rotation of the inner container with respect to the conduit does not occur when said inner container is rotated.

5. The invention of claim 4, wherein said conduit communicates said inner container with said outer container via apertures in the distal and proximal portions thereof.

6. In a container assembly comprising
   a. an outer container;
   b. an inner container, telescopically engageable with said outer container, and having an opening in the base thereof;
   c. a conduit threadably secured to the base of said outer container and communicating said outer container with said inner container through said opening in the base thereof; and
   d. sealing means for preventing fluid leakage into said outer container from said inner container through said opening in the base thereof; a method for separating the component phases of a fluid mixture contained in said inner container comprising:
      i. withdrawing said inner container from said outer container until fluid of the less dense phase flows into said conduit and enters said outer container;
      ii. continuing to withdraw said inner container from said outer container until the desired amount of fluid has entered said outer container; and
      iii. disengaging said conduit from said base of the outer container and removing said conduit and said inner container as a unit.

7. The invention of claim 6, wherein said opening in the base of said inner container is irregular and the circumference of the conduit conforms thereto, and wherein said conduit is disengaged from the base of said outer container by rotating said inner container in the appropriate direction.

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